NOTICE INVITING TENDER

FOR

TENDER DOCUMENT FOR UREA(NEEM OIL COATED) HANDLING & BAGGING PACKAGE AT TALCHER FERTILIZERS LIMITED, ODISHA (INDIA) ON LSTK AND SINGLE POINT RESPONSOBILITY BASIS.

OPEN DOMESTIC COMPETETIVE BIDDING

(NIT NO : PNMM/PC-183/E- 4010/NCB)

TALCHER FERTILIZERS LIMITED

[A JOINT VENTURE OF M/s GAIL (INDIA) LIMITED (GAIL), M/s RASHTRIYA CHEMICALS & FERTILIZERS LTD. (RCF), M/s COAL INDIA LTD. (CIL), & M/s FERTILIZER CORPORATION OF INDIA LTD (FCIL)]

ISSUED BY

PROJECTS & DEVELOPMENT INDIA LTD.
(A Govt. Of India Enterprise)
PDIL BHAWAN, A-14, Sector-1,
NOIDA U.P. (India)

06.08.2021

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INVITATION FOR BID (IFB)

SECTION-I
"INVITATION FOR BID (IFB)"

Ref No: PNMM/PC-183/E-4010 /NCB Dated: 06.08.2021

To,

PROSPECTIVE BIDDERS

SUB: UREA (Neem Oil Coated) HANDLING & BAGGING PACKAGE AT TALCHER FERTILIZERS LIMITED, ODISHA (INDIA) ON LSTK AND SINGLE POINT RESPONSIBILITY BASIS.

Dear Sir/Madam,

1.0 **INTRODUCTION:**

1.1 GAIL (India) Limited (GAIL), Rashtriya Chemicals & Fertilizers Limited (RCF), Coal India Limited (CIL) and Fertilizer Corporation of India Limited (FCIL) have formed a Joint Venture company in the name of Talcher Fertilizers Limited (TFL) hereinafter also referred to as "Owner", intends to carry out the work of Urea (Neem Coated) Handling & Bagging Package on single point responsibility basis for its Ammonia Urea Plant, an integrated fertilizer and chemical complex comprising of Coal Gasification and Gas Purification Unit, Ammonia Synthesis Unit, Urea Plant, along with necessary offsite and utility facilities at Talcher Unit, Angul district, in the state of Odisha, India.

1.2 GAIL (India) Limited is a Public Sector Unit under the Ministry of Petroleum & Natural Gas and Rashtriya Chemicals & Fertilizers Limited (RCF) & Fertilizer Corporation of India Limited (FCIL) are two Public Sector Units under the Ministry of Chemicals & Fertilizers and Coal India Limited (CIL) is a Public Sector Unit under the Ministry of Coal, Govt. of India.

1.3 Projects and Development India Limited (PDIL), hereinafter referred to as PROJECT MANAGEMENT CONSULTANT (PMC) on behalf of M/s Talcher Fertilizers Ltd. (TFL), hereinafter referred as OWNER, has the pleasure of inviting bids from eligible domestic bidders to submit Bid ONLINE through Central Public Procurement (CPP) Portal under Single Stage Two Bid System, for the subject works.

2.0 The brief details of the tender are as under:

(A)	NAME OF WORK / BRIEF SCOPE OF SERVICE/JOB	**UREA (Neem Oil Coated) HANDLING & BAGGING PACKAGE AT TALCHER ON LSTK AND SINGLE POINT RESPONSIBILITY BASIS.**
(B)	NIT NO. & DATE	PNMM/PC-183/E-4010/NCB DATED 06.08..2021
(B1)	TYPE OF TENDER	OPEN DOMESTIC COMPETITIVE BIDDING

(C)	TYPE OF BIDDING SYSTEM	SINGLE BID SYSTEM: TWO BID SYSTEM: √
(D)	TYPE OF TENDER	E-TENDER (CPP PORTAL): √ MANUAL:
(E)	COMPLETION PERIOD	Please Refer Clause 20.0 of SPECIAL CONDITIONS OF CONTRACT.
(F)	BID SECURITY /EARNEST MONEY DEPOSIT (EMD)	APPLICABLE: NOT APPLICABLE: √ Bidders are required to submit declaration for Bid security as per attached Proforma (Refer clause no.16 of ITB)
(G)	AVAILABILITY OF TENDER DOCUMENT ON WEBSITE(S)	CPP Portal (https://eprocure.gov.in/eprocure/app) TFL (http://tflonline.co.in)
(H)	LAST DATE OF RECEIPT OF BIDDER'S PRE-BID QUERIES	**23.08.2021**
(I)	DATE, TIME OF PRE-BID MEETING (Through Video Conferencing)	**26.08.2021at 11:00 Hrs. (IST)**
(J)	BID SUBMISSION START DATE	**21.09.2021at 15:00 Hrs (IST)**
(K)	BID CLOSING DATE	**05.10.2021 at 15:00 Hrs. (IST)**
(L)	BID OPENING DATE	**06.10.2021 at 15:00 Hrs. (IST)**
(M)	**Address for Communication**	

(i)	PDIL	M/s Projects & Development India Limited, P.D.I.L Bhawan, A-14, Sector-1, Noida, (PIN 201301) Dist. Gautam Budh Nagar (UP). (India) Kind Attention: Mr. P.R.Sahu, Addl. General Manager (M.M) Fax no. : +91-120-2529801 Tel no. : +91-120-2544063 E-mail : prsahu@pdilin.com anjali@pdilin.com tanzin@pdilin.com
(ii)	TFL	M/s Talcher Fertilizers Ltd. (TFL), C/O GAIL Training Institute, PARC Building, Plot No. 24, Sector-16A, Film City, Noida District – G.B. Nagar, U.P. - 201301 Kind Attention : Mr. Amit Kumar Singh (General Manager) Tel No. : +91-120-2518349 +91-120-4097150/199 E-mail : ak.singh@gail.co.in; sdasgupta@gail.co.in
(N)	Original Documents to be submitted at	Projects & Development India Limited, (Materials Management Department) P.D.I.L Bhawan, A-14, Sector-1, Noida, (PIN 201301) Dist. Gautam Budh Nagar (UP). (India) Kind Attention: Mr. P.R. Sahu, Addl. General Manager (M.M) Fax no. : +91-120-2529801 Tel no. : +91-120-2544063. E-mail : prsahu@pdilin.com
(O)	Contact Person for Site visit	M/s Talcher Fertilizers Ltd. (TFL), Administrative Building, Talcher, Post: Vikrampur, Dist: Angul, Pincode-759106, Odisha Kind Attention: Mr. Panchanan Halder, General Manager (PE) Tel No. : +91-9999692275 E-mail : phaldar@gail.co.in

In case of the days specified above happens to be a holiday in TFL/PDIL, the next working day shall be implied.

3.0 Bids must be submitted strictly in accordance with Clause No. 11 of ITB (Section-III) depending upon Type of Tender as mentioned at Clause no. 2.0 (D) above. The IFB is an integral and inseparable part of the bidding document.

4.0 In case of E-Tender, bid must be submitted only on CPP Portal (https://eprocure.gov.in/eprocure/app) _Further, the following documents in addition to uploading the bid on CPPP's Portal shall also be submitted in Original (in physical form) within 7 (seven) days from the bid due date provided the scanned copies of the same have been uploaded in e-tender by the bidder along with e-bid within the due date and time to the address mentioned in Bidding Data Sheet(BDS) [Annexure-IV to Section-III]:-

i) ~~EMD/Bid Security (if applicable)~~/Declaration for Bid Security
ii) Power of Attorney
iii) Integrity Pact (if applicable)

5.0 In case of Manual Tenders, bids complete in all respect should reach at the address specified in Bid Data Sheet on or before the due date & time. Bids received after the due date and time is liable to be rejected.

6.0 The following documents in addition to uploading the bid Central Public Procurement (CPP) Portal (https://eprocure.gov.in/eprocure/app) shall also be submitted in Original (in physical form) within 7 (seven) days from the bid due date provided the scanned copies of the same have been uploaded on CPP Portal (https://eprocure.gov.in/eprocure/app) by the bidder along with e-bid within the due date and time to the address mentioned in Clause no. 2.0 (M) of IFB:-

i) Declaration for Bid Security
ii) Power of Attorney
iii) Pre-Signed Integrity Pact

7.0 Bidder(s) are advised to quote strictly as per terms and conditions of the tender documents and not to stipulate any deviations/exceptions.

8.0 Any bidder, who meets the Bid Evaluation Criteria (BEC) and wishes to quote against this Tender Document, may download the complete Tender Document alongwith its amendment(s) if any from websites as mentioned at 2.0 (G) of IFB and submit their Bid complete in all respect as per terms & conditions of Tender Document on or before the Due Date & Time of Bid Submission.

9.0 Bid(s) received from bidders to whom tender/information regarding this Tender Document has been issued as well as offers received from the bidder(s) by downloading Tender Document from above mentioned website(s) shall be taken into consideration for evaluation & award provided that the Bidder is found responsive subject to provisions contained in Clause No. 2 of ITB (Section-III)..

The Tender Document calls for offers on single point "Sole Bidder" responsibility basis (except where JV/Consortium bid is allowed pursuant to clause no. 3.0 of ITB) and in total

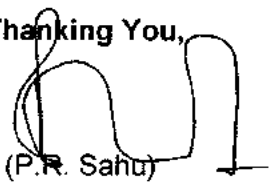
compliance of Scope of Works as specified in Tender Document.

10.0 Any revision, clarification, corrigendum, time extension, etc. to this Tender Document will be hosted on the website(s) only as mentioned at 2.0 (G) of IFB. Bidders are requested to visit the website regularly to keep themselves updated. In case of manual tendering, Clarification(s)/Corrigendum(s), if any, shall be sent to the prospective bidder(s) by email/post.

11.0 All bidders who are willing to submit their bid are required to submit F-6 (Acknowledgement cum Consent letter) duly filled within 7 days from date of receipt of tender information.

This is not an Order.

Thanking You,



(P.R. Sahu)
Addl. General Manager (M.M)
Projects & Development India Limited
Tel No. : +91-120-2544063
E-mail : prsahu@pdilin.com

PHYSICAL DOCUMENTS (Declaration for Bid Security \ POA, IP & Original Letter of TPI)

Tender Document No. : PNMM/PC-183/E-4010/NCB dated 06.08.2021

Description : **UREA (Neem Coated) HANDLING & BAGGING PACKAGE AT TALCHER ON SINGLE POINT RESPONSIBILITY BASIS.**

Due Date & Time : __.__.2021 at 15:00 hrs.

From: *……* *……* *……* *……*	***To:*** M/s Projects & Development India Limited, P.D.I.L Bhawan, A-14, Sector-1, Noida, (PIN 201301) Dist. Gautam Budh Nagar (UP). (India) Kind Attention: Mr. P.R.Sahu, Addl. General Manager (M.M)

(To be pasted on the envelope containing Physical Document)

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SECTION-II

BID EVALUATION CRITERIA

&

EVALUATION METHODOLOGY

SECTION-II

A. BID EVALUATION CRITERIA (BEC)

Bids are hereby invited from competent Domestic Bidders meeting the technical and financial criteria of respective BEC stated hereunder.

Evaluation of Techno-Commercial offers shall be carried out for only those Bidders who shall meet the BEC.

1.0 Technical Criteria:

1.1 The bidder must have completed one **"Similar work"**, having completed value not less than **INR 53.92 Crore** (including all applicable taxes & duties), during the last Ten (10) years reckoned from the bid opening date.

"**Similar work**" shall mean the following:

Design/Detailed Engineering, Procurement/Supply, Erection/Installation, and Commissioning of Bulk Material Handling Plant/System, comprising of Belt Conveyors having a minimum capacity of 170 TPH design capacity, including all Mechanical, Electrical, Instrumentation and Erection works and all other accessories and facilities required to make it complete in all respects on single point responsibility basis.

1.2 (i) The bidder must have completed one **"Similar work"**, during the last Ten (10) years reckoned from the bid opening date.

"**Similar work**" shall mean the Design, Engineering, Supply, Installation/erection and Testing & Commissioning of at least one (1) no. Scraper Reclaimer of minimum reclaiming capacity of 50 TPH.

(OR)

1.2 (ii) In case, bidder does not have experience of similar work as mentioned at 1.2 above, bidder has to submit MOU/MOU's (maximum 3 Nos.) with Scraper Reclaimer suppliers/vendors who has experience of having executed "Similar work" as described under 1.2 above.

The MOU/MOUs should inter alia include a clause whereby the Supplier/Vendor undertakes to execute the Scraper Reclaimer system of TFL project in case the said bidder emerges as successful bidder. Bidder should also give an undertaking that in case they emerge as successful bidder, they will execute the Scraper Reclaimer system only through the Supplier/vendor as per submitted MOU/MOU's.

However, only in exceptional circumstances and for justifiable reasons, successful bidder can request for a different supplier/vendor for completion of Scraper Reclaimer system, for PDIL's/TFL's approval. Decision of PDIL/TFL shall be final and binding on approval/rejection of such request.

Further, in addition to approved vendor list for scrapper reclaimer as attached in NIT, bidder can submit the MOU's from other Scraper Reclaimer system suppliers who meet the above criteria.

Note:

1. Bidder can submit a single contract consisting of [(1.1) & 1..2 (i)] or multiple contracts each for (1.1) & [1..2 (i)]. However, each job (1.1) & [1..2 (i)] must have been completed against a single contract only.
2. In case bidder has executed and completed composite works which includes any of the qualifying works(s) stated above i.e. (1.1) / 1.2 (i), then value of such qualifying works out of the total value of composite works shall be considered for the purpose of qualification.

1.3 The said **"Similar Work" referred at 1.1 and 1.2(i) / (ii) above** must have been in operation for at least 1 (one) year from the Date of Acceptance / Commissioning of the works.

1.4 Applicability of Policy for providing preference to Domestically Manufactured Iron & Steel (DMI & SP) Products.

Bidder should have minimum prescribed domestic value addition requirement in line with the Domestic Manufactured iron & Steel Policy (DMI & SP) for the Iron & Steel products involved in execution of the contract. Bidder shall submit affidavit from the domestic manufacturers of such Iron & steel products as per the Form-I mentioned in the policy document.

A bidder who is not manufacturer of Iron & Steel product and is unable to submit the Affidavit from domestic manufacturers at bidding stage, such bidder can submit the Affidavit issued by domestic manufacturers after placement of order. In this case bidder along with his bid shall submit an undertaking as per attached format **(Annexure-1 to Appendix-II).**

If a bidder does not submit above affidavit/ undertaking as per format, the offer of bidder shall be rejected.

Notes for 1.1 & 1.2 (i) / (ii) above:

I. Job completed by a Bidder for its own plant/ project cannot be considered as experience for the purpose of meeting BEC of the tender. However, jobs completed for Subsidiary/ Fellow subsidiary/ Holding company will be considered as experience for the purpose of meeting BEC subject to submission of tax paid invoice(s) duly certified by Statutory Auditor of the Bidder towards payments of statutory tax in support of the job completed for Subsidiary/ Fellow subsidiary/ Holding company. Such Bidders to

submit these documents in addition to the documents specified to meet BEC.

II. The bidder must submit the completion certificate/acceptance certificate issued by end user/ owner (or their consultant who has been duly authorized by them to issue such certificate) only after completion of work/ supply in all aspects.

III. Only documents (Work order, completion certificate, execution certificate etc.) which have been referred /specified in the bid shall be considered in reply to the queries during evaluation of bids.

IV. In case more than one contract/order/agreement/DLOA are emanating against same tender, these contracts are to be considered as single contract for evaluation of credentials of a bidder for meeting their experience criteria.

V. Experience of bidder acquired as a sub-contractor is acceptable against submission of certificate from end user by such bidder along with other specified documents.

2.0 Financial Criteria

2.1 The Annual Turnover of the bidder in any one of the last three (03) preceding financial years should be at least INR 32.35 Crore.

2.2 Net Worth of the bidder should be positive as per last audited financial year.

2.3 The Bidder should have minimum working capital equal to INR 6.47 Crore as per last audited financial year. However, if the bidder's working capital is negative or inadequate, the bidder shall submit a letter from their Bank having Net worth of the bank not less than Rs. 100.0 Crore (or equivalent USD , confirming the availability of line of credit for **INR 6.47 Crore**. The line of credit from bank shall be submitted strictly as per prescribed format

Notes for 2.1, 2.2 & 2.3"

Annual Turnover: Preceding 3 financial years mentioned in aforesaid BEC refer to immediate 3 preceding financial years wherever the closing date of the bid is after 30th Sept. of the relevant financial year. In case the tenders having the due date for submission of bid up to 30th September of the relevant financial year, and audited financial results of the immediate 3 preceding financial years are not available, the audited financial results of the 3 years immediately prior to that will be considered. Further, in case bidder is meeting the Annual Turnover criteria of BEC based on Audited Financial Statement of any one of the preceding 3 financial years (as mentioned above), the same shall suffice and bidder may submit prescribed format accordingly.

Net Worth/Working Capital: Immediate preceding financial year mentioned in aforesaid BEC refer to audited financial results for the immediate preceding financial year wherever the closing date of the bid is after 30th Sept. of the relevant financial year. In case the tenders having the due date for submission of bid up to 30th September of the relevant financial year, and audited financial results of the immediate preceding financial year is not available,

in such case the audited financial results of the year immediately prior to that year will be considered. Bidder is to submit Audited Financial Statement of immediate preceding financial years (as mentioned above) along with format F-10 accordingly for Networth / Working Capital..

3.0 General Notes (for both Technical BEC and Financial BEC):

Exchange rate for conversion of currency for evaluation of documents relating to BEC:

Exchange rate for Conversion of Currency for evaluation of documents submitted by bidders for BEC which are in a currency other than INR, shall be as follows:

a) **BEC (Technical):** Bill Selling (foreign exchange) Rate of State Bank of India as prevailing on the date of award of order / contract submitted by bidder (Not applicable for present BEC).

b) **BEC (Financial)**

(i) **For Annual Turnover**: The average of Bill Selling (foreign exchange) Rate of State Bank of India as prevailing on the First date and Last date of the respective Financial Year**.**

(ii) **For Net Worth & Working Capital**: The Bill Selling (foreign exchange) Rate of State Bank of India as prevailing on the Last date of the respective Financial Year

c) In case, the SBI Selling rate is not available as on the date of conversion as specified above for respective cases, the exchange rate for conversion of currency shall be taken from the internet, such as:

https://www.xe.com/currencyconverter
https://economictimes.indiatimes.com/markets/forex/currency-converter
https://www.oanda.com/currency/converter

4.0 BEC for START-UPS:

The Technical and Financial BEC as stipulated above shall also be applicable for start-ups.

5.0 Documents to be submitted for Compliance to BEC

(i) Technical Criteria of BEC:

To meet the criteria **1.1 & 1.2(i)** above, Bidder must submit Copy of Detailed Letter of Acceptance (DLOA) / Work Order /relevant extract of work Order/ Contract Agreement along with detailed scope of work and Completion / Acceptance Certificate.

The Detailed Letter of Acceptance (DLOA) / Work Order / Contract Agreement must clearly indicate nature of Work, period and contract value. Similarly, the Completion Certificate/ Acceptance Certificate must clearly indicate reference of relevant work order/DLOA/Contract Agreement, Name of Work, Contract Value, Completed order value and date of completion.

For Sl.no. **[1.2 (ii)]:** Where bidder does not have experience of Scrapper Reclaimer system, Bidder must submit copy of MOU(s) between bidder and concerned supplier of Scraper Reclaimer system. In addition, copy of Detailed Letter of Acceptance (DLOA) / Work Order /relevant extract of work Order/ Contract Agreement along with detailed scope of work and Completion / Acceptance Certificate for providing Design, Engineering, Supply, Erection/ installation of minimum 50 TPH Scrapper Reclaimer system by the said supplier/vendor must also be submitted.

To meet the criteria **1.3** above, for the "Similar Works" applicable for **1.1** and **1.2(i) / (ii)**, a certificate in respect of minimum one year successful operation of the Plant/System from the date of acceptance/Commissioning of work issued by the Owner/End user shall be submitted**.**

To meet the criteria 1.4 above, Bidder shall submit affidavit from the domestic manufacturers of such Iron & steel products as per the Form-I enclosed with the policy documents. A bidder who is not manufacturer of Iron & Steel product and is unable to submit the Affidavit from domestic manufacturers at bidding stage, such bidder can submit the Affidavit issued by domestic manufacturers after placement of order. In this case bidder along with his bid shall submit an undertaking as per prescribed format.

(ii) Financial Criteria of BEC:

(a) To meet the criteria for Sr. No. **2.1,** Bidder shall submit the Audited Financial Statements of the company for any one of the preceding three (03) financial years whichever meets the annual turnover criteria.

(b) To meet the criteria for Sr. No. **2.2**, Bidder shall submit the Audited Financial Statements of the last financial year.

(c) To meet the criteria for Sr. No. **2.3,** Bidder shall submit the Audited Financial Statements of last financial year along with (i) Bank's Letter (if applicable).

(d) If the bidder's working capital is negative or inadequate, the bidder shall submit a letter from their bank having net worth not less than Rs.100 Crores (or equivalent USD), confirming the availability of line of credit for working capital amount mentioned herein above. The line of credit letter from bank to be submitted strictly as per prescribed format.

For 5.0 (ii) above, the "<u>Notes for 2.1,2.2 & 2.3 under 2.0</u>" (Financial Criteria of BEC) shall apply.

(iii) Bidder shall submit Checklist as per prescribed format in respect of documents to be submitted by bidder towards BEC.

6.0 Authentication of documents submitted against BEC

6.1 Technical BEC

All documents in support of "Technical Criteria" of Bid Evaluation Criteria (BEC) furnished by the bidders shall be verified and certified by any one of the following independent third party inspection agency (as per prescribed format):

1. Société Générale de Surveillance (SGS)
2. Gulf Lloyds Industrial Services (India) Pvt. Ltd (GLISPL)
3. International Certification Services (ICS)
4. Bureau Veritas (Ind.) Pvt. Ltd (BVIS)
5. DNV GL
6. TUV Rheinland (India) Pvt. Ltd.
7. TÜV SÜD South Asia Pvt. Ltd.
8. TUV India Pvt. Ltd. (TÜV Nord Group)
9. Intertek India Pvt. Ltd.
10. Moody International (India) Pvt. Ltd.
11. RINA India Pvt. Ltd.
12. Tata Projects Ltd.
13. Competent Inspectorate and Consultants LLP
14. ABS Industrial Verification (India) Pvt. Ltd

Further, TPIA will provide in addition a certificate toward verification and certification of documents pertaining to Technical Bid Evaluation Criteria (BEC) as per prescribed proforma and the same will be submitted by bidder in their bid.

All charges of the Third party for verification and certification shall be borne by the Bidder.

If any above mentioned agency themselves are participating in bidding, then they shall authenticate the documents by a different agency from the list given above.

6.2 Financial BEC

Bidder shall submit "Details of financial capability of Bidder" in prescribed format (F-10) duly signed and stamped by a chartered accountant/ Certified Public Accountant (CPA).

Further, copy of audited annual financial statements submitted in bid shall be duly certified/ attested by Notary Public with legible stamp.

B. Evaluation Methodology

The subject work is indivisible and complete work shall be awarded to successful overall lowest bidder as per evaluation methodology described below :

The Evaluation methodology shall be arrived as per following:

a) TOTAL CONTRACT PRICE

The TOTAL CONTRACT PRICE (Including all taxes, duties, levies and GST) as derived from the SCHEDULE OF RATES (Annexure-A under Section-VII of NIT).

b) NPV OF TOTAL WORKS COST

Bidder shall furnish the Guaranteed Consumption Figures for Power (Annexure-B under Section –VII of NIT). The differential Works cost (in comparison to Bidder quoting the lowest Works Cost) considering 330 stream days per year will be calculated and will be discounted at discount rate of 10.0% p.a. for a period of 25 years of operation starting from Preliminary Acceptance.

The NPV of differential works cost (Power) so obtained on achieving Preliminary Acceptance (20 months) shall be further discounted at the rate of 10.0% p.a. to arrive at present value i.e. month zero. Total works Cost loading for entire PLANT/SYSTEM is to be considered in evaluation.

To summarize the above, the evaluated cost shall be ascertained as per following:

(a) QUOTED TOTAL CONTRACT PRICE

Plus (+)

(b) NPV of Differential Works cost

7.0 Applicability of Public Procurement (Make in India) Policy

The said policy shall be applicable for this package. Further, as the work is non divisible/non-splittable, therefore, the relevant provisions of policy shall be applicable. The minimum local content and all other provisions shall be as per Public Procurement (Make in India) Policy latest policy no. P-45021/2/2017-PP (BE-II) dated 16th September, 2020 or as updated from time to time.

8.0 Applicability of purchase preference of MSE's

Considering that the subject work falls under "Works Contract", Purchase preference to MSE Bidders shall not be applicable as per government guidelines.

Appendix-I

Format for Undertaking from TPIA

(on TPIA letter head duly stamped & signed)

Ref.:
Date :

To,

Talcher Fertilizers Limited.
……
……..
……

Dear Sir,

Subject: Verification and certification of documents pertaining to Technical Bid Evaluation Criteria (BEC)

Ref : Tender no. …….. for …….

M/s. ……having Registered office at……intend to participate in above referred tender of Talcher Fertilizers Limited having its registered office at Plot 2/H, Kalpana Area, BJB Nagar, Khordha, Bhubaneswar-751014.

The tender conditions stipulates that the BIDDER shall submit Documents pertaining to Technical Bid Evaluation Criteria (BEC) duly verified and certified by designated independent Third Party Inspection Agency.

In this regard, this is to certify that copies of documents pertaining to Technical Bid Evaluation Criteria (BEC) submitted to us by the bidder have been verified and certified by us with the originals and found to be genuine. We have signed and stamped on the copies of all the verified and certified documents.

(Signature of a person duly authorized to
Sign on behalf of the TPIA)
(Seal of the Company)
Name: ……..
Contact No…….

Appendix-II

POLICY FOR PROVIDING PREFERENCE TO DOMESTICALLY MANUFACTURED IRON & STEEL PRODUCTS IN GOVERNMENT PROCUREMENT

रजिस्ट्री सं० डी० एल०-33004/99 REGD. NO. D. L.-33004/99

भारत का राजपत्र
The Gazette of India

असाधारण
EXTRAORDINARY
भाग II—खण्ड 3—उप-खण्ड (i)
PART II—Section 3—Sub-section (i)
प्राधिकार से प्रकाशित
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इस्पात मंत्रालय

अधिसूचना

नई दिल्ली, 29 मई, 2019

सा.का.नि. 385(अ).—घरेलू रूप से उत्पादित किए जाने वाले लौह एवं स्टील उत्पाद की सरकारी खरीद को प्राथमिकता दिए जाने के लिए संशोधित नीति सामान्य सूचना हेतु प्रकाशित की जाती है।

[फा. सं. 3(2)/2018-आईडीडी]

रसिका चौबे, अपर सचिव

सरकारी खरीद में घरेलू स्तर पर निर्मित लौह एवं इस्पात उत्पादों को वरीयता देने के लिए नीति - संशोधित, 2019

1. भूमिका

1.1 यह नीति सरकारी खरीद में घरेलू स्तर पर निर्मित लौह एवं इस्पात उत्पादों (डी एम आई एंड एस पी) को वरीयता देती है।

1.2 यह नीति यथा लागू निर्धारित गुणवत्ता मानदंडों के अनुपालन में उत्पादित लौह एवं इस्पात उत्पादों जिसे परिशिष्ट क में दिया गया है और परिशिष्ट ख में दिए गए लौह एवं इस्पात उत्पादों के लिए पूंजीगत माल पर लागू होती है।

1.3 यह नीति सरकार के प्रत्येक मंत्रालय अथवा विभाग और उनके प्रशासनिक नियंत्रण के अधीन सभी एजेंसियों/प्रतिष्ठानों तथा सरकारी परियोजनाओं के वास्ते लौह एवं इस्पात उत्पादों की खरीद के लिए इन एजेंसियों द्वारा वित्त पोषित परियोजनाओं पर लागू है। हालांकि, यह नीति वाणिज्यिक पुन: बिक्री के उद्देश्य से अथवा वाणिज्यिक बिक्री के लिए वस्तुओं के उत्पादन में उपयोग करने के उद्देश्य से लौह एवं इस्पात उत्पादों की खरीद पर लागू नहीं होगी।

2. परिभाषाएं

2.1 **बोली** लगाने वाला लौह एवं इस्पात का कोई घरेलू/विदेशी निर्माता अथवा उनके बिक्री एजेंट/अधिकृत वितरक/अधिकृत डीलर/अधिकृत आपूर्ति गृह अथवा सरकारी एजेंसियों द्वारा वित्त पोषित निधि परियोजनाओं की बोली लगाने में कार्यरत कोई अन्य कंपनी हो सकती है।

2.2 **घरेलू स्तर पर निर्मित लौह एवं इस्पात उत्पाद (डी एम आई एंड एस पी)** वे लौह एवं इस्पात उत्पाद हैं जिनका निर्माण उन प्रतिष्ठानों द्वारा किया जाता है जो भारत में पंजीकृत और स्थापित हैं, जिसमें विशेष आर्थिक क्षेत्र (एस ई जैड) शामिल है। इसके अलावा, इस प्रकार के उत्पाद परिशिष्ट क में किये गये उल्लेख के अनुसार घरेलू न्यूनतम मूल्यवर्धन के मानदंडों को पूरा करेंगे।

2.3 **घरेलू निर्माता** खंड 7 में दिशा-निर्देशों और केंद्रीय उत्पाद शुल्क अधिनियम में दी गई 'निर्माता' की परिभाषा के अनुरूप लौह एवं इस्पात उत्पादों का एक निर्माता है।

2.4 इस नीति के प्रयोजन से **सरकार** का तात्पर्य भारत सरकार से है।

2.5 **सरकारी एजेंसियों** में सरकार के सार्वजनिक क्षेत्र के उपक्रम, सरकार द्वारा स्थापित सोसायटी, ट्रस्ट और सांविधिक निकाय शामिल हैं।

2.6 **एम ओ एस** का आशय इस्पात मंत्रालय, भारत सरकार से है।

2.7 **निवल बिक्री कीमत** बीजक कीमत होगी जिसमें निवल घरेलू कर और शुल्क शामिल नहीं होंगे।

2.8 **अर्ध तैयार इस्पात** का तात्पर्य इनगोट्स, बिलेट, ब्लूम और स्लेब्स से है, जिसे बाद में प्रसाधित कर तैयार इस्पात बनाया जा सकता है।

2.9 **तैयार इस्पात** का तात्पर्य सपाट और लंबे उत्पादों से होगा जिन्हें बाद में प्रसाधित कर निर्मित मद बनाया जा सकता हैं।

2.10 **एल1** का तात्पर्य निविदा अथवा अन्य खरीद संबंधी अनुरोध के अनुसार मूल्यांकन प्रक्रिया में यथाघोषित निविदा, बोली लगाने संबंधी प्रक्रिया अथवा अन्य खरीद संबंधी अनुरोधों में प्राप्त निम्नतम निविदा अथवा निम्नतम बोली अथवा निम्नतम भाव से होगा।

2.11 **खरीद वरीयता के मार्जिन** का तात्पर्य उस अधिकतम सीमा से है जिस सीमा तक किसी घरेलू आपूर्तिकर्ता द्वारा लगाई गई कीमत खरीद वरीयता के प्रयोजन से एल1 से अधिक हो। डी एम आई एंड एस पी नीति के मामले में, खरीद वरीयता का मार्जिन परिशिष्ट ख में मदों के लिए 20 प्रतिशत होगा।

2.12 **लौह एवं इस्पात उत्पाद** का तात्पर्य ऐसे लौह एवं इस्पात उत्पादों से होगा जिनका उल्लेख परिशिष्ट क में किया गया है।

2.13 **घरेलू मूल्यवर्धन** निवल बिक्री कीमत (निवल घरेलू करों और शुल्कों को छोड़कर बीजक कीमत) होगी जिससे प्रतिशत में निवल बिक्री कीमत के एक अनुपात के रूप में भारत में निर्माण संयंत्र (सभी सीमा शुल्कों सहित) में आयात की गई इनपुट सामग्री की पहुंच लागत घटाई गई हो, 'घरेलू मूल्यवर्धन' परिभाषा डी पी आई आई टी (पूर्व में डी आई पी पी) के दिशानिर्देशों के अनुरूप होगी और उसमें भविष्य में डी पी आई आई टी द्वारा परिवर्तन किये जाने की स्थिति में उपयुक्त रूप से संशोधन किया जाएगा। इस नीति दस्तावेज के प्रयोजन के लिए घरेलू मूल्यवर्धन और स्थानीय विषय वस्तु का उपयोग एक दूसरे के स्थान पर किया गया है।

3. अपवर्जन

3.1 इस्पात मंत्रालय द्वारा इस प्रकार की सभी सरकारी खरीदों के लिये निम्नलिखित शर्तों के अध्यधीन छूट प्रदान की जाएगी।

3.1.1 जहां विशिष्ट ग्रेडों के इस्पात का निर्माण इस देश में नहीं किया जाता हो, अथवा

3.1.2 जहां परियोजना की मांग के अनुसार इन मात्राओं को घरेलू स्रोतों के माध्यम से पूरा नहीं किया जा सकता हो।

अपवर्जन संबंधी अनुरोधों को घरेलू स्तर पर निर्मित लौह एवं इस्पात उत्पादों के उपलब्ध न होने के पर्याप्त प्रमाण के साथ स्थायी समिति को प्रस्तुत किया जाएगा।

4. स्थायी समिति

इस नीति के कार्यान्वयन का पर्यवेक्षण करने के लिए इस्पात मंत्रालय (एम ओ एस) के अधीन एक स्थायी समिति का गठन किया जाएगा। जिसके अध्यक्ष सचिव इस्पात होंगे। इस समिति में उद्योग/उद्योग संघ/सरकारी संस्था अथवा निकाय/इस्पात मंत्रालय (एम ओ एस) से लिए गए विशेषज्ञ होंगे। इस्पात मंत्रालय में उक्त समिति के पास निम्नलिखित के लिए अधिदेश होगा :

4.1 इस नीति के कार्यान्वयन की मॉनीटरिंग करना

4.2 परिशिष्ट क और परिशिष्ट ख में यथा उल्लिखित लौह एवं इस्पात उत्पादों की सूची और घरेलू बिक्री वर्धन की आवश्यकता से संबंधित मानदंडों की समीक्षा करना और उसे अधिसूचित।

4.3 खंड 3 के अनुसार खरीद एजेंसियों को अपवर्जन की स्वीकृति देने सहित इस नीति के कार्यान्वयन के लिए आवश्यक स्पष्टीकरण जारी करना।

4.4 शिकायत निवारण करने के लिए एक अलग समिति का गठन करना।

4.5 स्थायी समिति इस्पात मंत्रालय को अनुमोदन हेतु अपनी सिफारिशें प्रस्तुत करेगी।

5. सरकार द्वारा खरीदे जाने वाले लौह एवं इस्पात उत्पादों को अधिसूचित करना

5.1 निम्नलिखित दिशानिर्देशों का उपयोग इस नीति के अंतर्गत उपरोक्त उत्पादों की पहचान करने और उसे अधिसूचित करने के लिए किया जा सकता है :

5.1.1 यह नीति परिशिष्ट क में दिए गए अनुसार लौह एवं इस्पात उत्पादों और परिशिष्ट ख में लौह एवं इस्पात उत्पादों का निर्माण करने के लिए पूंजीगत माल पर लागू है।

5.1.2 परिशिष्ट क में लौह एवं इस्पात उत्पादों की सूची दी गई है जिसका निर्माण अनन्य रूप से घरेलू स्तर पर किया जाना है और उसका आयात इस्पात मंत्रालय के अनुमोदन के बिना नहीं किया जा सकता है।

5.1.3 परिशिष्ट ख में पूंजीगत माल की एक सूची (जो विस्तृत नहीं है) दी गई है जिसके लिए खरीद संबंधी वरीयता घरेलू स्तर पर निर्मित पूंजीगत माल को दी जाएगी, यदि उनकी दी गई कीमत सदृश्य आयात किये गये पूंजीगत माल के लिए दी गई कीमत के 20 प्रतिशत के अंदर आती हो।

5.1.4 इस नीति का उद्देश्य सभी लौह एवं इस्पात उत्पादों को अधिसूचित करना है जिसकी खरीद सरकारी एजेंसियों द्वारा सरकारी परियोजनाओं के लिए की जाती है और न कि वाणिज्यिक पुन: बिक्री के उद्देश्य से अथवा वाणिज्यिक बिक्री के लिए उत्पादों के उत्पादन में प्रयोग करने के उद्देश्य से की गई हो।

5.1.5 यह नीति सरकार के मंत्रालय अथवा विभाग के द्वारा निधि प्रदत्त सभी परियोजनाओं और उनके प्रशासनिक नियंत्रण के अधीन सभी एजेंसियों/प्रतिष्ठानों पर लौह एवं इस्पात उत्पादों की खरीद के लिए लागू है।

5.1.6 यह नीति उन परियोजनाओं पर लागू होगी जहां लौह एवं इस्पात उत्पादों का खरीद मूल्य 25 करोड़ रुपए से अधिक होता हो। यह नीति अन्य खरीद (गैर परियोजना) के लिए भी लागू होगी जहां उस सरकारी संगठन के लिए लौह एवं इस्पात उत्पादों का वार्षिक खरीद मूल्य 25 करोड़ रुपए से अधिक होता हो।

5.1.7 यह नीति सरकार के मंत्रालय अथवा विभाग अथवा उनके सार्वजनिक क्षेत्र के उपक्रमों की किसी अन्य आवश्यकता को पूरा करने के लिए और/अथवा ई पी सी संविदा को पूरा करने के लिए प्राइवेट एजेंसियों द्वारा लौह एवं इस्पातों की खरीद पर लागू है।

5.1.8 घरेलू लौह एवं इस्पात उत्पादों के विभिन्न ग्रेडों की उपलब्धता का विश्लेषण इस नीति के अंतर्गत अधिसूचित करने से पहले करना होगा। केवल उन लौह एवं इस्पात को उत्पादों को जिनके संबंध में कम से कम एक घरेलू निर्माता मौजूद हो, अधिसूचित किया जाएगा। स्थायी समिति से परामर्श किया जा सकता है।

5.1.9 यह नीति यथा लागू निर्धारित गुणवत्ता मानदंडों के अनुपालन में उत्पादित परिशिष्ट ख में दिए गए लौह एवं इस्पात उत्पादों का निर्माण करने के लिए पूंजीगत माल के लिए लागू है।

5.1.10 लौह एवं इस्पात उत्पादों का निर्माण करने के लिए पूंजीगत मालों की घरेलू खरीद के लिए नीति लौह एवं इस्पात उत्पादों का निर्माण करने के लिए और न कि वाणिज्यिक पुन: बिक्री के उद्देश्य से पूंजीगत मालों की खरीद के वास्ते और सार्वजनिक क्षेत्र के इस्पात विनिर्माताओं और उनके प्रशासनिक नियंत्रणाधीन सभी एजेंसियों/प्रतिष्ठानों पर लागू है।

5.1.11 यह नीति ई पी सी संविदा और/अथवा सार्वजनिक क्षेत्र से इस्पात निर्माताओं और उनके प्रशासनिक नियंत्रण के अधीन सभी एजेंसियों/प्रतिष्ठानों की किसी अन्य आवश्यकता को पूरा करने के लिए निजी एजेंसियों द्वारा लौह एवं इस्पात उत्पादों का निर्माण करने के लिए पूंजीगत माल की खरीद पर लागू है।

5.1.12 सरकारी एजेंसियां जो लौह एवं इस्पात उत्पादों के निर्माण के लिए पूंजीगत माल और लौह एवं इस्पात उत्पादों की खरीद में उन स्थितियों में शामिल है जहां लौह एवं इस्पात उत्पादों का उल्लेख परिशिष्ट क और परिशिष्ट ख में नहीं किया गया हो, स्थायी समिति को निर्धारित मानदंडों के साथ इस उत्पाद के विवरण और तकनीकी विनिर्देशन उपलब्ध करायेगा। स्थायी समिति खंड 3 और खंड 4 में अधिदेश के अनुसार कार्य करेगी।

5.2 इस्पात मंत्रालय (एम ओ एस) परिशिष्ट क में दिए गए न्यूनतम निर्धारित घरेलू मूल्यवर्धन के साथ लौह एवं इस्पात उत्पादों को अधिसूचित करेगा।

5.3 लौह एवं इस्पात उत्पादों का निर्माण करने के लिए पूंजीगत माल के संबंध में नीतिगत दिशानिर्देश, परियोजना के आकार पर विचार किये बिना परिशिष्ट ख में लौह एवं इस्पात उत्पादों का निर्माण करने के लिए पूंजीगत माल की सभी खरीदों के लिए सार्वजनिक क्षेत्र के इस्पात निर्माताओं पर लागू होंगे।

5.4 परिशिष्ट क में लौह एवं इस्पात उत्पादों के लिए तथा परिशिष्ट ख में लौह एवं इस्पात उत्पादों का निर्माण करने के लिए पूंजीगत माल के लिए सुझाव दिए गए न्यूनतम घरेलू मूल्यवर्धन आवश्यकता घरेलू आपूर्तिकर्ता का आधार, आपूर्तिकर्ताओं की संख्या और खपत की तुलना में आयात का अनुपात जैसे कारकों के आधार पर तय किया गया है।

5.5 घरेलू मूल्यवर्धन आवश्यकता संबंधी मानदंडों का इस प्रकार से निर्धारण किया जाएगा जिस से कि यह किसी दिए गए समय में लौह एवं इस्पात उत्पादों के लिए घरेलू उद्योग की औसत/औसत से अधिक निर्माण क्षमता दर्शाता हो। स्थायी समिति द्वारा समय समय पर उपयुक्त रूप से इसकी समीक्षा की जाएगी और आवश्यकता पड़ने पर इस्पात मंत्रालय के अनुमोदन से इसमें संशोधन किया जाएगा।

6. सरकार एवं सरकारी एजेंसियों द्वारा खरीद के लिए निविदा प्रक्रिया

6.1 खरीद करने वाली/सरकारी एजेंसियां डी एम आई एंड एस पी का पालन करते समय वित्त मंत्रालय और सी वी सी के अनुदेशों के अनुसार मानक खरीद संबंधी प्रक्रियाओं का पालन करेगी। यह नीति सभी निविदाओं जहां कीमत बोली नहीं खोली गई है, में इसके अधिसूचना की तिथि से लागू होगी।

6.2 दोनों वस्तुओं की खरीद तथा ई पी सी संविदाओं के लिए निविदा दस्तावेज में लौह एवं इस्पात उत्पादों का निर्माण करने के लिए लौह एवं इस्पात उत्पादों तथा पूंजीगत माल (जैसा कि परिशिष्ट क और परिशिष्ट ख में दर्शाया गया है, के लिए बोली लगाने वाले द्वारा न्यूनतम निर्धारित घरेलू मूल्यवर्धन का पालन करने के लिए अर्हता मानदंडों का स्पष्ट उल्लेख होना चाहिए।

6.3 घरेलू उत्पादों के विकास का सहयोग करने में, लौह एवं इस्पात व्यापार क्रियाकलापों में घरेलू मूल्यवर्धन का लक्ष्य निर्धारित किया गया है जिसे **परिशिष्ट क और परिशिष्ट ख** में दिया गया है।

6.4 परिशिष्ट क में लौह और इस्पात उत्पादों के खरीद की प्रक्रिया केवल उन निर्माताओं/आपूर्तिकर्ताओं के लिए ही खुली रहेगी जिसमें घरेलू मूल्यवर्धन लक्ष्यों को पूरा करने/उससे ज्यादा पूरा करने की क्षमता हो। घरेलू मूल्यवर्धन लक्ष्यों को पूरा न करने वाले निर्माता/आपूर्तिकर्ता बोली लगाने में भाग लेने के लिए पात्र नहीं हैं।

6.5 परिशिष्ट ख में दी गई मदों के मामलों में, यदि खरीद करने वाली कंपनी की राय में, निविदाओं (खरीदी गई मात्रा) को 50:50 के निर्धारित अनुपात में नहीं बांटा जा सकता है, तब उनके पास मात्रा जो 50 प्रतिशत से कम नहीं हो, जो कि विभाज्य हो, के लिए पात्र घरेलू निर्माता को संविदा देने का अधिकार होगा।

6.6 उपर्युक्त शर्त को जारी रखते हुए, परिशिष्ट ख की मदों के लिए, यदि निविदा दी गई मद विभाज्य न हो (खरीद करने वाली कंपनी द्वारा निविदा दस्तावेज में शामिल किए जाने के लिए) यह संविदा समग्र मात्रा के लिए पात्र घरेलू निर्माता को दी जा सकती है।

6.7 परिशिष्ट ख के मदों के मामलों में, यदि घरेलू मूल्यवर्धन की आवश्यकताओं को पूरा करने वाले पात्र निर्माताओं में से कोई भी एल1 की बोली के अनुरूप न हो, तब एल1 की बोली धारण करने वाले मूल बोली लगाने वाला खरीद के पूर्ण मूल्य के लिए आदेश प्राप्त करेंगे।

6.8 वे बोली लगाने वाले जो लौह एवं इस्पात उत्पादों के घरेलू निर्माताओं के बिक्री एजेंट/अधिकृत वितरक/अधिकृत डीलर/अधिकृत आपूर्ति गृह हैं इस नीति के अंतर्गत घरेलू निर्माताओं की ओर से बोली लगाने के लिए पात्र हैं। हालांकि, यह निम्नलिखित शर्तों के अध्यधीन होगा।

6.8.1 बोली लगाने वाले घरेलू स्तर पर निर्मित लौह एवं इस्पात उत्पादों की बिक्री करने के लिए घरेलू निर्माता द्वारा जारी किए गए अधिकार प्रमाण पत्र प्रस्तुत करेगा।

6.8.2 यदि खरीद को डी एम आई एंड एस पी नीति के परिशिष्ट क के अंतर्गत शामिल किया गया हो तब बोली लगाने वाला यह घोषणा करते हुए खरीद करने वाली एजेंसी को घरेलू निर्माता द्वारा जारी किया गया स्व-प्रमाणन का शपथ पत्र प्रस्तुत करेगा कि लौह और इस्पात उत्पादों का घरेलू स्तर पर निर्माण निर्धारित घरेलू मूल्यवर्धन के मामले में किया जाता है।

6.8.3 यदि खरीद को डी एम आई एंड एस पी नीति के परिशिष्ट ख के अंतर्गत शामिल किया गया हो तब बोली लगाने वाला यह घोषणा करते हुए घरेलू निर्माता को सांविधिक लेखा परीक्षक द्वारा जारी किया गया प्रमाणन प्रस्तुत करेगा कि लौह और इस्पात उद्योग में उपयोग किये जाने वाले पूंजीगत माल का घरेलू स्तर पर निर्माण निर्धारित घरेलू मूल्यवर्धन के मामले में किया जाता है।

6.8.4 बोली लगाने वाले की यह जिम्मेदारी होगी कि वह इस नीति के अनुसार खरीद करने वाली एजेंसी को घरेलू निर्माता द्वारा जारी किये जाने के लिए अपेक्षित अन्य आवश्यक दस्तावेज प्रस्तुत करे।

7. घरेलू मूल्यवर्धन आवश्यकता

7.1 घरेलू रूप में निर्मित लौह और इस्पात उत्पाद अथवा पूंजीगत माल के रूप में उत्पाद के रूप में पात्र होने के लिए न्यूनतम घरेलू मूल्यवर्धन आवश्यकता का उल्लेख परिशिष्ट क और परिशिष्ट ख में किया गया है।

7.2 घरेलू मूल्यवर्धन निवल बिक्री कीमत (निवल घरेलू करों और शुल्कों को छोड़कर बीजक कीमत) होगी जिसमें से प्रतिशत में निवल बिक्री कीमत के एक अनुपात के रूप में भारत में निर्माण करने वाले संयंत्र में आयात की गई इनपुट सामग्री की पहुंच लागत (सभी सीमा शुल्कों को शामिल करते हुए) घटाई जाएगी।

7.2.1 यदि लौह और इस्पात उत्पादों को घरेलू इनपुट इस्पात (अर्ध तैयार/तैयार इस्पात) का उपयोग करके निर्माण किया जाता हो, तब खरीदी गई मात्रा और अन्य संबंधित दस्तावेजों के साथ वास्तविक घरेलू उत्पादों से खरीद का बीजक खरीद करने वाली सरकारी एजेंसी को अवश्य प्रस्तुत किया जाना चाहिए।

7.2.2 यदि लौह एवं इस्पात उत्पादों ने इनपुट इस्पात का आयात किया हो तब खरीदी गई मात्रा और अन्य संबंधित दस्तावेजों के साथ वास्तविक उत्पादकों से खरीदों के बीजकों को अलग से प्रस्तुत किया जाना चाहिए। घरेलू मूल्यवर्धन की सीमा निकालने के लिए, दोनों इनपुट इस्पातों (आयात किये और घरेलू) की भारित औसत पर विचार यह सुनिश्चित करने के लिए किया जाएगा कि इस नीति की न्यूनतम निर्धारित घरेलू मूल्यवर्धन आवश्यकता का पालन किया गया है।

7.3 यह सिफारिश की जाती है कि निविदा की प्रक्रिया में भाग लेने वाले प्रत्येक बोली लगाने वाले को नीचे दिए गए सूत्र का उपयोग करते हुए घरेलू मूल्यवर्धन की गणना करनी चाहिए ताकि यह सुनिश्चित किया जा सके कि दावा किये गये घरेलू मूल्यवर्धन इस नीति के न्यूनतम निर्धारित घरेलू मूल्यवर्धन के अनुरूप है।

लौह एवं इस्पात उत्पादों के लिए

% घरेलू मूल्यवर्धन

$$= \frac{\text{अंतिम उत्पाद की निवल बिक्री कीमत} - \text{संयंत्र में आयात किये गये लौह अथवा इस्पात की पहुंच लागत}}{\text{अंतिम उत्पाद की निवल बिक्री कीमत}} \times 100\%$$

पूंजीगत माल के लिए

% घरेलू मूल्यवर्धन

$$= \frac{\text{अंतिम उत्पाद की निवल बिक्री कीमत} - \text{संयंत्र में आयात किये गये इनपुट सामग्री की पहुंच लागत}}{\text{अंतिम उत्पाद की निवल बिक्री कीमत}} \times 100\%$$

8. प्रमाणन और लेखा परीक्षण

8.1 परिशिष्ट क में दिए गए उत्पादों के लिए, प्रत्येक घरेलू निर्माता यह घोषणा करते हुए खरीद करने वाली सरकारी एजेंसी को स्व-प्रमाणन का शपथ पत्र प्रस्तुत करेगा कि लौह एवं इस्पात उत्पाद का निर्धारित घरेलू मूल्यवर्धन के संबंध में घरेलू स्तर पर निर्माण किया गया है। परिशिष्ट ख के पूंजीगत माल के लिए, बोली लगाने वाला यह घोषणा करते हुए घरेलू निर्माता को सांविधिक लेखा परीक्षक द्वारा जारी किया गया प्रमाणन प्रस्तुत करेगा कि पूंजीगत माल का निर्माण घरेलू स्तर पर निर्धारित घरेलू मूल्यवर्धन के संबंध में किया गया है। वे बोली लगाने वाले जो लौह एवं इस्पात उत्पादों के घरेलू निर्माताओं का एकमात्र बिक्री एजेंट/अधिकृत वितरक/अधिकृत डीलर/अधिकृत आपूर्ति गृह हैं, ई पी सी के अंतर्गत घरेलू निर्माताओं की ओर से बोली लगाने के लिए पात्र हैं।

बोली लगाने वाला घरेलू निर्माताओं के द्वारा जारी किए गए स्व-प्रमाणन और सांविधिक लेखा परीक्षकों द्वारा जारी किये गये प्रमाणनों को यह घोषणा करते हुए खरीद करने वाली एजेंसी को प्रस्तुत करेगा कि लौह एवं इस्पात उत्पादों का घरेलू स्तर पर निर्माण निर्धारित घरेलू मूल्यवर्धन के संबंध में किया गया है। स्व प्रमाणन का शपथ पत्र इन दिशानिर्देशों से संलग्न **प्रपत्र 1** में प्रस्तुत किया जाएगा।

8.2 घरेलू निर्माता की यह जिम्मेदारी होगी कि वह यह सुनिश्चित करे कि इस प्रकार से दावा किये गये उत्पादों का घरेलू स्तर पर उस उत्पाद के लिए निर्धारित घरेलू मूल्यवर्धन के संबंध में किया गया है। बोली लगाने वाले से यह भी अपेक्षित होगा कि वह घरेलू निर्माता के सांविधिक लेखा परीक्षकों द्वारा विधिवत प्रमाणित अर्धवार्षिक (सितंबर 30 और मार्च 31) आधार पर घरेलू मूल्यवर्धन प्रमाणपत्र उपलब्ध कराये कि पहले 6 महीनों के दौरान इस उत्पाद के लिए किये गये घरेलू मूल्यवर्धन के दावे इस नीति के अनुसार हैं। इस प्रकार के प्रमाण पत्र को संबंधित सरकारी एजेंसियों को प्रत्येक छमाही के शुरू होने के 60 दिनों के भीतर प्रस्तुत किया जाएगा और उस उत्पादों की आपूर्ति को पूरा करने तक प्रस्तुत करता रहेगा।

8.3 खरीद करने वाली एजेंसी बोली लगाने वाले द्वारा प्रस्तुत किये गये इस्पात उत्पाद में घरेलू मूल्यवर्धन के संबंध में स्व-प्रमाणन का शपथ पत्र स्वीकार करेगा। सामान्य तौर पर खरीद करने वाली एजेंसी की यह जिम्मेदारी होगी कि वह इस दावे की सत्यतता की जांच करे। इसकी सत्यतता प्रदर्शित करने की जिम्मेदारी बोली लगाने वाले की होगी जब उसे ऐसा करने के लिए कहा जाए।

8.4 यदि खरीद करने वाली एजेंसी अथवा संबंधित सरकारी एजेंसी द्वारा लौह एवं इस्पात उत्पादों में घरेलू मूल्यवर्धन के संबंध में बोली लगाने वाले के दावे के विरुद्ध कोई शिकायत प्राप्त होती है तब खरीद करने वाली एजेंसी के पास सभी संबंधित दस्तावेजों का निरीक्षण करने और उसकी जांच करने तथा निर्णय लेने का पूर्ण अधिकार होगा। यदि कोई स्पष्टीकरण की आवश्यकता होती है तब मामले को तकनीकी सहायता के लिए अनुरोध के साथ इस्पात मंत्रालय को भेजा जा सकता है।

8.5 सरकारी एजेंसी को भेजे गए किसी शिकायत का निपटारा सभी आवश्यक दस्तावेजों को प्रस्तुत करने के साथ इसे भेजे जाने के 4 सप्ताह के भीतर किया जाएगा। बोली लगाने वाले से यह अपेक्षित होगा कि वह शिकायत दायर करने के 2 सप्ताह के भीतर सरकारी एजेंसी को लौह एवं इस्पात उत्पादों में दावा किये गये घरेलू मूल्यवर्धन के समर्थन में आवश्यक दस्तावेज प्रस्तुत करे।

8.6 यदि इस मामले को इस्पात मंत्रालय के पास भेजा जाता है तब इस्पात मंत्रालय के अधीन गठित शिकायत निवारण समिति सरकारी एजेंसी के दृष्टिकोण पर विचार करने के बाद बोली लगाने वाले से सभी दस्तावेजों के प्राप्त होने और उसका संदर्भ भेजे जाने के 4 सप्ताह के भीतर शिकायत का निपटारा करेगी। बोली लगाने वाले से यह अपेक्षित होगा कि वे इस मामले के संदर्भ के 2 सप्ताह के भीतर इस्पात मंत्रालय के अंतर्गत शिकायत निवारण समिति को लौह एवं इस्पात उत्पादों में दावा किए गए घरेलू मूल्यवर्धन के समर्थन में आवश्यक दस्तावेज प्रस्तुत करे। यदि बोली लगाने वाले द्वारा कोई सूचना प्रस्तुत नहीं की जाती है तब शिकायत निवारण समिति दावे की प्रमाणिकता अधिक करने के लिए सरकारी एजेंसी के परामर्श से आगे आवश्यक कार्रवाई कर सकती है।

8.7 घरेलू मूल्यवर्धन की निर्धारित सीमा का आकलन करने की लागत का वहन खरीद करने वाली एजेंसी द्वारा किया जाएगा यदि घरेलू मूल्यवर्धन प्रमाण पत्र के अनुसार सही पाया गया हो। हालांकि, यदि ऐसा पाया गया हो कि दावा किए गए अनुसार घरेलू मूल्यवर्धन सही नहीं है तब आकलन की लागत बोली लगाने वाले द्वारा भुगतान के योग्य होगी जिन्होंने एक गलत प्रमाण पत्र प्रस्तुत किया है। इसे लागू करने के तरीके को निविदा दस्तावेज में परिभाषित किया जाएगा।

9. प्रतिबंध

9.1 प्रत्येक सरकारी एजेंसी निविदा दस्तावेज में निर्धारित घरेलू मूल्यवर्धन का बोली लगाने वाले के द्वारा गलत घोषणा किए जाने की स्थिति में दण्ड को स्पष्ट रूप से परिभाषित करेगा। इस दण्ड में ऐसे निर्माता/सेवा प्रदाता की ई एम डी को जब्त करना, अन्य वित्तीय दंड लगाना और उसे काली सूची में डालना शामिल हो सकता है।

9.2 संबंधित बोली लगाने वाले के द्वारा इस्पात मंत्रालय को किसी प्रकार की शिकायत भेजे जाने की स्थिति में, 10 लाख रुपए अथवा खरीदी जा रही डी एम आई एंड एस पी के मूल्य का 0.2 प्रतिशत (अधिकतम 20 लाख के अध्यधीन) इसमें से जो भी अधिक हो, का शिकायत शुल्क होगा जिसका भुगतान शिकायतकर्ता द्वारा शिकायत के साथ इस्पात मंत्रालय के अधीन शिकायत निवारण समिति के पास जमा किए गए डिमाण्ड ड्राफ्ट के द्वारा किया जाएगा। यदि, शिकायत को सही नहीं पाया जाता है तब सरकारी एजेंसी के पास उक्त राशि को जब्त करने का अधिकार सुरक्षित है। यदि शिकायत पर्याप्त रूप से सही पाई जाती है तब शिकायतकर्ता द्वारा जमा किए गए शुल्क को बिना किसी ब्याज के वापिस किया जाएगा।

10. इस्पात मंत्रालय द्वारा कार्यान्वयन की मॉनीटरिंग

10.1 इस नीति के प्रावधान प्रकाशन की तिथि से 5 वर्षों की अवधि के लिए लागू रहेंगे। इस नीति की अवधि को इस्पात मंत्रालय के विवेक से और आगे बढ़ाया जा सकता है।

10.2 इस्पात मंत्रालय इस नीति के कार्यान्वयन की मानीटरिंग करने के लिए नोडल मंत्रालय होगा।

10.3 डी एम आई एंड एस पी नीति के अंतर्गत सभी लागू एजेंसियां इस नीति का कार्यान्वयन सुनिश्चित करेंगी और वार्षिक रूप से जून के महीने में एक घोषणा भेजेंगी जिसमें इस नीति के अनुपालन की सीमा और पिछले वित्तीय वर्ष के दौरान उसके अनुपालन न किए जाने के कारणों को दर्शाया जाएगा।

इस्पात मंत्रालय को संदर्भ

किसी ऐसे प्रश्न की स्थिति में कि क्या खरीदी जा रही मद इस नीति के अंतर्गत शामिल किए जाने वाले डी एम आई एंड एस पी है, इस मामले को स्पष्टीकरण के लिए इस्पात मंत्रालय के पास भेजा जाएगा।

परिशिष्ट क – घरेलू स्तर पर निर्मित उत्पादों के लिए अनन्य

क्र. सं.	लौह एवं इस्पात उत्पादों की सांकेतिक सूची	लागू एच एस कोड	न्यूनतम घरेलू मूल्यवर्धन आवश्यकता
1	600 मि. मी. अथवा उससे अधिक की चौड़ाई वाले लौह अथवा गैर एलॉय इस्पात का फ्लेट रोल उत्पाद, हॉट रोल्ड, न ढका हुआ, प्लेट लगाया हुआ अथवा कोट किया हुआ	7208	50%
2	600 मि. मी. अथवा उससे अधिक की चौड़ाई वाले लौह अथवा गैर एलॉय इस्पात का फ्लेट रोल उत्पाद, कोल्ड रोल्ड (कोल्ड - कम किया हुआ), न ढका हुआ, प्लेट लगाया हुआ अथवा कोट किया हुआ	7209	50%
3	600 मि. मी. अथवा उससे अधिक की चौड़ाई वाले लौह अथवा गैर एलॉय इस्पात का फ्लेट रोल उत्पाद, ढका हुआ, प्लेट लगाया हुआ अथवा कोट किया हुआ	7210	50%
4	600 मि. मी. से कम की चौड़ाई वाले लौह अथवा गैर एलॉय इस्पात का फ्लेट रोल उत्पाद, न ढका हुआ, प्लेट लगाया हुआ अथवा कोट किया हुआ	7211	35%
5	600 मि. मी. कम की चौड़ाई का लौह अथवा गैर एलॉय इस्पात का फ्लेट रोल उत्पाद, ढका हुआ, प्लेट लगाया हुआ अथवा कोड किया हुआ	7212	35%
6	लौह एवं गैर एलॉय इस्पात का अनियमित रूप से ऐंठा हुआ क्वाइल में बार्स और रॉड, हॉट रोल्ड	7213	35%
7	लौह अथवा गैर एलॉय इस्पात के अन्य बार्स और रॉड्स जिसे फोर्ज किए जाने की तुलना में आगे अधिक वर्क नहीं किया हुआ, हॉट रोल्ड, हॉट ड्रॉन अथवा हॉट एक्सट्रूडेड परंतु रोलिंग के बाद उसे टिविस्ट किये जाने सहित	7214	35%
8	लौह अथवा गैर एलॉय इस्पात का अन्य बार्स एंड रोड्स	7215	35%
9	लौह अथवा गैर एलॉय इस्पात का एंगल, शेप और सेक्शन्स	7216	35%
10	लौह अथवा गैर एलॉय इस्पात का तार	7217	50%
11	600 मि. मी. अथवा उससे अधिक की चौड़ाई का स्टेनलैस इस्पात का फ्लेट रोल्ड इस्पात	7219	50%
12	600 मि. मी. से कम की चौड़ाई का स्टेनलैस इस्पात का फ्लेट रोल्ड इस्पात	7220	50%
13	स्टेनलैस स्टील का अन्य बार्स और रोड्स; स्टेनलैस स्टील का एंगल शेप और सेक्शन्स	7222	50%
14	अन्य एलॉय इस्पात का तार	7229	35%
15	लौह अथवा इस्पात को रेल, रेलवे अथवा ट्रामवे ट्रेक निर्माण सामग्री	7302	50%

16	कास्ट लौह का ट्यूब, पाइप और होलो पाइप	7303	35%
17	लौह (कास्ट आयरन को छोड़कर) अथवा इस्पात का ट्यूब पाइप और होलो प्रोफाइल, सीमलैस	7304	35%
18	लौह अथवा इस्पात का सर्कुलर क्रॉस सेक्शन वाले अन्य ट्यूब और पाइप (उदाहरण के लिए, वेल्ड किया हुआ, रिवेट किया हुआ अथवा समान रूप से बंद किया गया हुआ), जिसकी बाहरी त्रिज्या 406.4 मि. मी. से अधिक हो	7305	35%
19	लौह अथवा इस्पात के अन्य ट्यूब, पाइप और होलो प्रोफाइल (उदाहरण के लिए ओपन सीन अथवा वेल्ड किया हुआ, रिवेट किया हुआ अथवा समान रूप से बंद किया गया हुआ)	7306	35%
20	लौह अथवा इस्पात का ट्यूब अथवा पाइप फिटिंग (उदाहरण के लिए, कनेक्टर/कप्लिंग, एल्बो स्लीव्स)	7307	35%
21	स्टेनलैस स्टील का अनियमित रूप से ऐंठा हुआ कुंडलों में बार्स और रॉड, हॉट रोल्ड	7221	35%
22	स्टेनलैस स्टील का वायर	7223	35%
23	इलेक्ट्रिकल स्टील सहित 600 मि. मी. अथवा उससे अधिक की चौड़ाई वाले अन्य एलॉय स्टील का फ्लेट रोल्ड इस्पात	7225	35%
24	इलेक्ट्रिकल स्टील सहित 600 मि. मी. से कम की चौड़ाई वाले अन्य एलॉय स्टील का फ्लेट रोल्ड इस्पात	7226	35%
25	अन्य एलॉय स्टील का अनियमित रूप से ऐंठा हुआ क्वाइल में बार्स और रोड, हॉट रोल्ड	7227	15%
26	अन्य एलॉय स्टील का अन्य बार्स और रोड्स; अन्य एलॉय स्टील का एंगल, शेप्स और सेक्शन्स; एलॉय अथवा नॉन एलॉय स्टील का होलो ड्रील बार्स और रोड्स	7228	35%
27	लौह अथवा इस्पात की शीट पाइलिंग, चाहे ड्रील किया हुआ हो अथवा नहीं, चाहे पंच किया हुआ हो अथवा नहीं, चाहे असेम्बल किये हुए तत्वों से बना हुआ हो अथवा नहीं; लौह अथवा इस्पात का वेल्ड किया हुआ एंगल, शेप और सेक्शन्स	7301	15%
28	स्ट्रक्चर्स (9406 के शीर्ष का प्रीफेबरिकेटिड भवनों को छोड़कर) और स्ट्रक्चर्स का हिस्सा	7308	15%
29	300 लीटर से अधिक क्षमता का लौह अथवा इस्पात का किसी सामग्री (कम्प्रेस किए हुए अथवा सरलीकृत गैस को छोड़कर) के लिए भंडार, टैंक, वैट और समान कन्टेनर चाहे उसे लाइन किया गया हो अथवा नहीं या उसे हीट से इन्सुलेट किया गया हो अथवा नहीं लेकिन यांत्रिक अथवा तापीय उपक्रम से युक्त न हो	7309	15%
30	अधिकतम 300 लीटर की क्षमता का लौह अथवा इस्पात का किसी सामग्री (कम्प्रेस किए हुए अथवा सरलीकृत गैस को छोड़कर) के लिए टैंक, कास्ट, ड्रम, केन, बॉक्स और समान कन्टेनर चाहे उसे लाइन किया गया हो अथवा नहीं या उसे हीट से इन्सुलेट किया गया हो अथवा नहीं लेकिन यांत्रिक अथवा तापीय उपक्रम से युक्त न हो	7310	15%
31	लौह अथवा इस्पात का कम्प्रेस किया हुआ अथवा सरलीकृत गैस के लिए कन्टेनर	7311	15%
32	लौह अथवा इस्पात का स्टेंडिड वायर, रोप, केबल, प्लेटिड बैंड, स्लिंग और उसके समान वस्तु जिसे विद्युतीय रूप से इन्सुलेट न किया गया	7312	15%
33	लौह अथवा इस्पात का फेनसिंग के लिए उपयोग किये जाने वाला बार किया हुआ वायर; ट्विस्ट किया हुआ हूप अथवा सिंगल फ्लेट वायर, बार्स किया हुआ अथवा नहीं और लूज तरीके से ट्विस्ट किया हुआ डबल वायर	7313	15%
34	लौह अथवा इस्पात तार का ड्रील, नेटिंग और फेनसिंग; लौह अथवा इस्पात का विस्तार किया हुआ धातु	7314	15%

35	लौह अथवा इस्पात का चैन और उसका हिस्सा	7315	15%
36	लौह अथवा इस्पात का टैंकर, ग्रेपनेल्स और उसका हिस्सा	7316	15%
37	लौह एवं इस्पात की वस्तुएं	7317	15%
38	लौह एवं इस्पात की वस्तुएं	7318	15%
39	लौह एवं इस्पात की वस्तुएं	7319	15%
40	लौह अथवा इस्पात का स्प्रिंग और स्प्रिंग के लिए लीव्स	7320	15%
41	लौह अथवा इस्पात का स्टोव्स, रेंज, ग्रेड, कूकर (केंद्रीय हिटिंग के लिए सहायक बायलरों के साथ उन वस्तुओं सहित), बारबेक्यूज, ब्रेजियर्स, गैस रिंग, प्लेट वामर्स और समान गैर-विद्युतीय घरेलू उपकरण और उसका हिस्सा	7321	15%
42	लौह अथवा इस्पात का केंद्रीय हिटिंग के लिए रेडियेटर जिसे विद्युतीय रूप से हीट न किया गया हो और उसका हिस्सा; लौह अथवा इस्पात का हेयर हीटर और हॉट एयर वितरक जिसे विद्युतीय रूप से हीट न किया गया हो, फेन अथवा ब्लोअर जो मोटर से चलती हो और उसके हिस्से को शामिल करते हुए	7322	15%
43	लौह अथवा इस्पात का टेबल और समान घरेलू वस्तुएं और उसका हिस्सा	7323	15%
44	लौह अथवा इस्पात का सेनेटरी वेयर और उसको पार्ट्स	7324	15%
45	लौह अथवा इस्पात का अन्य कास्ट सामान	7325	15%
46	लौह अथवा इस्पात का विद्युतीय इस्पात और अन्य वस्तु	7326	15%
47	रेलवे अथवा ट्रामवे पेसेंजर कोच जो स्वयं आगे नहीं बढ़ता हो	8605	50%
48	रेलवे अथवा ट्रामवे माल वेन और वेगेन जो स्वयं आगे नहीं बढ़ता हो	8606	50%
49	रेलवे अथवा ट्रामवे लोकोमोटिव का हिस्सा अथवा रोलिंग स्टॉक जैसे बोगिज, बिसल बोगिज, एक्सेल और फोज्ड किया हुआ पहिया और उसका हिस्सा	8607	50%

विवरणों में शामिल किए गए उत्पाद सांकेतिक हैं, विनिर्दिष्ट एच एस कोड के अंतर्गत सभी उत्पादों को परिशिष्ट के भाग के रूप में शामिल किया गया है।

परिशिष्ट ख

लौह और इस्पात उत्पादों का निर्माण करने के लिए पूंजीगत माल की सांकेतिक सूची (जो विस्तृत नहीं है)

क्र. सं.	संयंत्र शॉप	पूंजीगत माल	न्यूनतम घरेलू मूल्यवर्धन आवश्यकता
1	कच्चा माल संभाल प्रणाली	चूर्ण की हुई सामग्री के लिए एप्रोन फीडर, बेरल कप्लिंग, हैवी ड्यूटी बियेरिंग, हाइड्रोलिक डिस्क ब्रेक्स, टेंकर एंड कंटेनर, पाइप कंवेयर के लिए कंवेयर बेल्ट, हाई एंगल कंवेयर प्रणाली, क्रशर्स, क्रेन रेल लुब्रिकेशन, चार गरडर ग्राइडर ई ओ टी क्रेन, क्रेन वेइंग प्रणाली, क्रेन ऐयर कंडीशनिंग, फ्यूड कप्लिंग, 4 लिफ्ट ट्रक्स, हाइड्रोलिक मोटर्स, हाइड्रोलिक सिस्टम, लॉकिंग एसेम्बली (फ्रिक्शन ग्रिप), लोड सेल्स, लेवल सेन्र्सस, पाइप कंवेयर प्रणाली, प्लग/पाडेल फीडर, न्यूमेटिक हुलाई – घना एवं लिन फेस, रिक्लेमर्स, रेडियो रिमोट कंट्रोल, रेल फिक्सिंग व्यवस्था (विशेष), रेपिड/फ्लेड लोडिंग प्रणाली, स्टेकर्स, स्पेशल स्क्रीन, स्लिव रिंग बियरिंग, ट्रिप्पलर्स, ट्रांसफर कार, टॉग्स (स्पेशल), वाइब्रेशन, आइसोलेशन प्रणाली (स्परिंग डम्पर) वेगन टिप्पलर्स, वेगन लोडर	50%
2	मिनिरल बेनिफेक्शन (लौह अयस्क और कोयला) उपकरण	इंडस्ट्रीयल क्रशर्स, ग्राइनडिंग मिल, परम्परागत स्क्रीन, स्लूरी पम्पस, हिरेंट थिकनर्स, फिल्टर्स, हाइड्रोक्लोन्स	50%

3	कॉक अवेन	कोक ओवन सिलिका रिफेक्टरी, एन्करेज सिस्टम, ब्रस्च नरडन के साथ वेस्ट गैस वाल, फ्लेस प्लेट, डोर फ्रेम, डोर बॉडी, माइनर कास्टिंग: गुजनेक, वाल बॉक्स, ए पी लिड, चार्जिंग और इंस्पेक्शन होल लिड एंड फ्रेम रिवर्सिंग मेकेनिजम, केंद्रीकृत लूब्रिकेशन प्रणाली हाइड्रोजेट डोर क्लीनिंग तंत्र, कोड कंवेयर सिस्टम, स्किप होइस्ट, डोर लोवरिंग रैक, आइसोलेशन/रिवर्सिंग कॉक्स, II ऑटोमेशन, अवेन मशीन	50%
4	उप-उत्पाद संयंत्र	प्राथमिक गैस कूलर, इलेक्ट्रोस्टेटिक तार प्रेसिपिटेटर, H2S, NH3 और नप्थलिन स्कूबबर, कोम्बी स्ट्रीप्पर, फ्लेशिंग लिकर पम्प, क्लास किन, क्लाक रियेक्टर, वेस्ट हीट बायलर, डिकेंटर्स	50%
5	सिंटर संयंत्र उपकरण	पेलेट कार, ड्राइव/डिस्चार्ज इंड स्प्रोकेट ऐसेम्बली कब्ड रेल, स्लाइड रेल, हॉट सिंटर ब्रेकर और ग्रिजली, डिप रेल एंड रनिंग रेल, प्रोसेस फेन के लिए इम्पेलर एसेम्बली, सिन्टर मशीन का ड्राइव एसेम्बली, उच्च तीव्रता वाला मिक्सर और नोडूलाइजर	50%
6	पेलेट संयंत्र उपकरण	पेलेट कार, ड्राइव/डिस्चार्ज इंड स्प्रोकेट ऐसेम्बली कब्ड रेल, स्लाइड रेल, रनिंग रेल वरटिकल रोलर मिल, प्रोसेस फेन के लिए इम्पेलर एसेम्बली, इनडूरेटिंग मशीन का ड्राइव एसेम्बली, उच्च तीव्रता वाला मिक्सर, बालिंग डिक्स, सिंगल डेक्स रोलर स्क्रीन एंड डबल डेक्स रोलर स्क्रीन	50%
7	ब्लास्ट फरनेस उपकरण	ब्लेडर वाल के साथ बेल रहित टॉप प्रणाली, एस जी आयरन स्टेव कूलर, कोपर स्टेव कूलर, स्टॉक लेवल इंडिकेटर (रडार टाइप), मड गन, ड्रिलिंग मशीन एंड मेनिपुलेटर, गैस क्लिलिंग प्लांट प्रणाली, इसके बाइस-पास वाल सहित टॉप रिकवरी टूबाइन सिस्टम, डि-ब्रिकिंग मशीन, रि-रेलिंग उपकरण, पी सी आई प्रणाली, पी सी आई के लिए ग्राइनडिंग मिल, स्टॉक लेवल इंडिकेटर, टूयेरे स्टाक एसेम्बली, वेस्ट हीट रिकवरी प्रणाली, बी एफ एवं हॉट ब्लास्ट स्टोव प्रौद्योगिकीय वाल, एब्व ब्रर्डन प्रोब्स, स्लग ग्रेन्यूलेशन यूनिट, टूयेरे एंड टूयेरे कूलर, टोरपेडो लेडल कार, बी एफ हरथ रिफेक्ट्री	50%
8	डायरेक्ट रिडक्शन प्लांट उपकरण	चार्ज डिस्ट्रीब्यूटर, अपर एंड लोअर सील लेग, रिफोमर एंड रि-क्यूरेटर सिस्टम, बर्डन फिडर्स, ट्रबो-एक्सपेंडर, प्रोसेस गैस कम्प्रेशर, सील गैस कम्प्रेशर एवं बोटम सील गैस कम्प्रेशर, सील गैस जेनरेटर एवं डायर्स, प्रोसेस गैस हीटर, CO2 रिमूवल प्लांट	50%
9	बेसिक ऑक्सीजन फर्नेस उपकरण	मुख्य और अनुरक्षण उपकरण जिसमें कंवेटर, गनिंग मशीन, रिफेक्ट्री/स्लग मॉनीटरिंग उपकरण, कंवेटर वेसेल, ट्रनिअन रिंग एंड सस्पेशन प्रणाली, ट्रनिअन बियरिंग और हाउसिंग, कंवेटर बुल गियर यूनिट और टिल्ट ड्राइव सिस्टम, कंवेटर के रोटेरी ज्वाइंट, बोटम स्ट्रिंग सिस्टम, क्लपिंग के साथ लांस बाडी, लांस कोपर टिप्स, ऑक्सीजन ब्लोविंग/बोटम स्टीरिंग के लिए वाल स्टेशन, सब-लान सिस्टम, प्रोसेस मॉड्यूल अर्थात प्रोसेस साफ्टवेयर/हार्डवेयर के साथ ऑफ गैस एनेलाइजर, कंटेनर लैब मेजरमेंट प्रोब, स्विच ओवर स्टेशन, प्राइमरी गैस के लिए आई डी फेन, होट मेटल और स्टील लेडल, लेडल ट्रांसफर कार, लेडल अनुरक्षण उपकरण, सूलेग पोट, स्लग पोट ट्रांसफर कार, स्क्रेप बॉक्स क्रेप ट्रांसफर कार, लांस करेज, लांस गाइड, क्रेन एंड हाइस्ट, लांस होइस्ट एंड ट्राली, लांस टिल्टिंग उपकरण, लांस को लिफ्ट करने के लिए ट्रेवस, विभिन्न आकर के बंकर, बिन बाइब्रेटर, वेइंग हूपर, अनुरक्षण स्टेण्ड, डी डस्टिंग सक्शन हूड, टीमिंग/एच एम, लेडल रिलाइनिंग स्टेंड, स्टेंड कूलिंग स्टेक इंस्पेक्शन उपकरण, हूड ट्रेवर्स केरेज, रिफेक्ट्री, बाइपास एवं आइसोलेशन वाल्व, फ्लेयर स्टेक एवं इगनिगेशन सिस्टम, स्क्रबिंग टोवर सेल – वेट गैस क्लीनिंग सिस्टम, डॉग हाउस लेडल ड्रायर, लेडल	50%

		प्री-हीटर, लेडल कूलर, फ्यूम कॉलेक्शन हूड्स, क्लीन गैस स्टेक, डस्ट सिलो, बेग ब्रिज, स्लग रिटेनिंग उपकरण	
10	इलेक्ट्रिक आर्क फर्नेस	फर्नेस प्रोपर (जिसमें फ्रनेस लोवर सेल, अपर सेल और रूफ, टिलटिंग प्लेटफार्म, फ्रनेस गेन्ट्री शामिल है) और ट्रांसफार्मर, इलेक्ट्रोल रेगूलेशन प्रणाली, , हाइड्रोलिक सिस्टम, रिफेक्ट्री, लेवल I एंड II आटोमेशन सिस्टम के पार्टस। एल एफ – वाटर कूल्ड लेडल रूफ, इलेक्ट्रोड मास्ट एंड आमर्स, इलेक्ट्रोड रेगूलेटिंग सिस्टम, बायर फिडिंग सिस्टम, बोटम इनइरट गैस स्टिरिंग बाल सिस्टम पोरूस प्लग और टॉप लांस के लिए, इमरजेंसी लांसतंत्र, ड्राइव यूनिट के साथ लांस केरेजि सिस्टम, स्वचालित तापक्रम, सेम्पिलिंग और बाथ लेबल/ओ2 मेजरमेंट, तापक्रम और आक्सीजन इम्मजन लांस, ड्राइव यूनिट के साथ लांस केरेज सिस्टम, हाइड्रोलिक सिस्टम, रिफैक्ट्री, लेडल रूफ डेल्टा पोरशन, आर एच प्रोपर (जिसमें लेडल ट्रांसफर कार, वेक्यूम वेसेल, वेसेल लिफिटिंग और लोवरिंग सिस्टम शामिल है, हाइड्रोलिंग सिस्टम, मल्टी फंक्शन लांस, वाल्व रेक्स/स्टेशन, इलेक्ट्रोड क्लेप यूनिट, इलेक्ट्रोड आमर्स का कंडक्टर, वाटर कूल्ड केबल, ए आर स्टेरिंग वाल्व रेक, लांस ट्रांसपोर्ट कार, रिफेक्ट्री लांस, हाइड्रोलिक सिलेंडर, लेडल रूफ लिफटिंग सिलेंडर, लूब्रिकेशन प्रणाली, सक्शन हूड, डम्पर, वाइब्रो फीडर, वेइंग होपर, बायर फिडिंग प्रणाली, इलेक्ट्रोड निपिलिंग स्टेड, क्रेन, होइस्ट, तापमान और सेम्पलिंग टिप्स, लेडल स्टेंड, ई एस पी, डिडक्टिंग हूड, रिफेक्ट्री, बेग फिल्टर, क्रेन इत्यादि।	50%
11	सतत कास्टिंग उपकरण	लाडले टरेट, लेडल कवर मेनिपुलेटर, लेडल शारउड मेनिपुलेटर, टनडिस कार, कंटिन्यूअस टनडिस टेम्पेचर मेजरमेंट सिस्टम, टनडिस स्टोपर रूड मेकेनिजम, इमरजेंसी कट-आफ गेट, मोल्ड एसेम्बली, नोजल ब्रिक चेंज डिवाइस, मोल्ड ओसीलेटर एंड ई एम एस सिस्टम, इलेक्ट्रो-मेगेनेटिक ब्रेकिंग सिस्टम, स्ट्रेड गाइड सेगमेंट, विदड्राबल एंड स्ट्रेघटेनिंग यूनिट (डब्ल्यू एस यू), रोल गेप चेकर इमरजेंसी टार्च कटर, टार्च कटिंग मशीन, डेबरर, मार्किंग मशीन, टेकेनोलोजी कंट्रोल सिस्टम एंड प्रोसेस मोडल, ब्लेक रिफेक्ट्रीज, स्ट्रेंड गन्डे सेग्मेंट, टनडिश, लाडले कवर, रोलर टेबल एंड आक्सीलिरीज, माल्ड एंड सेग्मेंट मेनटेनेस इक्यूपमेंट टनडिस मेनटेनेस इक्यूपमेंट, ई एम बी आर सिस्टम	50%
12	फ्लेट प्रोडक्ट मिल	लार्ज कास्टिंग एंड फाजिंग लाइक मिल हाउसिंग, बेड प्लेट्स वर्क्स रोल, बेकअप रोल, इंड स्पिंडल्स; रोलर टेबल, बेकअप रोल एंड वर्क रोल चक्स क्वाडलर/टेनशन रिल/अनक्वाइलर, ए जी सी सिलंडर, शेयर्स, लेवेलेर्स, लाजेर वेल्डर, पेकेजिंग मशीन, नॉन कान्टेक्ट, गेज/प्रोफाइल गेज, एंटी-फ्रिक्शन रोल नेक बियेरिंग, आयल फिल्म बियेरिंग, गियर बॉक्स, मिल मोटर्स	50%
13	लॉंग प्रोडक्ट मिल	मिलस हाउसिंग, बेड प्लेट, वर्क रोल, बेकअप रोल, स्पिनडेल्स; रोलर टेबल, कॉयलर /टेशन रिल /अनकॉयलर, शेयर्स, बिल्डट वेल्डर, पेकेजिंग मशीन, नान-कानटेक्ट गॉज/प्रोफाइल गॉज, एंटी-फ्रिक्शन रोल नेक बियरिंग, आयल फिल्म बियरिंग, फिनिशिंग ब्लाक्स, गियर बॉक्स, मिल मोटर	50%

** परिशिष्ट ख में मदें निर्माण करने वाले इस्पात के लिए पूंजीगत सामानों की एक सांकेतिक सूची है. यह सूची विस्तृत नहीं है। इस्पात के निर्माण के लिए सभी पूंजीगत मालों पर* 50% *की न्यूनतम घरेलू मूल्यवर्धन आवश्यकता के साथ इस नीति के अंतर्गत खरीद वरीयता के लिए विचार किया जाएगा।*

फार्म - 1

100/- **रुपए के स्टाम्प पेपर पर दिए जाने के लिए लौह एवं इस्पात उत्पादों/पूंजीगत मालों में घरेलू मूल्यवर्धन के संबंध में स्व-प्रमाणन शपथ के लिए प्रपत्र :**

मैं _____ सुपुत्र, सुपुत्री, पत्नी, _____ का निवासी _____ _____ एतद् द्वारा निष्ठापूर्वक नीचे दिए गए अनुसार वचन देता हूँ और घोषणा करता हूँ :

कि मैं अधिसूचना सं. : _____ के माध्यम से जारी किए गए भारत सरकार की नीति के नियम और शर्तों का पालन करने के लिए सहमत होउंगा।

कि यहां नीचे दी गई सूचना मेरे सर्वोत्तम ज्ञान और विश्वास के अनुसार सही है और मैं घरेलू मूल्यवर्धन का आकलन करने के प्रयोजन से खरीद करने वाली एजेंसी के समक्ष संगत रिकार्ड प्रस्तुत करने का वचन देता हूं।

कि सभी इनपुट्स के लिए घरेलू मूल्यवर्धन जिसमें उक्त लौह एवं इस्पात उत्पाद शामिल हैं का सत्यापन मेरे द्वारा कर लिया गया है और मैं उसमें किये गये दावों की सत्यतता के लिए जिम्मेदार हूं।

कि इसमें उल्लिखित उत्पाद घरेलू मूल्यवर्धन सही नहीं पाये जाने और मूल्यवर्धन के लिए निर्धारित मानदंडों को पूरा नहीं किये जाने की स्थिति में, घरेलू मूल्यवर्धन का आकलन करने के उद्देश्य से खरीद करने वाली एजेंसी के आकलन के आधार पर मैं 36 महीनों की अवधि के लिए किसी सरकारी निविदा से अयोग्य ठहराया जाऊंगा। इसके अलावा मैं इस प्रकार के आकलन की सभी लागतों का वहन करूंगा।

कि मैंने अधिसूचना संख्या _____ जिसमें सरकारी खरीद में घरेलू स्तर पर निर्मित लौह एवं इस्पात उत्पादों को वरीयता दी गई है, में संदर्भित सभी शर्तों का पालन किया है और यह कि खरीद करने वाली एजेंसी को एतद् द्वारा अधिकार दिया जाता है कि वह मेरे ई एम डी को जब्त करे। मैं यह भी वचन देता हूं कि आकलन की लागत का भुगतान करूंगा और निविदा दस्तावेज में यथा उल्लिखित सभी दण्ड राशि का भुगतान करूंगा।

मैं 8 वर्षों की अवधि के लिए कम्पनी के रिकॉर्ड में निम्नलिखित सूचना रखने के लिए सहमत हूं और किसी सांविधिक प्राधिकारी को सत्यापन के लिए इसे उपलब्ध कराऊंगा।

i. बोली लगाने वाले का नाम और ब्यौरा (पंजीकृत कार्यालय, विनिर्माण इकाई का स्थान, कानूनी प्रतिष्ठान की प्रकृति)

ii. वह तिथि जब यह प्रमाण पत्र जारी किया गया है।

iii. लौह एवं इस्पात उत्पाद जिसके लिए इस प्रमाण पत्र को प्रस्तुत किया जाता है।

iv. खरीद करने वाली एजेंसी जिसे यह प्रमाण पत्र प्रस्तुत किया जाता है।

v. दावा की गई घरेलू मूल्यवर्धन की प्रतिशतता और क्या यह निर्धारित घरेलू मूल्यवर्धन के आरंभिक मूल्य को पूरा करता है।

vi. विनिर्माता की इकाई का नाम और संपर्क विवरण

vii. लौह और इस्पात उत्पादों की निवल बिक्री कीमत

viii. संयंत्र तक भाड़ा, बीमा और रखरखाव

ix. लौह एवं इस्पात उत्पादों का निर्माण करने के लिए उपयोग की जाने वाली इनपुट इस्पात (आयात किया गया) की सूची और कुल लागत मूल्य।

x. इनपुट इस्पात जिसकी आपूर्ति घरेलू स्तर पर की जाती है की सूची और कुल लागत

xi. कृपया यदि इनपुट इन हाऊस नहीं हो तब आपूर्तिकर्ताओं से प्राप्त घरेलू मूल्यवर्धन प्रमाणपत्र संलग्न करें।

xii. आयात किये गये इनपुट इस्पात के लिए, सी आई एफ मूल्य, शुल्क और करों, पोर्ट पर उतारने से संबंधित प्रभारों और अंतर्देशीय भाड़े की लागत के ब्यौरे के साथ भारतीय पोर्ट पर पहुंच कीमत।

(प्रतिष्ठान/कंपनी का नाम) के लिए और उसकी ओर से

अधिकृत हस्ताक्षरकर्ता (निदेशक बोर्ड द्वारा विधिवत अधिकृत किये जाने के लिए)

<नाम, पदनाम और संपर्क सं. की प्रविष्टि करें>

MINISTRY OF STEEL

NOTIFICATION

New Delhi, the 29th May, 2019

G.S.R. 385(E).—The revised Policy for providing preference to domestically manufactured Iron & Steel Products in Government procurement is hereby published for general information.

[F. No.3(2)/2018-IDD]

RASIKA CHAUBE, Addl. Secy.

POLICY FOR PROVIDING PREFERENCE TO DOMESTICALLY MANUFACTURED IRON & STEEL PRODUCTS IN GOVERNMENT PROCUREMENT- REVISED, 2019

1 Background

1.1 This policy provides preference to Domestically Manufactured Iron and Steel Products (DMI&SP) in Government procurement.

1.2 The policy is applicable to iron & steel products as provided in Appendix A and capital goods for manufacturing iron & steel products in Appendix B, produced in compliance to prescribed quality standards, as applicable.

1.3 The policy is applicable to every Ministry or Department of Government and all agencies/entities under their administrative control and to projects funded by these agencies for purchase of iron & steel products for government projects. However, this policy shall not apply for purchase of iron & steel products with a view to commercial resale or with a view to use in the production of goods for commercial sale.

2 Definitions

2.1 **Bidder** may be a domestic/ foreign manufacturer of iron & steel or their selling agents/ authorized distributors/ authorized dealers/ authorized supply houses or any other company engaged in the bidding of projects funded by Government agencies.

2.2 **Domestically Manufactured Iron & Steel Products (DMI&SP)** are those iron and steel products which are manufactured by entities that are registered and established in India, including in Special Economic Zones (SEZs). In addition, such products shall meet the criteria of domestic minimum value-addition as mentioned in Appendix A.

2.3 **Domestic Manufacturer** is a manufacturer of iron & steel products conforming to guidelines in section 7 and confirming to the definition of 'manufacturer' as per Central Excise Act.

2.4 **Government** for the purpose of the Policy means Government of India.

2.5 **Government agencies** include Government PSUs, Societies, Trusts and Statutory bodies set up by the Government.

2.6 **MoS** shall mean Ministry of Steel, Government of India.

2.7 **Net Selling Price** shall be the invoiced price excluding net domestic taxes and duties

2.8 **Semi-Finished Steel** shall mean Ingots, billet, blooms and slabs, which can be subsequently processed to finished steel.

2.9 **Finished Steel** shall mean Flat and Long products, which can be subsequently processed into manufactured items.

2.10 **L1** means the lowest tender or the lowest bid or the lowest quotation received in a tender, bidding process or other procurement solicitation as adjudged in the evaluation process as per the tender or other procurement solicitation.

2.11 **Margin of purchase preference** means the maximum extent to which the price quoted by a domestic supplier may be above L1 for the purpose of purchase preference. In case of DMI&SP policy, the margin of purchase preference shall be 20% for items in Appendix B.

2.12 **Iron & Steel Product(s)** shall mean such iron and steel product(s) which are mentioned in Appendix A.

2.13 **Domestic value addition** shall be the net selling price (invoiced price excluding net domestic taxes and duties) minus the landed cost of imported input materials at the manufacturing plant in India (including all customs duties) as a proportion of the net selling price, in percent. The 'domestic value addition' definition shall be in line with the DPIIT(formerly DIPP) guidelines, and shall be suitably amended in case of any changes by DPIIT in the future. For the purpose of this policy document, domestic value addition and local content have been used interchangeably.

3 Exclusions

3.1 Waivers shall be granted by the Ministry of Steel to all such Government procurements subject to the below conditions.

3.1.1 Where specific grades of steel are not manufactured in the country, or

3.1.2 Where the quantities as per the demand of the project cannot be met through domestic sources

The exclusion requests shall be submitted to the Standing Committee along with sufficient proof of unavailability of domestically manufactured iron & steel products

4 Standing Committee

A Standing Committee under the Ministry of Steel (MoS) to be chaired by the Secretary (Steel), shall be constituted to oversee the implementation of the policy. The Committee shall comprise of experts drawn from Industry / Industry Association / Government Institution or Body / Ministry of Steel (MoS). The said Committee in MoS shall have the mandate for the following:

4.1 Monitoring the implementation of the policy

4.2 Review and notify the list of Iron & Steel products and the domestic value addition requirement criteria as mentioned at Appendix A and Appendix B.

4.3 Issue necessary clarifications for implementation of the policy including grant of exclusions to procuring agencies as per section 3

4.4 Constitute a separate committee to carry out grievance redressal

4.5 The Standing Committee shall submit its recommendations for approval to Ministry of Steel.

5 Notifying Iron & Steel Products Procured by Government

5.1 The following guidelines may be used for identifying and notifying the aforementioned products under the policy:

5.1.1 The policy is applicable to iron & steel products as provided in Appendix A and to capital goods for manufacturing iron & steel products in Appendix B.

5.1.2 Appendix A contains list of iron & steel products which are to be exclusively domestically manufactured and cannot be imported without the approval of the Ministry of Steel

5.1.3 Appendix B contains a list (non-exhaustive) of capital goods for which purchase preference shall be provided to domestically manufactured capital goods, if their quoted price falls within 20% of the price quoted for corresponding imported capital good.

5.1.4 The objective of the policy is to notify all iron & steel products which are procured by Government Agencies for government projects and not with a view to commercial resale or with a view to use in the production of products for commercial sale.

5.1.5 The policy is applicable to all projects funded by Ministry or Department of Government and all agencies/ entities under their administrative control for purchase of iron & steel products.

5.1.6 The policy shall be applicable to projects where the procurement value of iron and steel products is greater than Rs. 25 crores. The policy shall also be applicable for other procurement (non-project), where annual procurement value of iron and steel products for that Government organization is greater than Rs. 25 crores.

5.1.7 The policy is applicable to purchase of iron & steel products by private agencies for fulfilling an EPC contract and/or any other requirement of Ministry or Department of Government or their PSUs.

5.1.8 Analysis of the availability of various grades of domestic iron and steel products needs to precede for notification under the policy. Only those iron & steel products, in respect of which at least one domestic manufacturer exists, shall be notified. Consultation may be carried out by the Standing Committee.

5.1.9 The policy is applicable to capital goods for manufacturing iron & steel products in Appendix B produced in compliance to prescribed quality standards, as applicable.

5.1.10 Policy for domestic procurement of capital goods for manufacturing iron and steel products is applicable to all public sector steel manufacturers and all agencies/ entities under their administrative control for purchase of capital goods for manufacturing iron & steel products, not with a view to commercial resale.

5.1.11 The policy is applicable to purchase of capital goods for manufacturing iron & steel products by private agencies for fulfilling an EPC contract and/or any other requirement of public sector steel manufacturers and all agencies/ entities under their administrative control

5.1.12 Government agencies which are involved in procurement of iron and steel products, and capital goods for manufacturing of iron and steel products, in cases where the iron and steel products are not mentioned in Appendix A and Appendix B, shall provide description and technical specifications of the product along with prescribed standards to the Standing Committee. The Standing Committee will act as per mandate in section 3 and section 4.

5.2 The Ministry of Steel (MoS) would notify iron & steel products along with the minimum prescribed domestic value addition, furnished at Appendix A.

5.3 The policy guidelines on capital goods for manufacturing iron & steel products shall be applicable to public sector steel manufacturers for all purchases of capital goods for manufacturing iron & steel products in Appendix B, irrespective of the project size.

5.4 Minimum domestic value addition requirement suggested for iron and steel products in Appendix A, and for capital goods for manufacturing iron and steel products in Appendix B have been decided on the basis of factors such as domestic supplier base, number of suppliers and import to consumption ratio.

5.5 The domestic value addition requirement norm shall be so calibrated that it reflects the average/above average manufacturing capability of the domestic industry for the iron & steel products at a point of time. This shall be suitably reviewed by the Standing Committee from time to time and amended, if required with the approval of Ministry of Steel.

6 Tender procedure for procurement by government and government agencies

6.1 The procuring/ Government agencies shall follow standard procurement procedures, in accordance with instructions of Ministry of Finance and CVC while adhering to DMI&SP. The policy shall come into effect from the date of its notification in all tenders where price bid have not been opened.

6.2 The tender document, for procurement of both Goods as well as for EPC contracts, should explicitly outline the qualification criteria for adherence to minimum prescribed domestic value addition by the bidder for iron and steel products and capital goods for manufacturing iron & steel products(as indicated in Appendix A and Appendix B)

6.3 In supporting the growth of domestic products, the target of domestic value addition in iron and steel business activities has been set as contained in **Appendix A and Appendix B**.

6.4 For iron and steel products in Appendix A, the procurement process shall be open only to the manufacturers / suppliers having the capability of meeting / exceeding the domestic value addition targets. Manufacturers / suppliers not meeting the domestic value addition targets are not eligible to participate in the bidding.

6.5 In case of Appendix B items, if in the opinion of the procuring company, the tenders (procured quantity) cannot be divided in the prescribed ratio of 50:50, then they shall have the right to award contract to the eligible domestic manufacturer for quantity not less than 50%, as may be divisible.

6.6 In continuation to the above clause, for Appendix B items, if the tendered item is non divisible, (to be included in the tender document by procuring company) the contract can be awarded to the eligible domestic manufacturer for the entire quantity.

6.7 In case of Appendix B items, if none of the eligible manufacturers meeting domestic value addition requirements match the L1 bid, the original bidder holding L1 bid shall secure the order for full value of procurement.

6.8 The bidders who are selling agents/ authorized distributors/ authorized dealers/ authorized supply houses of the domestic manufacturers of iron & steel products are eligible to bid on behalf of the domestic manufacturers under the policy. However, this shall be subject to the following conditions:

6.8.1 The bidder shall furnish the authorization certificate issued by the domestic manufacturer for selling domestically manufactured iron & steel products.

6.8.2 In case the procurement is covered under Appendix A of the DMI&SP policy, the bidder shall furnish the Affidavit of self-certification issued by the domestic manufacturer to the procuring agency declaring that the iron & steel products is domestically manufactured in terms of the domestic value addition prescribed.

6.8.3 In case the procurement is covered under Appendix B of the DMI&SP policy, the bidder shall furnish the certification issued by the statutory auditor to domestic manufacturer declaring that the capital goods to be used in Iron & Steel industry are domestically manufactured in terms of the domestic value addition prescribed.

6.8.4 It shall be the responsibility of the bidder to furnish other requisite documents required to be issued by the domestic manufacturer to the procuring agency as per the policy.

7 Domestic value addition requirement

7.1 Minimum domestic value addition requirement to qualify the product as a domestically manufactured iron & steel product or a Capital good are mentioned in Appendix A and B.

7.2 Domestic value addition shall be the net selling price (invoiced price excluding net domestic taxes and duties) minus the landed cost of imported input materials at the manufacturing plant in India (including all customs duties) as a proportion of the net selling price, in per cent.

7.2.1 In case the iron & steel products are made using domestic input steel (semi-finished/ finished steel), invoices of purchases from the actual domestic producers along with quantities purchased and the other related documents must be furnished to the procuring Government agency.

7.2.2 In case the iron & steel products have imported input steel, the invoices of purchases from the actual producers along with quantities purchased and the other related documents must be furnished separately. To derive the extent of domestic value addition, the weighted average of both (imported & domestic) input steel shall be considered to ensure that the minimum stipulated domestic value addition requirement of the policy is complied with.

7.3 It is recommended that each bidder participating in the tender process should calculate the domestic value addition using the below formula below so as to ensure the domestic value addition claimed is consistent with the minimum stipulated domestic value addition requirement of the policy.

For Iron and Steel products

$$\%\ Domestic\ value\ addition = \frac{Net\ selling\ price\ of\ final\ product - Landed\ cost\ of\ imported\ iron\ or\ steel\ at\ plant}{Net\ selling\ price\ of\ final\ product} \times 100\%$$

For Capital Goods

$$\%\ Domestic\ value\ addition = \frac{Net\ selling\ price\ of\ final\ product - Landed\ cost\ of\ imported\ input\ materials\ at\ plant}{Net\ selling\ price\ of\ final\ product} \times 100\%$$

8 Certification and audit

8.1 For products in Appendix A, each domestic manufacturer shall furnish the Affidavit of self-certification to the procuring Government agency declaring that the iron & steel products are domestically manufactured in terms of the domestic value addition prescribed. For capital goods in Appendix B, the bidder shall furnish the certification issued by the statutory auditor to the domestic manufacturer declaring that the capital goods are domestically manufactured in terms of the domestic value addition prescribed. The bidders who are sole selling agents / authorized distributors / authorized dealers / authorized supply houses of the domestic manufacturers of iron & steel products are eligible to bid on behalf of domestic manufacturers under the policy. The bidder shall furnish the Affidavits of self-certification issued by the domestic manufacturers and the certifications issued by the statutory auditors, to the procuring agency declaring that the iron & steel products are domestically manufactured in terms of the domestic value addition prescribed. The Affidavit of self-certification shall be furnished in **Form 1** attached to these guidelines.

8.2 It shall be the responsibility of the domestic manufacturer to ensure that the products so claimed are domestically manufactured in terms of the domestic value addition prescribed for the product. The bidder shall also be required to provide a domestic value addition certificate on half-yearly basis (Sep 30 and Mar 31), duly certified by the Statutory Auditors of the domestic manufacturer, that the claims of domestic value addition made for the product during the preceding 6 months are in accordance with the Policy. Such certificate shall be filed within 60 days of commencement of each half year, to the concerned Government agencies and shall continue to be filed till the completion of supply of the said products.

8.3 The procuring agency shall accept the Affidavit of self-certification regarding domestic value addition in a steel product submitted by a bidder. It shall not normally be the responsibility of procuring agency to verify the correctness of the claim. The onus of demonstrating the correctness of the same shall be on the bidder when asked to do so.

8.4 In case a complaint is received by the procuring agency or the concerned Government Agency against the claim

of a bidder regarding domestic value addition in iron & steel products, the procuring agency shall have full rights to inspect and examine all the related documents and take a decision. In case any clarification is needed, matter may be referred to MoS with a request for technical assistance.

8.5 Any complaint referred to the Government Agency shall be disposed off within 4 weeks of the reference along with submission of all necessary documents. The bidder shall be required to furnish the necessary documentation in support of the domestic value addition claimed in iron & steel products to the Government Agency within 2 weeks of filing the complaint.

8.6 In case, the matter is referred to the Ministry of Steel, the grievance redressal committee setup under the MoS shall dispose of the complaint within 4 weeks of its reference and receipt of all documents from the bidder after taking in consideration, the view of the Government Agency. The bidder shall be required to furnish the necessary documentation in support of domestic value addition claimed in iron & steel products to the grievance redressal committee under MoS within 2 weeks of the reference of the matter. If no information is furnished by the bidder, the grievance redressal committee may take further necessary action, in consultation with Government Agency to establish bonafides of claim.

8.7 The cost of assessing the prescribed extent of domestic value addition shall be borne by the procuring agency if the domestic value addition is found to be correct as per the certificate. However, if it is found that the domestic value addition as claimed is incorrect, the cost of assessment will be payable by the bidder who has furnished an incorrect certificate. The manner of enforcing the same shall be defined in the tender document.

9 Sanctions

9.1 Each Government Agency shall clearly define the penalties, in case of wrong declaration by the bidder of the prescribed domestic value addition, in the tender document. The penalties may include forfeiting of the EMD, other financial penalties and blacklisting of such manufacturer/ service provider.

9.2 In case of reference of any complaint to MoS by the concerned bidder, there would be a complaint fee of Rs. 10 Lakh or 0.2 % of the value of the DMI&SP being procured (subject to a maximum of Rs. 20 Lakh), whichever is higher, to be paid by Demand Draft deposited with the grievance redressal committee under MoS along with the complaint by the complainant. In case, the complaint is found to be incorrect, the Government Agency reserves the right to forfeit the said amount. In case, the complaint is found to be substantially correct, deposited fee of the complainant would be refunded without any interest.

10 Implementation monitoring by Ministry of Steel

10.1 The policy provisions shall be applicable for a period of 5 years from the date of publication. The policy period may further be extended at the discretion of Ministry of Steel.

10.2 MoS shall be the nodal ministry to monitor the implementation of the policy.

10.3 All applicable agencies under DMI&SP policy shall ensure implementation of the policy and shall annually, in the month of June, send a declaration indicating the extent of compliance to the policy and reasons for noncompliance thereof, during the preceding financial year.

Reference to Ministry of Steel

In case of a question whether an item being procured is a DMI&SP to be covered under the policy, the matter would be referred to the Ministry of Steel for clarification.

Appendix A - Exclusive for domestically manufactured products

Sl. No.	Indicative list of Iron & Steel Products	Applicable HS code	Minimum domestic value addition requirement
1	Flat-rolled products of iron or non alloy steel, of a width of 600 mm or more, hot rolled, not clad, plated or coated	7208	50%
2	Flat-rolled products of iron or non alloy steel, of a width of 600 mm or more, cold rolled (cold-reduced), not clad, plated or coated	7209	50%
3	Flat-rolled products of iron or non alloy steel, of a width of 600 mm or more, clad, plated or coated	7210	50%

4	Flat-rolled products of iron or non alloy steel, of a width of less than 600 mm, not clad, plated or coated	7211	35%
5	Flat-rolled products of iron or non alloy steel, of a width of less than 600 mm, clad, plated or coated	7212	35%
6	Bars and rods, hot-rolled, in irregularly wound coils, of iron or non-alloy steel	7213	35%
7	Other bars and rods of iron or non alloy steel, not further worked than forged, hot rolled, hot-drawn or hot-extruded, but including those twisted after rolling	7214	35%
8	Other bars and rods of iron or non alloy steel	7215	35%
9	Angles, shapes and sections of iron or non-alloy steel	7216	35%
10	Wire of iron or non-alloy steel	7217	50%
11	Flat-rolled products of stainless steel, of a width of 600 mm or more	7219	50%
12	Flat-rolled products of stainless steel, of a width of less than 600 mm	7220	50%
13	Other bars and rods of stainless steel; angles, shapes and sections of stainless steel	7222	50%
14	Wire of other alloy steel	7229	35%
15	Rails, railway or tramway track construction material of iron or steel	7302	50%
16	Tubes, pipes and hollow profiles, of cast iron	7303	35%
17	Tubes, pipes and hollow profiles, seamless, of iron (other than cast iron) or steel	7304	35%
18	Other tubes and pipes (for example, welded, riveted or similarly closed), having circular cross-sections, the external diameter of which exceeds 406.4 mm, of iron or steel	7305	35%
19	Other tubes, pipes and hollow profiles (for example, open seam or welded, riveted or similarly closed), of iron or steel	7306	35%
20	Tube or pipe fittings (for example, connectors/couplings, elbow sleeves), of iron or steel	7307	35%
21	Bars and rods, hot-rolled, in irregularly wound coils, of stainless steel	7221	35%
22	Wire of stainless steel	7223	35%
23	Flat-rolled products of other alloy steel, of a width of 600 mm or more, including electrical steel	7225	35%
24	Flat-rolled products of other alloy steel, of a width of less than 600 mm, including electrical steel	7226	35%
25	Bars and rods, hot-rolled, in irregularly wound coils, of other alloy steel	7227	15%
26	Other bars and rods of other alloy steel; angles, shapes and sections, of other alloy steel; hollow drill bars and rods, of alloy or nonalloy steel	7228	35%
27	Sheet piling of iron or steel, whether or not drilled, punched or made from assembled elements; welded angles, shapes and sections, of iron or steel	7301	15%
28	Structures (excluding prefabricated buildings of heading 9406) and parts of structures	7308	15%
29	Reservoirs, tanks, vats and similar containers for any material (other than compressed or liquefied gas), of iron or steel, of a capacity exceeding 300 whether or not lined or heatinsulated, but not fitted with mechanical or Thermal equipment	7309	15%

30	Tanks, casks, drums, cans, boxes and similar containers, for any material (other than compressed or liquefied gas), of iron or steel, of a capacity not exceeding 300 L, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment	7310	15%
31	Containers for compressed or liquefied gas, of iron or steel	7311	15%
32	Stranded wire, ropes, cables, plaited bands, slings and the like, of iron or steel, not electrically insulated	7312	15%
33	Barbed wire of iron or steel; twisted hoop or single flat wire, barbed or not, and loosely twisted double wire, of a kind used for fencing, of iron or steel	7313	15%
34	Grill, netting and fencing, of iron or steel wire; expanded metal of iron or steel	7314	15%
35	Chain and parts thereof, of iron or steel	7315	15%
36	Anchors, grapnels and parts thereof, of iron or steel	7316	15%
37	Articles of iron and steel	7317	15%
38	Articles of iron and steel	7318	15%
39	Articles of iron and steel	7319	15%
40	Springs and leaves for springs, of iron or steel	7320	15%
41	Stoves, ranges, grates, cookers (including those with subsidiary boilers for central heating), barbecues, braziers, gas-rings, plate warmers and similar non-electric domestic appliances, and parts thereof, of iron or steel	7321	15%
42	Radiators for central heating, not electrically heated, and parts thereof, of iron or steel; air heaters and hot air distributors, not electrically heated, incorporating a motor-driven fan or blower, and parts thereof, of iron or steel	7322	15%
43	Tables and similar household articles and parts thereof, of iron or steel	7323	15%
44	Sanitary ware and parts thereof, of iron or steel	7324	15%
45	Other cast articles of iron or steel	7325	15%
46	Electrical steel and other articles of iron or steel	7326	15%
47	Railway or tramway passenger coaches, not self-propelled	8605	50%
48	Railway or tramway goods vans and wagons, not self-propelled	8606	50%
49	Parts of railway or tramway locomotives or rolling-stock; such as bogies, bissel-bogies, axles and forged wheels, and parts thereof	8607	50%

Products included in descriptions are indicative; all products under the specified HS codes are included as part of the appendix

Appendix B

Indicative list of capital goods(non-exhaustive) for manufacturing iron & steel products

Sl. No.	Plant shop	Capital goods	Minimum domestic value addition requirement
1	Raw material handling system	Apron feeder, barrel couplings, heavy duty bearings, hydraulic disc brakes, tanker &container for powdered materials, conveyor belt for pipe conveyors, high angle conveyor system, crushers, crane rail lubrication system, four girder EOT Crane, crane weighing system, crane air conditioning, fluid couplings, fork lift trucks, hydraulic motors, hydraulic system, locking assembly (friction grip), load cells, level sensors, pipe	50%

		conveyor system, plough/ paddle feeder, pneumatic transportation - dense &lean phase, reclaimers, radio remote control, rail fixing arrangements (special), rapid/ flood loading system, stackers, special screen, slew ring bearings, tipplers, transfer cars, tongs (special), vibration, isolation system (spring damper), wagon tipplers, wagon loaders	
2	Mineral benefaction (iron ore and coal) equipment	Industrial crushers, grinding mills, conventional screens, slurry pumps,hirate thickeners, filters, hydroclones	50%
3	Coke oven	Coke Oven Silica Refractory, Anchorage System, Waste gas valve with branch pipe, Flash Plate, Door Frame, door body, Minor Casting: Gooseneck, Valve box, AP Lid, Charging & inspection hole lid and frame Reversing mechanism, Centralised lubrication system, Hydrojet Door Cleaning Mechanism, Spillage code conveyor system, skip hoist, Door Lowering Rack, Isolation/ Reversing Cocks, Level II automation, Oven machines	50%
4	By-product plant	Primary Gas Cooler, Electrostatic Tar Precipitator,H2S, NH3 & Naphthalene Scrubber, Combi Stripper, Flushing Liquor Pump, Claus Kiln, Claus reactors, Waste Heat Boilers, Decanters	50%
5	Sinter plant equipment	Pallet car, Drive/discharge end Sprocket assembly, Curved rail, Slide rails, Hot sinter breaker and Grizzly, Dip rail & running rail, Impeller assembly for Process fan, Drive assembly of Sinter machine, Hi-intensity Mixer &Noduliser	50%
6	Pellet plant equipment	Pallet car, Drive/discharge end Sprocket assembly, Curved rail, Slide rails, running rail, Vertical roller mill, Impeller assembly for Process fan, Drive assembly of Indurating machine, Hi-intensity Mixer, Balling disc, Single deck roller screen and Double deck roller screen	50%
7	Blast furnace equipment	Bell less top system with Bleeder valve, SG Iron stave coolers, Copper stave coolers, Stock level indicator (Radar Type), Mud gun, Drilling machine and Manipulator, Gas Cleaning Plant system, Top Recovery Turbine system including its by-pass valve, De-bricking Machine, Re-railing equipment, PCI system, Grinding mill for PCI, Stock level indicator, Tuyere Stock assembly, Waste Heat Recovery system, BF & Hot Blast Stoves Technological Valves, Above Burden probes, Slag granulation unit, Tuyere&Tuyere cooler, Torpedo Ladle Car, BF hearth refractory	50%
8	Direct reduction plant equipment	Charge distributer, Upper & lower seal leg, Reformer & Re-cuperator system, Burden feeders, Turbo-expander, Process Gas Compressor , Seal gas compressors & bottom seal gas compressors, Seal gas generators & driers, Process Gas Heater, CO2 removal plant	50%
9	Basic oxygen furnace equipment	Main and Maintenance equipment comprising of converter, gunning machine, Refractory/ slag monitoring device, converter vessel, trunnion ring and suspension system, trunnion bearings and housing, Converter bull gear unit and tilt drive system, Rotary joint for converter, bottom stirring system, Lance body with clamping, Lance copper tips, Valve stations for oxygen blowing/ bottom stirring, Sub-lance system, Off gas analyzer with process module i.e. Process software/ hardware, container lab Measurement probes, Switch over station, ID fan for primary gas, Hot metal and steel ladle, Ladle Transfer car, Ladle maintenance equipment, Slag pot, Slag pot transfer car, Scrap boxes, Scrap Transfer car, Lance carriage, Lance guide, Crane & hoist, Lance hoist & trolley, Lance tilting device, Traverse for lifting lances, Bunker of various sizes, Bin Vibrator, Weighing Hopper, Maintenance stands, De dusting suction hood, Teeming/HM, ladle relining stands, Stand Cooling stack inspection device, Hood traverse carriage, Refractories, Bypass & isolation valves, Flare stack & ignition system, Scrubbing tower	50%

		shell - Wet gas cleaning system, Dog house, Ladle drier, ladle pre-heater, ladle cooler, Fume collection hoods, Clean gas stack, Dust silo, Weigh Bridge, Slag retaining device	
10	Electric arc furnace	Furnace proper (includes furnace lower shell, upper shell and roof, Tilting platform, Furnace Gantry) and transformer, Electrode regulation system, Hydraulic system, Refractories, Parts of Level I & Level II Automation system. LF - water cooled ladle roof, electrode mast and arms, electrode regulating system, wire feeding system, Bottom inert gas stirring Valve stand for porous plug and top lance, Emergency lance mechanism, Lance carriage system with drive unit, Automatic temperature, sampling & bath level / O2 measurement, Temp. & oxygen immersion lance, lance carriage system with drive unit, Hydraulic system, Refractories, Ladle roof Delta portion, RH proper (includes Ladle transfer car, vacuum vessel, Vessel lifting & lowering system. Hydraulic system, Multi Function lance, Valve racks/station, Electrode clamp unit, conductor of electrode arms, water cooled cable, A R stirring valve rack, lance transport car, Refractory lance, Hydraulic cylinder, Ladle roof lifting cylinder, Lubrication system, Suction hood, damper, Vibro feeder, weighing hopper, wire feeding system, Electrode nipiling stand, Cranes, hoist, Temperature & sampling tips, ladle stands, ESP, Deducting hoods, Refractories, bag filter, Cranes etc.	50%
11	Continuous casting equipment	Ladle turret, ladle cover manipulator, Ladle Shroud manipulator, tundish car, Continuous tundish temperature measurement system, Tundish stopper rod mechanism, emergency cut-off gate, mould assembly, Nozzle quick change device, mould oscillator and EMS system, Electro-Magnetic braking system, Strand guide segment, Withdrawal & Straightening unit (WSU), Roll gap checker, Emergency torch cutter, Torch cutting machine, Deburrer, Marking machine, Technological control system & process models, Black Refractories, strand gunde segment, tundish, ladle cover, roller tables & auxiliaries, mould& segment maintenance equipments, tundish maintenance equipments, EMBR system	50%
12	Flat product mills	Large castings and forgings like mill housing, bed plates, work rolls, backup rolls, end spindles; roller tables, backup roll and work roll chucks, coilers / tension reels / uncoilers, AGC cylinders, shears, levelers, lazer welders, packaging machines, non-contact gauges / profile gauges, anti-friction roll neck bearings, oil film bearings, gear boxes, mill motors	50%
13	Long product mills	Mill housing, bed plates, work rolls, backup rolls, spindles; roller tables, coilers / tension reels / uncoilers, shears, billet welder, packaging machines, non-contact gauges / profile gauges, anti-friction roll neck bearings, oil film bearings, finishing blocks, gear boxes, mill motors	50%

**Items in appendix B are an indicative list of capital goods for manufacturing steel, the list is not exhaustive. All capital goods for steel manufacturing shall be considered for purchase preference under the policy with a minimum domestic value addition requirement of 50%*

Form-1

Format for Affidavit of Self Certification regarding Domestic Value Addition in Iron & Steel Products/capital goods to be provided on Rs.100/- Stamp Paper Date:

I _____S/o, D/o, W/o, _____ Resident of _____ _____ hereby solemnly affirm and declare as under:

That I will agree to abide by the terms and conditions of the policy of Government of India issued vide Notification No: _____.

That the information furnished hereinafter is correct to the best of my knowledge and belief and I undertake to produce relevant records before the procuring agency (ies) for the purpose of assessing the domestic value addition.

That the domestic value addition for all inputs which constitute the said iron & steel products has been verified by me and I am responsible for the correctness of the claims made therein.

That in the event of the domestic value addition of the product mentioned herein is found to be incorrect and not meeting the prescribed value-addition criteria, based on the assessment of procuring agency (ies) for the purpose of assessing the domestic value-addition, I will be disqualified from any Government tender for a period of 36 months. In addition, I will bear all costs of such an assessment.

That I have complied with all conditions referred to in the Notification No._____ wherein preference to domestically manufactured iron & steel products in Government procurement is provided and that the procuring agency (ies) is hereby authorized to forfeit and my EMD. I also undertake to pay the assessment cost and pay all penalties as specified in the tender document.

I agree to maintain the following information in the Company's record for a period of 8 years and shall make this available for verification to any statutory authority.

i. Name and details of the Bidder (Registered Office, Manufacturing unit location, nature of legal entity)

ii. Date on which this certificate is issued

iii. Iron & Steel Products for which the certificate is produced

iv. Procuring agency to whom the certificate is furnished

v. Percentage of domestic value addition claimed and whether it meets the threshold value of domestic value addition prescribed

vi. Name and contact details of the unit of the manufacturer (s)

vii. Net Selling Price of the iron & steel products

viii. Freight, insurance and handling till plant

ix. List and total cost value of input steel (imported) used to manufacture the iron & steel products

x. List and total cost of input steel which are domestically sourced.

xi. Please attach domestic value addition certificates from suppliers, if the input is not in house.

xii. For imported input steel, landed cost at Indian port with break-up of CIF value, duties & taxes, port handling charges and inland freight cost.

For and on behalf of(Name of firm / entity)

Authorized signatory (To be duly authorized by the Board of Directors)

<Insert Name, Designation and Contact No.>

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Annexure-1

रजिस्ट्री सं. डी.एल.- 33004/99 REGD. No. D. L.-33004/99

भारत का राजपत्र
The Gazette of India

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EXTRAORDINARY

भाग II—खण्ड 3—उप-खण्ड (i)
PART II—Section 3—Sub-section (i)

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इस्पात मंत्रालय

अधिसूचना

नई दिल्ली, 31 दिसम्बर, 2020

सा.का.नि. 1(अ).—सरकारी प्रापण में देशी निर्मित लोहा और इस्पात उत्पादों को प्राथमिकता प्रदान करने हेतु नीति (डीएमआई एंड एसपी नीति) – परिशोधित, 2019 में संशोधनों को आम सूचना के लिए एतद्वारा प्रकाशित किया जाता है:

"सं. S-13026/1/-2020-आईडीडी

इस्पात मंत्रालय

आईडी प्रभाग

उद्योग भवन,

नई दिल्ली 31 दिसंबर, 2020

विषय : सरकारी खरीद में घरेलू निर्मित लौहा और इस्पात उत्पादों को प्राथमिकता प्रदान करने की नीति-परिशोधित, 2019-में संशोधन/परिवर्धन

सरकारी खरीदमें स्वदेशी निर्मित लौहा और इस्पात उत्पादों को प्राथमिकता प्रदान करने की नीति-परिशोधित, 2019-(डीएमआईएंडएसपी परिशोधित, 2019) में निम्नलिखित संशोधन/ परिवर्धन तत्काल प्रभाव से लागू हैं। ये संशोधन/

परिवर्धन ऐसी निविदा या खरीद पर लागू नहीं होंगे जिनके लिए निविदा आमंत्रित करने वाला नोटिस अथवा अन्य प्रकार का खरीद अधियाचन इस अधिसूचना के जारी होने से पूर्व जारी हुआ है।

I – संशोधन:तालिका 1

क्रम सं.	डीएमआईएंडएसपी परिशोधित 2019 ,में मौजूदा खंड	डीएमआईएंडएसपी परिशोधित 2019 ,में संशोधित खंड
1	**खंड 1.3:** यह नीति सरकार के प्रत्येक मंत्रालय अथवा विभाग और उनके प्रशासनिक नियंत्रण के अधीन सभी एजेंसियों/ प्रतिष्ठानों तथा सरकारी परियोजनाओं के वास्ते लौह एवं इस्पात उत्पादों की खरीद के लिए इन एजेंसियों द्वारा वित्तपोषित परियोजनाओं पर लागू है। हालांकि, यह नीति वाणिज्यिक पुन: बिक्री के उद्देश्य से अथवा वाणिज्यिक बिक्री के लिए वस्तुओं के उत्पादन में उपयोग करने के उद्देश्य से लौह एवं इस्पात उत्पादों की खरीद पर लागू नहीं होगी।	**खंड 1.3:** यह नीति सरकार के प्रत्येक मंत्रालय अथवा विभाग और उनके प्रशासनिक नियंत्रण के अधीन सभी एजेंसियों/ प्रतिष्ठानों तथा सरकारी परियोजनाओं के वास्ते लौह एवं इस्पात उत्पादों की खरीद के लिए इन एजेंसियों द्वारा वित्त पोषित परियोजनाओं पर लागू है। केन्द्रीय क्षेत्र की सभी योजनाएं (सीएस)/ केन्द्रीय प्रायोजित योजनाएं (सीएसएस) जिनके लिए राज्यों और स्थानीय निकायों द्वारा खरीद की जाती है, इस नीति की परिधि में आएंगी यदि उस परियोजना/योजना को भारत सरकार द्वारा पूर्णतया/ अंशत: वित्तपोषित किया जाता है। हालांकि, यह नीति वाणिज्यिक पुन: बिक्री के उद्देश्य से अथवा वाणिज्यिक बिक्री के लिए वस्तुओं के उत्पादन में उपयोग करने के उद्देश्य से लौह एवं इस्पात उत्पादों की खरीद पर लागू नहीं होगी।
2	**खंड 2.13:** घरेलू मूल्यवर्धन निवल बिक्री कीमत(निवलघरेलू करों और शुल्कों को छोड़कर बीजक कीमत) होगी जिससे प्रतिशत में निवल बिक्री कीमत के एक अनुपात के रूप में भारत में निर्माण संयंत्र(सभी सीमा शुल्कों सहित) में आयात की गई इनपुट सामग्री की पहुंच लागत घटाई गई हो, 'घरेलू मूल्यवर्धन'परिभाषा डी पी आई आई टी (पूर्व में डी आई पी पी) के दिशानिर्देशों के अनुरूपहोगी और उसमें भविष्य में डी पी आई आई टी द्वारा परिवर्तन किये जाने की स्थिति में उपयुक्त रूप से संशोधन किया जायेगा। इस नीति दस्तावेज के प्रयोजन के लिए घरेलूमूल्यवर्धन और स्थानीय विषय वस्तु का उपयोग एक दूसरे के स्थान पर किया गया है।	**खंड 2.13:** घरेलू मूल्यवर्धन का तात्पर्य है- भारत में वर्धित मूल्य की राशि जो खरीदी/बेची जाने वाली वस्तुओं का कुल मूल्य होगा (निवल घरेलू अप्रत्यक्ष करों को छोडकर)- खरीदी/बेची जाने वाली वस्तुओं के कुल मूल्य के समानुपात के रूप में प्रतिशत में मद में आयातित सामग्री का मूल्य (सभी सीमा शुल्कों सहित)। घरेलू मूल्यवर्धन निवल बिक्री कीमत (निवल घरेलू करों और शुल्कों को छोड़कर बीजक कीमत) होगी जिससे प्रतिशत में निवल बिक्री कीमत के एक अनुपात के रूप में भारत में निर्माण संयंत्र (सभी सीमा शुल्कों सहित) में आयात की गई इनपुट सामग्री की पहुंच लागत घटाई गई हो, 'घरेलू मूल्यवर्धन'परिभाषा डी पी आई आई टी (पूर्व में डी आई पी पी) के दिशानिर्देशों के अनुरूप होगी और उसमें भविष्य में डी पी आई आई टी द्वारा परिवर्तन किये जाने की स्थिति में उपयुक्त रूप से संशोधन किया जायेगा। इस नीति दस्तावेज के प्रयोजन के लिए घरेलू मूल्यवर्धन और स्थानीय विषय वस्तु का उपयोग एक दूसरे के स्थान पर किया गया है।

3	**खंड 5.1.5** यह नीति सरकार के मंत्रालय अथवा विभाग के द्वारा वित्त-पोषित सभी परियोजनाओं और उनके प्रशासनिक नियंत्रण के अधीन सभी एजेंसियों/ प्रतिष्ठानों पर लौह एवं इस्पात उत्पादों की खरीद के लिए लागू है।	**खंड 5.1.5** यह नीति सरकार के मंत्रालय अथवा विभाग के द्वारा वित्त पोषित सभी परियोजनाओं और उनके प्रशासनिक नियंत्रण के अधीन सभी एजेंसियों/ प्रतिष्ठानों पर लौह एवं इस्पात उत्पादों की खरीद के लिए लागू है।केन्द्रीय क्षेत्र की सभी योजनाएं (सीएस)/ केन्द्रीय प्रायोजित योजनाएं (सीएसएस) जिनके लिए राज्यों और स्थानीय निकायों द्वारा खरीद की जाती है, इस नीति की परिधि में आएंगी यदि उस परियोजना/योजना को भारत सरकार द्वारा पूर्णतया/ अंशत: वित्तपोषित किया जाता है
4	**खंड 5.1.6** यह नीति उन परियोजनाओं पर लागू होगी जहां लौह एवं इस्पात उत्पादों का खरीद मूल्य 25 करोड़ रुपए से अधिक होता हो। यह नीति अन्य खरीद (गैर परियोजना) के लिए भी लागू होगी जहां उस सरकारी संगठन के लिए लौह एवं इस्पात उत्पादों का वार्षिक खरीद मूल्य 25 करोड़ रुपए से अधिक होता हो।	**खंड 5.1.6** यह नीति उन परियोजनाओं पर लागू होगी जहां लौह एवं इस्पात उत्पादों (डीएमआई एंड एसपी नीति का परिशिष्ट-क) का खरीद मूल्य 5लाख रुपए से अधिक होता हो। यह नीति अन्य खरीद (गैर परियोजना) के लिए भी लागू होगी जहां उस सरकारी संगठन के लिए लौह एवं इस्पात उत्पादों का वार्षिक खरीद मूल्य 5 लाख करोड़ रुपए से अधिक होता हो। तथापि, प्रापण इकाइयों द्वारा इस बात को सुनिश्चित किया जाएगा कि इस नीति के प्रावधानों से बचने के प्रयोजनार्थ खरीद का विभाजन न किया जाए।
5	**खंड 7.2** घरेलू मूल्यवर्धन निवल बिक्री कीमत (निवल घरेलू करों और शुल्कों को छोड़कर बीजककीमत) होगी जिसमें से प्रतिशत में निवल बिक्री कीमत के एक अनुपात केरूप में भारत में निर्माण करने वाले संयंत्र में आयात की गई इनपुट सामग्री की पहुंच लागत (सभी सीमा शुल्कों को शामिल करते हुए) घटाई जायेगी।	**खंड 7.2** घरेलू मूल्यवर्धन का तात्पर्य है- भारत में वर्धित मूल्य की राशि जो खरीदी/बेची जाने वाली वस्तुओं का कुल मूल्य होगा (निवल घरेलू अप्रत्यक्ष करों को छोडकर)- खरीदी/बेची जाने वाली वस्तुओं के कुल मूल्य के समानुपात के रूप में प्रतिशत में मद में आयातित सामग्री का मूल्य (सभी सीमा शुल्कों सहित)।
6	**खंड 7.3** यह सिफारिश की जाती है कि निविदा की प्रक्रिया में भाग लेने वाले प्रत्येक बोली लगाने वाले को नीचे दिए गए सूत्र का उपयोग करते हुए घरेलू मूल्यवर्धन की गणना करनी चाहिए ताकि यह सुनिश्चित किया जा सके कि दावा किये गये घरेलू मूल्यवर्धन इस नीति के न्यूनतम निर्धारित घरेलू मूल्यवर्धन के अनुरूप है। **लौह एवं इस्पात उत्पादों के लिए** **% घरेलू मूल्यवर्धन** अंतिम उत्पाद की निवल बिक्री कीमत- संयंत्र में आयात किये गये लौह अथवा इस्पात की पहुंच लागत----------X100%	**खंड 7.3** यह सिफारिश की जाती है कि प्रापण करने वाली सरकारी एजेंसी/ निविदा की प्रक्रिया में भाग लेने वाले प्रत्येक बोली लगाने वाले को नीचे दिए गए सूत्र का उपयोग करते हुए घरेलू मूल्यवर्धन की गणना करनी चाहिए ताकि यह सुनिश्चित किया जा सके कि दावा किये गये घरेलू मूल्यवर्धन इस नीति के न्यूनतम निर्धारित घरेलू मूल्यवर्धन के अनुरूप है। **लौह एवं इस्पात उत्पादों तथा पूंजीगत माल के लिए** **% घरेलू मूल्यवर्धन** खरीदी/बेची जाने वाली वस्तु का कुल मूल्य (निवल घरेलू अप्रत्यक्ष करों को छोड़कर - मद में आयातित सामग्री का मूल्य (सभी सीमा शुल्कों सहित) ----------X100%

	अंतिम उत्पाद की निवल ब्रिकी कीमत **पूंजीगत माल के लिए** **% घरेलू मूल्यवर्धन** अंतिम उत्पाद की निवल ब्रिकी कीमत- संयंत्र में आयात किये गये इनपुट सामग्री की पहुंच लागत----------X 100% अंतिम उत्पाद की निवल ब्रिकी कीमत	खरीदी/बेची जाने वाली वस्तु का कुल मूल्य

II डीएमआईएंडएसपी परिशोधित, 2019 के परिशिष्ट क में निम्नलिखित संशोधन किया जाता है:- जहां कहीं न्यूनतम घरेलू मूल्य वर्धन आवश्यकता कॉलम के अंतर्गत डीएमआईएंडएसपी परिशोधित, 2019 के परिशिष्ट क में 15% का न्यूनतम घरेलू मूल्य वर्धन विनिर्दिष्ट होगा, वहां उसे 20% न्यूनतम घरेलू मूल्यवर्धन से प्रतिस्थापित कर दिया जाएगा (परिशोधित परिशिष्ट-क संलग्न है)

III– परिवर्धन/सन्निवेशन: तालिका 2

क्रम सं	डीएमआईएंडएसपी परिशोधित, 2019 में शामिल/जोड़े गये खंड
1	**खण्ड 5.1.13 को खण्ड 5.1.12 के नीचे निम्नवत जोड़ा जाता है:** खण्ड 5.1.13: लोहे और इस्पात उत्पादों की खरीद से संबंधित निविदाओं के लिए कोई वैश्विक निविदा इन्क्वायरी (जीटीई) आमंत्रित नहीं की जाएगी (डीएमआईऔर एसपीनीति का परिशिष्ट-क)। लोहे और इस्पात उत्पादों के विनिर्माण जिनका अनुमानित मूल्य 200 करोड़ रु तक हो, (डीएमआई और एसपी नीति के परिशिष्ट- ख) के लिए पूंजीगत सामानों की खरीद से संबंधित निविदाओं के लिए कोई वैश्विक निविदा इन्क्वायरी (जीटीई) व्यय विभाग द्वारा यथा नाम-निर्दिष्ट सक्षम प्राधिकारी के अनुमोदन के अलावा आमंत्रित नहीं की जाएगी,
2	खंड6.9 को खंड 6.8 के नीचे निम्नवत जोड़ा जाता है: **खंड 6.9: निविदाओं और अन्य खरीद अधियाचनों में विनिर्देशन:** **6.9.1** प्रत्येक क्रय इकाई यह सुनिश्चित करेगी कि किसी भी निविदा या अधियाचन में निर्धारित पिछले अनुभव के संबंध में पात्रता की शर्तों हेतु अन्य देशों में आपूर्ति के प्रमाण या निर्यात के प्रमाण की आवश्यकता नहीं है। **6.9.2** क्रय इकाइयाँ यह देखने का प्रयास करेंगी कि पात्रता की शर्तें, जैसे टर्नओवर, उत्पादन क्षमता और वित्तीय ताकत जैसे मामलों में वैसे स्थानीय आपूर्तिकर्ता का अनुचित अपवर्जन नहीं होता है 'जो आपूर्तिकर्ता की गुणवत्ता या साख संबंधी पात्रता सुनिश्चित करने के लिए जो आवश्यक है, उससे परे अन्यथा पात्र होंगे। **6.9.3** क्रय इकाइयाँ, इस नीति के जारी होने के 2 महीने के भीतर ऊपर उप-पैराग्राफ 6.9.1 और 6.9.2 के संदर्भ में सभी मौजूदा पात्रता मानदंडों और शर्तों की समीक्षा करेंगी। **6.9.4** यदि इस्पात मंत्रालय इस बात से संतुष्ट है कि लौह और इस्पात उत्पादों के भारतीय आपूर्तिकर्ताओं को प्रतिबंधात्मक निविदा शर्तों के कारण किसी भी विदेशी सरकार द्वारा खरीद में भाग लेने और / या प्रतिस्पर्धा करने की अनुमति नहीं है, जिसका भारतीय कंपनियों को प्रतिबंधित करने पर प्रत्यक्ष या अप्रत्यक्ष प्रभाव पड़ता है, जैसे कि प्रापण देश में पंजीकरण, प्रापण देश इत्यादि में विशिष्ट मूल्य की परियोजना का निष्पादन इत्यादि। यदि उपयुक्त समझा जाएगा तो उस देश के बोलीदाताओं को इस्पात मंत्रालय से संबंधित उस वस्तु तथा/ या अन्य वस्तुओं की खरीद के लिए पात्रता से प्रतिबंधित या अपवर्जित किया जा सकता है। **6.9.5** ऊपर उप-पैरा 6.9.4 के प्रयोजन से, किसी आपूर्तिकर्ता या बोलीदाता को उस देश से माना जाएगा यदि (i) इकाई को उस देश में निगमित किया गया है, या (ii) उसकीशेयरधारिता या इकाई काप्रभावी नियंत्रण उस देश से किया जाता है; या (iii) आपूर्ति की जा रही वस्तु के मूल्य का 50% से अधिक उस देश में शामिल किया गया है। भारतीय आपूर्तिकर्ताओं का अर्थ उन संस्थाओं से होगा जो भारत के संबंध में इनमें से किसी भी मानदंड को पूरा करते हैं। किसी देश की'इकाई'(एन्टिटी) शब्द का अर्थ वहीं होगा जो डीपीआईआईटी की एफडीआई नीति के तहत समय-समय पर यथा संशोधित के अंतर्गत है।

3	खंड 6.10 कोखंड 6.9 के नीचे निम्नवत जोड़ा जाता है: **खंड 6.10:** यदि घरेलू आपूर्तिकर्ताओं के खिलाफ प्रतिबंधात्मक या भेदभावपूर्ण शर्तों को बोली दस्तावेजों में शामिल किया जाता है, तो उस के लिए जिम्मेदारी तय करने के लिए खरीद (इसके प्रशासनिक नियंत्रणाधीन किसी ईकाई द्वारा खरीद सहित) करने वाले प्रशासनिक विभाग द्वारा जांच शुरू की जाएगी। तत्पश्चात, संबंधित प्रावधानों के तहत खरीद संस्थाओं के अधिकारियों के खिलाफ उचित, प्रशासनिक या अन्यथा कार्रवाई की जाएगी। ऐसी सभी कार्रवाई की सूचना डीएमआई और एसपी नीति के तहत स्थायी समिति को भेजी जाएगी।

संशोधित परिशिष्ट क – घरेलू स्तर पर निर्मित उत्पादों के लिए विशिष्ट रूप से

क्र. सं.	लौह एवं इस्पात उत्पादों की सांकेतिक सूची	लागू एच एस कोड	न्यूनतम घरेलू मूल्यवर्धन आवश्यकता
1	600 मि. मी. अथवा उससे अधिक की चौड़ाई वाले लौह अथवा गैर एलॉय इस्पात का फ्लेट रोल उत्पाद, हॉट रोल्ड, न ढका हुआ, प्लेट लगाया हुआ अथवा कोट किया हुआ	7208	50%
2	600 मि. मी. अथवा उससे अधिक की चौड़ाई वाले लौह अथवा गैर एलॉय इस्पात का फ्लेट रोल उत्पाद, कोल्ड रोल्ड (कोल्ड - कम किया हुआ), न ढका हुआ, प्लेट लगाया हुआ अथवा कोट किया हुआ	7209	50%
3	600 मि. मी. अथवा उससे अधिक की चौड़ाई वाले लौह अथवा गैर एलॉय इस्पात का फ्लेट रोल उत्पाद, ढका हुआ, प्लेट लगाया हुआ अथवा कोट किया हुआ	7210	50%
4	600 मि. मी. से कम की चौड़ाई वाले लौह अथवा गैर एलॉय इस्पात का फ्लेट रोल उत्पाद, न ढका हुआ, प्लेट लगाया हुआ अथवा कोट किया हुआ	7211	35%
5	600 मि. मी. कम की चौड़ाई का लौह अथवा गैर एलॉय इस्पात का फ्लेट रोल उत्पाद, ढका हुआ, प्लेट लगाया हुआ अथवा कोड किया हुआ	7212	35%
6	लौह एवं गैर एलॉय इस्पात का अनियमित रूप से ऐंठा हुआ क्वाइल में बार्स और रॉड, हॉट रोल्ड	7213	35%
7	लौह अथवा गैर एलॉय इस्पात के अन्य बार्स और रॉड्स जिसे फोर्ज किए जाने की तुलना में आगे अधिक वर्क नहीं किया हुआ, हॉट रोल्ड, हॉट ड्रॉन अथवा हॉट एक्सटूडेड परंतु रोलिंग के बाद उसे टिविस्ट किये जाने सहित	7214	35%
8	लौह अथवा गैर एलॉय इस्पात का अन्य बार्स एंड रोड्स	7215	35%
9	लौह अथवा गैर एलॉय इस्पात का एंगल, शेप और सेक्शन्स	7216	35%
10	लौह अथवा गैर एलॉय इस्पात का तार	7217	50%
11	600 मि. मी. अथवा उससे अधिक की चौड़ाई का स्टेनलैस इस्पातका फ्लेट रोल्ड इस्पात	7219	50%
12	600 मि. मी. से कम की चौड़ाई का स्टेनलैस इस्पातका फ्लेट रोल्ड इस्पात	7220	50%
13	स्टेनलैस स्टील का अन्य बार्स और रोड्स; स्टेनलैस स्टील का एंगल शेप और सेक्शन्स	7222	50%
14	अन्य एलॉय इस्पात का तार	7229	35%
15	लौह अथवा इस्पात को रेल, रेलवे अथवा ट्रामवे ट्रेक निर्माण सामग्री	7302	50%

16	कास्ट लौह का ट्यूब, पाइप और होलो पाइप	7303	35%
17	लौह (कास्ट आयरन को छोड़कर) अथवा इस्पात का ट्यूब पाइप और होलो प्रोफाइल, सीमलैस	7304	35%
18	लौह अथवा इस्पात का सर्कुलर क्रॉस सेक्शन वाले अन्य ट्यूब और पाइप (उदाहरण के लिए, वेल्ड किया हुआ, रिवेट किया हुआ अथवा समान रूप से बंद किया गया हुआ), जिसकी बाहरी त्रिज्या 406.4 मि. मी. से अधिक हो	7305	35%
19	लौह अथवा इस्पात के अन्य ट्यूब, पाइप और होलो प्रोफाइल (उदाहरण के लिएओपन सीन अथवावेल्ड किया हुआ, रिवेट किया हुआ अथवा समान रूप से बंद किया गया हुआ)	7306	35%
20	लौह अथवा इस्पात का ट्यूब अथवा पाइप फिटिंग (उदाहरण के लिए, कनेक्टर/ कप्लिंग, एल्बो स्लीव्स)	7307	35%
21	स्टेनलैस स्टील का अनियमित रूप से ऐंठा हुआ क्वाइल में बार्स और रॉड, हॉट रोल्ड	7221	35%
22	स्टेनलैस स्टील का वायर	7223	35%
23	इलेक्ट्रिकल स्टील सहित 600 मि. मी. अथवा उससे अधिक की चौड़ाई वाले अन्य एलॉय स्टील का फ्लेट रोल्ड इस्पात	7225	35%
24	इलेक्ट्रिकल स्टील सहित 600 मि. मी. से कम की चौड़ाई वाले अन्य एलॉय स्टील का फ्लेट रोल्ड इस्पात	7226	35%
25	अन्य एलॉय स्टील का अनियमित रूप से ऐंठा हुआ क्वाइल में बार्स और रोड, हॉट रोल्ड	7227	20%
26	अन्य एलॉय स्टील का अन्य बार्स और रोड्स; अन्य एलॉय स्टील का एंगल, शेप्स और सेक्शन्स; एलॉय अथवा नॉन एलॉय स्टील का होलो ड्रील बार्स और रोड्स	7228	35%
27	लौह अथवा इस्पात की शीट पाइलिंग, चाहे ड्रील किया हुआ हो अथवा नहीं, चाहे पंच किया हुआ हो अथवा नहीं, चाहे असेम्बल किये हुए तत्वों से बना हुआ हो अथवा नहीं; लौह अथवा इस्पात का वेल्ड किया हुआ एंगल, शेप और सेक्शन्स	7301	20%
28	स्ट्रक्चर्स (9406 के शीर्ष का प्रीफेबरिकेटिड भवनों को छोड़कर) और स्ट्रक्चर्स का हिस्सा	7308	20%
29	300 से अधिक क्षमता का लौह अथवा इस्पात का किसी सामग्री (कम्प्रेस किए हुए अथवा सरलीकृत गैस को छोड़कर) के लिए भंडार, टैंक, वैट और समान कन्टेनर चाहे उसे लाइन किया गया हो अथवा नहीं या उसे हीट से इन्सुलेट किया गया हो अथवा नहीं लेकिन यांत्रिक अथवा तापीय उपक्रम से युक्त न हो	7309	20%
30	अधिकतक 300 लीटर की क्षमता का लौह अथवा इस्पात का किसी सामग्री (कम्प्रेस किए हुए अथवा सरलीकृत गैस को छोड़कर) के लिए टैंक, कास्ट, ड्रम, केन, बॉक्स और समान कन्टेनर चाहे उसे लाइन किया गया हो अथवा नहीं या उसे हीट से इन्सुलेट किया गया हो अथवा नहीं लेकिन यांत्रिक अथवा तापीय उपक्रम से युक्त न हो	7310	20%
31	लौह अथवा इस्पात का कम्प्रेस किया हुआ अथवा सरलीकृत गैस के लिए कन्टेनर	7311	20%

32	लौह अथवा इस्पात का स्टेंडिड वायर, रोप, केबल, प्लेटिड बैंड, स्लिंग और उसके समान वस्तु जिसे विद्युतीय रूप से इन्सुलेट न किया गया	7312	20%
33	लौह अथवा इस्पात का फेनसिंग के लिए उपयोग किये जाने वाला बार किया हुआ वायर; ट्विस्ट किया हुआ हूप अथवा सिंगल फ्लेट वायर, बार्स किया हुआ अथवा नहीं और लूज तरीके से ट्विस्ट किया हुआ डबल वायर	7313	20%
34	लौह अथवा इस्पात तार का ड्रील, नेटिंग और फेनसिंग; लौह अथवा इस्पात का विस्तार किया हुआ धातु	7314	20%
35	लौह अथवा इस्पात का चैन और उसका हिस्सा	7315	20%
36	लौह अथवा इस्पात का टैंकर, ग्रेपनेल्स और उसका हिस्सा	7316	20%
37	लौह एवं इस्पात की वस्तुएं	7317	20%
38	लौह एवं इस्पात की वस्तुएं	7318	20%
39	लौह एवं इस्पात की वस्तुएं	7319	20%
40	लौह अथवा इस्पात का स्प्रिंग और स्प्रिंग के लिए लीव्स	7320	20%
41	लौह अथवा इस्पात का स्टोव्स, रेंज, ग्रेड, कूकर (केंद्रीय हिटिंग के लिए सहायक बायलरों के साथ उन वस्तुओं सहित), बारबेक्यूज, ब्रेजियर्स, गैस रिंग, प्लेट वामर्स और समान गैर-विद्युतीय घरेलू उपकरण और उसका हिस्सा	7321	20%
42	लौह अथवा इस्पात का केंद्रीय हिटिंग के लिए रेडियेटर जिसे विद्युतीय रूप से हीट न किया गया हो और उसका हिस्सा; लौह अथवा इस्पात का हेयर हीटर और हॉट एयर वितरक जिसे विद्युतीय रूप से हीट न किया गया हो, फेन अथवा ब्लोअर जो मोटर से चलती हो और उसके हिस्से को शामिल करते हुए	7322	20%
43	लौह अथवा इस्पात का टेबल और समान घरेलू वस्तुएं और उसका हिस्सा	7323	20%
44	लौह अथवा इस्पात का सेनेटरी वेयर और उसकेपार्टस	7324	20%
45	लौह अथवा इस्पात का अन्य कास्ट सामान	7325	20%
46	लौह अथवा इस्पात का विद्युतीय इस्पात और अन्य वस्तु	7326	20%
47	रेलवे अथवा ट्रामवे पेसेंजर कोच जो स्वयं आगे नहीं बढ़ता हो	8605	50%
48	रेलवे अथवा ट्रामवे माल वेन और वेगेन जो स्वयं आगे नहीं बढ़ता हो	8606	50%
49	रेलवे अथवा ट्रामवे लोकोमोटिव का हिस्सा अथवा रोलिंग स्टॉक जैसे बोगिज, बिसल बोगिज, एक्सेल और फोज्ड किया हुआ पहिया और उसका हिस्सा	8607	50%

विवरणों में शामिल किए गए उत्पाद सांकेतिक हैं, विनिर्दिष्ट एच एस कोड के अंतर्गत सभी उत्पादों को परिशिष्ट के भाग के रूप में शामिल किया गया है।"

[फा. सं. एस-13026/1/2020-आईडीडी]

रसिका चौबे, अपर सचिव

MINISTRY OF STEEL

NOTIFICATION

New Delhi, the 31st December, 2020

G.S.R. 1(E).—The amendments in the Policy for providing preference to domestically manufactured Iron & Steel products in Government procurement (DMI&SP Policy)–Revised, 2019 is hereby published for general information.

"No. S-13026/1/2020- IDD

Ministry of Steel

ID Division

Udyog Bhawan,

New Delhi 31st December, 2020

Sub.: Amendments / additions to the Policy for Providing Preference to Domestically Manufactured Iron & Steel Products in Government Procurement - revised, 2019

The following amendments / additions to the Policy for Providing Preference to Domestically Manufactured Iron & Steel Products in Government Procurement - revised, 2019 (DMI&SP revised, 2019) are applicable with immediate effect. These amendments / additions shall not apply to any tender or procurement for which notice inviting tender or other form of procurement solicitation has been issued before the issue of this notification.

I - Amendments: Table 1

Sl. No.	Existing Clause in DMI&SP revised, 2019	Amended Clause in DMI&SP revised, 2019
1	**Clause 1.3:** The policy is applicable to every Ministry or Department of Government and all agencies/entities under their administrative control and to projects funded by these agencies for purchase of iron & steel products for government projects. However, this policy shall not apply for purchase of iron & steel products with a view to commercial resale or with a view to use in the production of goods for commercial sale.	**Clause 1.3:** The policy is applicable to every Ministry or Department of Government and all agencies/entities under their administrative control and to projects funded by these agencies for purchase of iron & steel products for government projects. All Central Sector Schemes (CS)/Centrally Sponsored Schemes (CSS) for which procurement is made by States and Local Bodies, would come within the purview of this Policy, if that project / scheme is fully / partly funded by Government of India. However, this policy shall not apply for purchase of iron & steel products with a view to commercial resale or with a view to use in the production of goods for commercial sale.
2	**Clause 2.13:** Domestic value addition shall be the net selling price (invoiced price excluding net domestic taxes and duties) minus the landed cost of imported input materials at the manufacturing plant in India (including all customs duties) as a proportion of the net selling price, in percent. The 'domestic value addition' definition shall be in line with the DPIIT(formerly DIPP) guidelines, and shall be suitably amended in case of any changes by DPIIT in the future. For the purpose of this policy document, domestic value addition and local content have been used interchangeably.	**Clause 2.13:** Domestic value addition means - amount of value added in India which shall be the total value of the item to be procured / sold (excluding net domestic indirect taxes) minus the value of imported content in the item (including all customs duties) as a proportion of the total value of the item to be procured / sold, in percent. The 'domestic value addition' definition shall be in line with the DPIIT (formerly DIPP) guidelines, and shall be suitably amended in case of any changes by DPIIT in the future. For the purpose of this policy document, domestic value addition and local content have been used interchangeably.

3	**Clause 5.1.5** The policy is applicable to all projects funded by Ministry or Department of Government and all agencies/ entities under their administrative control for purchase of iron & steel products.	**Clause 5.1.5:** The policy is applicable to all projects funded by Ministry or Department of Government and all agencies/ entities under their administrative control for purchase of iron & steel products. All Central Sector Schemes (CS)/Centrally Sponsored Schemes (CSS) for which procurement is made by States and Local Bodies, would come within the purview of this Policy, if that project / scheme is fully / partly funded by Government of India.
4	**Clause 5.1.6:** The policy shall be applicable to projects where the procurement value of iron and steel products is greater than Rs. 25 crores. The policy shall also be applicable for other procurement (non-project), where annual procurement value of iron and steel products for that Government organization is greater than Rs. 25 crores.	**Clause 5.1.6** The policy shall be applicable to projects where the procurement value of iron and steel products (Appendix - A of the DMI&SP Policy) is greater than Rs. 5 lakhs. The policy shall also be applicable for other procurements (non-project), where annual procurement value of iron and steel products for that Government organization is greater than Rs. 5 lakhs. However, it shall be ensured by procuring entities that procurement is not split for the purpose of avoiding the provisions of this policy.
5	**Clause 7.2:** Domestic value addition shall be the net selling price (invoiced price excluding net domestic taxes and duties) minus the landed cost of imported input materials at the manufacturing plant in India (including all customs duties) as a proportion of the net selling price, in per cent.	**Clause 7.2:** Domestic value addition means - amount of value added in India which shall be the total value of the item to be procured / sold (excluding net domestic indirect taxes) minus the value of imported content in the item (including all customs duties) as a proportion of the total value of the item to be procured / sold, in percent.
6	**Clause 7.3:** It is recommended that each bidder participating in the tender process should calculate the domestic value addition using the below formula below so as to ensure the domestic value addition claimed is consistent with the minimum stipulated domestic value addition requirement of the policy. **For iron and steel products** **% domestic value addition** *Net selling price of final product - landed cost of imported iron or steel at the plant* ---------- *X 100 %* *Net selling price of final product* **For capital goods** **% domestic value addition** *Net selling price of final product - landed cost of imported iron or steel at the plant* ---------- *X 100 %* *Net selling price of final product*	**Clause 7.3:** It is recommended that procuring Government agency / bidder participating in the tender process should calculate the domestic value addition using the below formula so as to ensure that the domestic value addition claimed is consistent with the minimum stipulated domestic value addition requirement of the policy. **For iron and steel products& capital goods** **% domestic value addition** *Total value of the item to be procured / sold (excluding net domestic indirect taxes) - the value of imported content in the item (including all customs duties)* ---------- *X 100 %* *Total value of the item to be procured / sold*

II - Following amendment is made to the Appendix A of the DMI&SP revised, 2019 :- Wherever minimum domestic value addition of **15%** is specified in the Appendix - A of the DMI&SP revised, 2019 under the column Minimum domestic value addition requirement, same shall be replaced with **20%** minimum domestic value addition). (Revised Appendix - A is attached)

III - Additions / Insertions: Table 2

Sl. No.	Added / Inserted Clause in DMI&SP revised, 2019
1	Clause 5.1.13 is inserted below Clause 5.1.12 as: **Clause 5.1.13:** No Global Tender Enquiry (GTE) shall be invited for tenders related to procurement of iron and steel products (Appendix-A of the DMI&SP Policy). No Global Tender Enquiry (GTE) shall be invited for tenders related to procurement of Capital Goods for manufacturing iron & steel products (Appendix- B of the DMI&SP Policy) having estimated value upto Rs. 200 Crore except with the approval of competent authority as designated by Department of Expenditure.
2	Clause 6.9 is inserted below Clause 6.8 as: **Clause 6.9: Specifications in Tenders and other procurement solicitations:** **6.9.1** Every procuring entity shall ensure that the eligibility conditions in respect of previous experience fixed in any tender or solicitation do not require proof of supply in other countries or proof of exports. **6.9.2** Procuring entities shall endeavour to see that eligibility conditions, including on matters like turnover, production capability and financial strength do not result in unreasonable exclusion of local supplier' who would otherwise be eligible, beyond what is essential for ensuring quality or creditworthiness of the supplier. **6.9.3** Procuring entities shall, within 2 months of the issue of this policy review all existing eligibility norms and conditions with reference to sub-paragraphs 6.9.1 and 6.9.2 above. **6.9.4** If Ministry of Steel is satisfied that Indian suppliers of iron and steel products are not allowed to participate and/ or compete in procurement by any foreign government due to restrictive tender conditions which have direct or indirect effect of barring Indian companies such as registration in the procuring country, execution of project of specific value in the procuring country etc., it may, if deemed appropriate, restrict or exclude bidders from that country from eligibility for procurement of that item and/ or other items relating to Ministry of Steel. **6.9.5** For the purpose of sub-paragraph 6.9.4 above, a supplier or bidder shall be considered to be from a country if (i) the entity is incorporated in that country, or (ii) a majority of its shareholding or effective control of the entity is exercised from that country; or (iii) more than 50% of the value of the item being supplied has been added in that country. Indian suppliers shall mean those entities which meet any of these tests with respect to India. The term 'entity' of a country shall have the same meaning as under the FDI Policy of DPIIT as amended from time to time.
3	Clause 6.10 is inserted below Clause 6.9 as: **Clause 6.10:** In case restrictive or discriminatory conditions against domestic suppliers are included in bid documents, an inquiry shall be conducted by the Administrative Department undertaking the procurement (including procurement by any entity under its administrative control) to fix responsibility for same. Thereafter, appropriate action, administrative or otherwise, shall be taken against erring officials of procurement entities under relevant provisions. Intimation on all such action shall be sent to the Standing Committee under the DMI&SP Policy.

IV - Revised Appendix A - Exclusive for domestically manufactured products

Sl. No	Indicative list of Iron & Steel Products	Applicable HS code	Minimum domestic value addition requirement
1	Flat-rolled products of iron or non alloy steel, of a width of 600 mm or more, hot rolled, not clad, plated or coated	7208	50%
2	Flat-rolled products of iron or non alloy steel, of a width of 600	7209	50%

	mm or more, cold rolled (cold-reduced), not clad, plated or coated		
3	Flat-rolled products of iron or non alloy steel, of a width of 600 mm or more, clad, plated or coated	7210	50%
4	Flat-rolled products of iron or non alloy steel, of a width of less than 600 mm, not clad, plated or coated	7211	35%
5	Flat-rolled products of iron or non alloy steel, of a width of less than 600 mm, clad, plated or coated	7212	35%
6	Bars and rods, hot-rolled, in irregularly wound coils, of iron or non-alloy steel	7213	35%
7	Other bars and rods of iron or non alloy steel, not further worked than forged, hot rolled, hot-drawn or hot-extruded, but including those twisted after rolling	7214	35%
8	Other bars and rods of iron or non alloy steel	7215	35%
9	Angles, shapes and sections of iron or non-alloy steel	7216	35%
10	Wire of iron or non-alloy steel	7217	50%
11	Flat-rolled products of stainless steel, of a width of 600 mm or more	7219	50%
12	Flat-rolled products of stainless steel, of a width of less than 600 mm	7220	50%
13	Other bars and rods of stainless steel; angles, shapes and sections of stainless steel	7222	50%
14	Wire of other alloy steel	7229	35%
15	Rails, railway or tramway track construction material of iron or steel	7302	50%
16	Tubes, pipes and hollow profiles, of cast iron	7303	35%
17	Tubes, pipes and hollow profiles, seamless, of iron (other than cast iron) or steel	7304	35%
18	Other tubes and pipes (for example, welded, riveted or similarly closed), having circular cross-sections, the external diameter of which exceeds 406.4 mm, of iron or steel	7305	35%
19	Other tubes, pipes and hollow profiles (for example, open seam or welded, riveted or similarly closed), of iron or steel	7306	35%
20	Tube or pipe fittings (for example, connectors/couplings, elbow sleeves), of iron or steel	7307	35%
21	Bars and rods, hot-rolled, in irregularly wound coils, of stainless steel	7221	35%
22	Wire of stainless steel	7223	35%
23	Flat-rolled products of other alloy steel, of a width of 600 mm or more, including electrical steel	7225	35%
24	Flat-rolled products of other alloy steel, of a width of less than 600 mm, including electrical steel	7226	35%
25	Bars and rods, hot-rolled, in irregularly wound coils, of other alloy steel	7227	20%

26	Other bars and rods of other alloy steel; angles, shapes and sections, of other alloy steel; hollow drill bars and rods, of alloy or nonalloy steel	7228	35%
27	Sheet piling of iron or steel, whether or not drilled, punched or made from assembled elements; welded angles, shapes and sections, of iron or steel	7301	20%
28	Structures (excluding prefabricated buildings of heading 9406) and parts of structures	7308	20%
29	Reservoirs, tanks, vats and similar containers for any material (other than compressed or liquefied gas), of iron or steel, of a capacity exceeding 300 whether or not lined or heatinsulated, but not fitted with mechanical or Thermal equipment	7309	20%
30	Tanks, casks, drums, cans, boxes and similar containers, for any material (other than compressed or liquefied gas), of iron or steel, of a capacity not exceeding 300 L, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment	7310	20%
31	Containers for compressed or liquefied gas, of iron or steel	7311	20%
32	Stranded wire, ropes, cables, plaited bands, slings and the like, of iron or steel, not electrically insulated	7312	20%
33	Barbed wire of iron or steel; twisted hoop or single flat wire, barbed or not, and loosely twisted double wire, of a kind used for fencing, of iron or steel	7313	20%
34	Grill, netting and fencing, of iron or steel wire; expanded metal of iron or steel	7314	20%
35	Chain and parts thereof, of iron or steel	7315	20%
36	Anchors, grapnels and parts thereof, of iron or steel	7316	20%
37	Articles of iron and steel	7317	20%
38	Articles of iron and steel	7318	20%
39	Articles of iron and steel	7319	20%
40	Springs and leaves for springs, of iron or steel	7320	20%
41	Stoves, ranges, grates, cookers (including those with subsidiary boilers for central heating), barbecues, braziers, gas-rings, plate warmers and similar non-electric domestic appliances, and parts thereof, of iron or steel	7321	20%
42	Radiators for central heating, not electrically heated, and parts thereof, of iron or steel; air heaters and hot air distributors, not electrically heated, incorporating a motor-driven fan or blower, and parts thereof, of iron or steel	7322	20%
43	Tables and similar household articles and parts thereof, of iron or steel	7323	20%
44	Sanitary ware and parts thereof, of iron or steel	7324	20%
45	Other cast articles of iron or steel	7325	20%

46	Electrical steel and other articles of iron or steel	7326	20%
47	Railway or tramway passenger coaches, not self-propelled	8605	50%
48	Railway or tramway goods vans and wagons, not self-propelled	8606	50%
49	Parts of railway or tramway locomotives or rolling-stock, such as bogies, bissel-bogies, axles and forged wheels, and parts thereof	8607	50%

Products included in descriptions are indicative; all products under the specified HS codes are included as part of the appendix."

[F. No. S-13026/1/2020-IDD]

RASIKA CHAUBE, Addl. Secy.

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Annexure-1 to Appendix-II

POLICY FOR PROVIDING PREFERENCE TO DOMESTICALLY MANUFACTURED IRON & STEEL PRODUCTS IN GOVERNMENT PROCUREMENT (TO BE SUBMITTED ON BIDDER'S LETTERHEAD) SELF-CERTIFICATE

To,
M/s Talcher Fertilizers Limited

_____

SUB:
TENDER NO:

Dear Sir,

This has reference to "Policy for providing Preference to Domestically Manufactured Iron & Steel Products in Government Procurement" issued by Ministry of Steel, Govt. of India, vide their revised notification "The Gazette of India, Notification No. 385 (E) dated 29.05.2019".

We confirm that we will obtain Affidavit of Self Certification of Domestic value addition in Iron & Steel Products from manufacturer before supply of iron and steel products required under the tender/bidding document.

Sign & Stamp of bidder

SECTION-III

INSTRUCTION TO BIDDERS

[TO BE READ IN CONJUNCTION WITH BIDDING DATA SHEET (BDS)]

SECTION-III

INSTRUCTION TO BIDDERS

INDEX

[F] AWARD OF CONTRACT:

[G] ANNEXURES:

: **FORM-I OF ANNEXURE-V** : Certificate from Statutory Auditor or Cost Auditor of the company (in the case of companies) or from a Practicing Cost Accountant or Practicing Chartered Accountant (in respect of suppliers other than companies)

: **FORM-II OF ANNEXURE-V**: Salient points of Public Procurement (Preference to Make in India) Policy.

6. Annexure-VI: PREAMBLE TO SCHEDULE OF RATES

7. Annexure-VII**:** PROVISION FOR PROCUREMENT FROM A BIDDER WHICH SHARES A LAND BORDER WITH INDIA

: **Form-I to Annexure-VII**: Undertaking On Letter Head

INSTRUCTION TO BIDDERS [ITB]
(TO BE READ IN CONJUNCTION WITH BIDDING DATA SHEET (BDS)

[A] – GENERAL

1 SCOPE OF BID

1.1 The Employer as defined in the "General Conditions of Contract [GCC]", wishes to receive Bids as described in the the Invitation For Bid (the"**Tender Document /Bid Document")** issued by Employer.. Employer/Owner/TFL occurring herein under shall be considered synonymous.

1.1 SCOPE OF BID: The scope of work/ Services shall be as defined in Section-VI of the Tender documents.

1.2 The successful bidder will be expected to complete the scope of Bid within the period stated in Special Conditions of Contract.

1.3 Throughout the Tender Documents, the terms 'Bid', 'Tender' & 'Offer' and their derivatives [Bidder/Tenderer,Bid/Tender/Offer etc.] are synonymous. Further, 'Day' means 'Calendar Day' and 'Singular' also means 'Plural'.

2 ELIGIBLE BIDDERS

2.1 Provision for procurement from a bidder which shares a land border with India has been attached as **Annexure-VII** herewith.

2.2 The Bidder shall not be under a declaration of ineligibility by Employer for Corrupt/ Fraudulent/ Collusive/ Coercive practices, as defined in "Instructions to Bidders [ITB], Clause No. 39" (Action in case Corrupt/ Fraudulent/ Collusive/ Coercive Practices).

2.3 The Bidder is not put on 'Holiday' by TFL or any of the JV partner of OWNER (viz. GAIL, RCF, CIL) or Public-Sector Project Management Consultant (like PDIL,EIL, MECON only due to "poor performance" or "corrupt and fraudulent practices") or banned/blacklisted by Government department/ Public Sector on due date of submission of bid.. Further, neither bidder nor their allied agency/(ies) (as defined in the Procedure for Action in case of Corrupt/Fraudulent/Collusive/ Coercive Practices)are on banning list of TFL or any of the JV partner of OWNER viz. GAIL, RCF, CIL.

If the Bidding documents were issued inadvertently/ downloaded from website, offers submitted by such bidders shall not be considered for opening/ evaluation/Award and will be returned immediately to such bidders.

In case there is any change in status of the declaration prior to award of contract, the same has to be promptly informed to TFL/PDIL by the bidder.

It shall be the sole responsibility of the bidder to inform about their status regarding para 1 of clause 2.2 herein above on due date of submission of bid and during the course of finalization of the tender. Concealment of the facts shall tantamount to misrepresentation of facts and shall lead to action against such Bidders as per clause 39 of ITB.

2.4 The Bidder should not be under any liquidation court receivership or similar proceedings on due date of submission of bid. In case there is any change in status of the declaration prior to award of contract, the same has to be promptly informed to TFL/PDIL by the bidder.

It shall be the sole responsibility of the bidder to inform TFL there status on above on due date of submission of bid and during the course of finalization of the tender. Concealment of the facts shall tantamount to misrepresentation of facts and shall lead to action against such Bidders as per clause no. 39 of ITB.

2.5 Bidder shall not be affiliated with a firm or entity:

(i) that has provided consulting services related to the work to the Employer during the preparatory stages of the work or of the project of which the works/services forms a part of or
(ii) that has been hired (proposed to be hired) by the Employer as an Engineer/ Consultant for the contract.

2.6 Neither the firm/entity appointed as the Project Management Consultant (PMC) for a contract nor its affiliates/ JV'S/ Subsidiaries shall be allowed to participate in the tendering process unless it is the sole Licensor/Licensor nominated agent/ vendor.

2.7 Pursuant to qualification criteria set forth in the bidding document, the Bidder shall furnish all necessary supporting documentary evidence to establish Bidder's claim of meeting qualification criteria.

2.8 **Power of Attorney:**

Power of Attorney (PoA) to be issued by the bidder in favour of the authorised employee(s),in respect of the particular tender, for purpose of signing the documents including bid, all subsequent communications, agreements, documents etc. pertaining to the tender and act and take any and all decision on behalf of the bidder (including Consortium). Any consequence resulting due to such signing shall be binding on the Bidder (including Consortium).

(I) In case of a Single Bidder, the Power of Attorney shall be issued as per the constitution of the bidder as below:

a) **In case of Proprietorship**: By Proprietor
b) **In case of Partnership**: by all Partners or Managing Partner.
c) **In case of Limited Liability Partnership**: by any bidder's employee authorized in terms of Deed of LLP.
d) **In case of Public /Limited Company**: PoA in favour of authorized employee(s) by Board of Directors through Board Resolution or by the designated officer authorized by Board to do so. Such Board Resolution should be duly countersigned by Company Secretary / MD / CMD / CEO.

The Power of Attorney should be valid till award of contract/order to successful bidder.

(II) In case of a Consortium, Power of Attorney shall be issued both by Leader as well as Consortium Member(s) of the Consortium as per procedure defined herein above in favour of employee of Leader of Consortium.

3 BIDS FROM "CONSORTIUM"

Not applicable.

4 ONE BID PER BIDDER

4.1 A Bidder shall submit only 'one [01] Bid' in the same Bidding Process either as single entity or as a member of any consortium (wherever consortium bid is allowed). A Bidder who submits or participates in more than 'one [01] Bid' will cause all the proposals in which the Bidder has participated to be disqualified.

4.2 More than one bid means bid(s) by bidder(s) having same Proprietor / Partners / Limited Liability Partner in any other Bidder (s). Further, more than one bids shall also include two or more bidders having common power of attorney holder.

Failure to comply this clause during tendering process will disqualify all such bidders from process of evaluation of bids.

4.3 Alternative Bids shall not be considered.

4.4 The provisions mentioned at sl. no. 4.1 and 4.2 shall not be applicable wherein bidders are quoting for different Items / Sections / Parts / Groups/ SOR items of the same tender which specifies evaluation on Items / Sections / Parts / Groups/ SOR items basis.

5 COST OF BIDDING

The Bidder shall bear all costs associated with the preparation and submission of the Bid including but not limited to Documentation Charges, Bank charges all courier charges translation charges, authentication charges and any associated charges including taxes & duties thereon . Further, TFL/PDIL will in no case, be responsible or liable for these costs, regardless of the outcome of the bidding process.

6 SITE VISIT

6.1 The Bidder is advised to visit and examine the site of works and its surroundings and obtain for itself on its own responsibility all information that may be necessary for preparing the Bid and entering into a Contract for the required job. The costs of visiting the site shall be borne by the Bidder.

6.2 The Bidder or any of its personnel or agents shall be granted permission by the Employer to enter upon its premises and land for the purpose of such visits, but only upon the express conditions that the Bidder, its personnel and agents will release and indemnify the Employer and its personnel, agents from and against all liabilities in respect thereof, and will be responsible for death or injury, loss or damage to property, and any other loss, damage, costs, and expenses incurred as a result of inspection.

6.3 he Bidder shall not be entitled to hold any claim against TALCHER FERTILIZERS LIMITED for non-compliance due to lack of any kind of pre-requisite information as it is the sole responsibility of the Bidder to obtain all the necessary information with regard to site, surrounding, working conditions, weather etc. on its own before submission of the bid.

[B] –BIDDING DOCUMENTS

7 CONTENTS OF BIDDING DOCUMENTS

7.1 The contents of Bidding Documents /Tender documents are those stated below, and should be read in conjunction with any 'Addendum / Corrigendum and Clarification(s)' issued in accordance with "ITB: Clause-8 & 9":

- Section-I : Invitation for Bid [IFB]
- Section-II : BID EVALUATION CRITERIA [BEC] & Evaluation methodology
- Section-III : Instructions to Bidders [ITB], Annexure, Forms & Formats
- Section-IV : General Conditions of Contract [GCC]
- Section-V : Special Conditions of Contract [SCC]
- Section-VI : Scope of Work & Technical Specifications
- Section-VII : Price Schedule/ Schedule of Rates

*'Request for Quotation', wherever applicable, shall also form part of the Bidding document.

For participation in e-tender, instructions are mentioned at Annexure-III to Section-III.

7.2 The Bidder is expected to examine all instructions, forms, terms & conditions in the Bidding Documents. The "Request for Quotation [RFQ] & Invitation for Bid (IFB)" together with all its attachments thereto, shall be considered to be read, understood and accepted by the Bidders. Failure to furnish all information required by the Bidding Documents or submission of a Bid not substantially responsive to the Bidding Documents in every respect will be at Bidder's risk and may result in the rejection of his Bid.

8 CLARIFICATION OF TENDER DOCUMENTS

8.1 A prospective Bidder requiring any clarification(s) of the Bidding Documents may notify TFL in writing or through CPP Portal (https://eprocure.gov.in/eprocure/app)or email at PDIL's mailing address indicated in the BDS no later than 02 (two) days prior to pre-bid meeting (in cases where pre-bid meeting is scheduled) or 05 (five) days prior to the due date of submission of bid in cases where pre-bid meeting is not scheduled. TFL/PDIL reserves the right to ignore the bidders request for clarification if received after the aforesaid period. TFL/PDIL may respond in writing to the request for clarification. TFL/PDIL's response including an explanation of the query, but without identifying the source of the query will be uploaded on the websites mentioned at Clause No. 2.0 (G) of IFB. Hence, bidders are requested to regularly visit the said websites for updates.

8.2 Any clarification or information required by the Bidder but same not received by the Employer at clause 8.1 (refer BDS for address) above is liable to be considered as "no clarification / information required".

8 AMENDMENT OF BIDDING DOCUMENTS

9.1 At any time prior to the 'Bid Due Date', Employer for any reason, whether at its own initiative or in response to a clarification requested by a prospective Bidder, modify the Bidding Documents by addenda / corrigendum.

9.2 Any corrigendum thus issued shall be integral part of the Tender Document and shall be hosted only on the websites as provided at clause no. 2.0 (G) of IFB. Bidders, in their own interest, are advised to regularly check the websites for any amendment/Corrigendum/Addendum. Bidders have to take into account all such amendment / corrigendum before submitting their Bid.TFL/PDIL will not take any responsibility or entertain any representation whatsoever, in case bidders have not checked/seen/downloaded such amendment/Corrigendum/Addendum or reply to pre-bid queries uploaded on the said websites.

9.3 The Employer, if it considers necessary, may extend the Bid Due Date in order to allow the Bidders a reasonable time to furnish their most competitive bid taking into account the addenda / corrigendum issued thereof.

[C] – PREPARATION OF BIDS

10 LANGUAGE OF BID:

The bid prepared by the Bidder and all correspondence, drawing(s), document(s), certificate(s) etc. relating to the Bid exchanged by Bidder and TFL shall be written in English language only. In case a document, certificate, printed literature etc. furnished by the Bidder in a language other than English, the same should be accompanied by an English translation duly authenticated by the Indian Chamber of Commerce , in which case, for the purpose of interpretation of the Bid, the English translation shall govern.

11. DOCUMENTS COMPRISING THE BID

11.1

Bidders are requested to refer instructions for participating in e-Tendering (Annexure-I to Section III), Ready Reckoner for Bidders and FAQs available in e-portal and bids submitted manually shall be rejected. All pages of the Bid must be digitally signed by the "authorized signatory" of the Bidder holding Power of Attorney. The bids must be submitted on e-tendering website of CPP portal (https://eprocure.gov.in/eprocure/app) comprising following documents:-

11.1.1 **PART-I: "TECHNO-COMMERCIAL / UN-PRICED BID"** shall contain the following:

(a) 'Covering Letter' on Bidder's 'Letterhead' clearly specifying the enclosed Contents with index.
(b) 'Bidder's General Information', as per 'Form F-1'.
(c) Copies of documents, as specified in tender document
(d) Copy of Schedule of Rate (SOR) with prices blanked out mentioning quoted / not quoted (as applicable) written against each item as a confirmation that the prices

are quoted in requisite format .

(e) 'Letter of Authority' on the Letter Head, as per 'Form F-3'

(f) 'Agreed Terms and Conditions', as per 'Form F-5'

(g) 'ACKNOWLEDGEMENT CUM CONSENT LETTER', as per 'Form F-6'

(h) Duly attested documents in accordance with the "BID EVALUATION CRITERIA [BEC]" establishing the qualification.

(i) Copy of Power of Attorney as per 'F-20'/copy of Board Resolution, in favour of the authorized signatory of the Bid, as per clause no. 2.8 of ITB (Original to be submitted physically).

(j) Copy of Declaration for Bid Security in original as per Clause 16 of ITB (Original to be submitted physically)

(k) Certification from the statutory auditor or cost auditor of the company (in the case of companies) or from a practicing cost accountant or practicing chartered accountant (in respect of other than companies) as per Form-I to Annexure-V and Declaration by bidder towards Minimum Local Content as per Form-II of Annexure-V.

(l) Undertaking as per Form-I to Annexure VII regarding Provisions for Procurement from a bidder which shares a land border with India.

(m) All forms and Formats including Annexures

(n) 'Integrity Pact' as per 'Fo*rm F-14'*

(o) *'Indemnity Bond' as per 'For*m ~~F~~-15'

(p) Checklist for Bid Evaluation Criteria (BEC) qualifying documents for bidder as per 'Form F-8 & F8B

(q) Tender Document, its Corrigendum/Amendment/Clarification(s) duly signed on each page (in case of manual tendering)/ digitally signed (in case of e-Tender) by the Authorized Signatory holding POA.

(r) Additional document specified in BDS, SCC, Scope of Supply or mentioned elsewhere in the Tender Document, its Corrigendum/Amendment/Clarification(s).

(s) Any other information/details required as per Tender Document

Note:

1. All the pages of the Bid must be signed/ digitally signed by the "Authorized Signatory" of the Bidder holding POA.

11.1.2 PART-II: Price Bid

The Prices are to be filled strictly in the Schedule of Rate of the bidding documents and provision mentioned at para 11.1.2 hereinabove and to uploaded in SOR attachment/Conditions of CPP portal.

11.3 In case of bids invited under *single bid system*, a single envelope containing all documents specified at Clause 11.1.1 & 11.1.2 of ITB above form the BID. All corresponding conditions specified at Clause 11.1.1 & 11.1.2 of ITB shall become applicable in such a case.

12 BID PRICES

12.1 Unless stated otherwise in the Bidding Documents, the Contract shall be for the whole works as described in Bidding Documents, based on the rates and prices submitted by the Bidder and accepted by the Employer. The prices quoted by the Bidders will be inclusive of all taxes except **GST (CGST & SGST/UTGST or IGST)**. Applicable rate of **GST (CGST & SGST/ UTGST or IGST)** on the contract value shall be indicated in SOR under column for GST.

12.2 Prices must be filled in format for "Schedule of Rates [SOR] " enclosed as part of Tender document. If quoted in separate typed sheets and any variation in item description, unit or quantity is noticed ; the Bid is liable to be rejected.

12.3 Bidder shall quote for all the items of "SOR" after careful analysis of cost involved for the performance of the completed item considering all parts of the Bidding Document. In case any activity though specifically not covered in description of item under "SOR" but is required to complete the works as per Specifications, Scope of Work / Service, Standards, General Conditions of Contract ("GCC"), Special Conditions of Contract ("SCC") or any other part of Bidding Document, the prices quoted shall deemed to be inclusive of cost incurred for such activity.

12.4 All duties, taxes and other levies [if any] payable by the Contractor under the Contract, or for any other cause except final **GST (CGST & SGST/ UTGST or IGST)** shall be included in the rates / prices and the total bid-price submitted by the Bidder.

12.5 Prices quoted by the Bidder, shall remain firm and fixed and valid till completion of the Contract and will not be subject to variation on any account unless any price escalation/variation is allowed elsewhere in Tender Document.

12.6 Deleted

12.7 Bidder shall also mention the **Service Accounting Codes** (SAC) / **Harmonized System of Nomenclature (HSN)** at the designated place in Techno-Commercial / Un-Priced bid.

13 GST (CGST & SGST/ UTGST or IGST)

13.1 Bidders are required to submit a copy of the GST Registration Certificate, while submitting the bids wherever **GST (CGST & SGST/UTGST or IGST)** is applicable

13.2 Please note that the responsibility of payment of **GST (CGST & SGST or IGST or UTGST)** lies with the Contractor only. Contractor providing taxable service shall issue an e- Invoice/ Invoice / Bill, as the case may be as per rules/ regulation of GST. Further, returns and details required to be filled under GST laws & rules should be timely filed by Contractor with requisite details.

Payments to Contractor for claiming **GST (CGST & SGST/UTGST or IGST)** amount will be made provided the above formalities are fulfilled. Further, TFL may seek copies of challan and certificate from Chartered Accountant for deposit of **GST (CGST & SGST/UTGST or IGST)** collected from Owner.

13.3 In case CBIC (Central Board of Indirect Taxes and Customs)/ any tax authority / any equivalent Government agencybrings to the notice of TFL that the Contractor has not remitted the amount towards **GST (CGST & SGST/UTGST or IGST)** collected from TFL to the government exchequer, then, that Contractor shall be put under Holiday list of TFL for period of six months after following the due procedure. This action will be in addition to the right of recovery of financial implication arising on TFL.

13.4 For statutory variation in **GST (CGST & SGST/UTGST or IGST), please refer clause no.**

13.0 of SCC (Section V of NIT)

13.5 Where TFL is entitled to avail the input tax credit of **GST (CGST & SGST/UTGST or IGST)**:-

13.5.1 Owner/TFL will reimburse the **GST (CGST & SGST/UTGST or IGST)** to the Contractor at actuals against submission of E-Invoices/Invoices as per format specified in rules/ regulation of GST, to enable Owner/TFL to claim input tax credit of **GST (CGST & SGST/UTGST or IGST)** paid. In case of any variation in the executed quantities, the amount on which the **GST (CGST & SGST/UTGST or IGST)** is applicable shall be modified in same proportion. Returns and details required to be filled under GST laws & rules should be timely filed by supplier with requisite details.

13.6 Where TFL is not entitled to avail/take the full input tax credit of **GST (CGST & SGST/UTGST or IGST)**:

13.6.1 Owner/TFL will reimburse **GST (CGST & SGST/UTGST or IGST)** to the Contractor at actuals against submission of E-Invoices/Invoices as per format specified in rules/ regulation of GST subject to the ceiling amount of **GST (CGST & SGST/UTGST or IGST)** as quoted by the bidder, subject to any statutory variations, except variations arising due to change in turnover. In case of any variation in the executed quantities (If directed and/or certified by the Engineer-In-Charge) the ceiling amount on which **GST (CGST & SGST/UTGST or IGST)** is applicable will be modified on pro-rata basis.

13.7 TFL will prefer to deal with registered supplier of goods/ services under GST. Therefore, bidders are requested to get themselves registered under GST, if not registered yet.

However, in case any unregistered bidder is submitting their bid, their prices will be loaded with applicable GST **(CGST & SGST/UTGST or IGST)** while evaluation of bid (if applicable as per Govt. Act/ Law in vogue). Where TFL is entitled for input credit of **GST (CGST & SGST/UTGST or IGST)**, the same will be considered for evaluation of bid as per evaluation methodology of tender document. Further, an unregistered bidder is required to mention its Income Tax PAN in bid document.

13.8 In case TFL is required to pay entire/certain portion of applicable **GST (CGST & SGST/UTGST or IGST)** and remaining portion, if any, is to be deposited by Bidder directly as per **GST (CGST & SGST/UTGST or IGST)** laws, entire applicable rate/amount of **GST (CGST & SGST/UTGST or IGST)** to be indicated by bidder in the SOR.

Where TFL has the obligation to discharge **GST (CGST & SGST/UTGST or IGST)** liability under reverse charge mechanism and TFL has paid or is /liable to pay **GST (CGST & SGST/UTGST or IGST)** to the Government on which interest or penalties becomes payable as per GST laws for any reason which is not attributable to TFL or ITC with respect to such payments is not available to TFL for any reason which is not attributable to TFL, then TFL shall be entitled to deduct/ setoff / recover such amounts against any amounts paid or payable by TFL to Contractor /Supplier..

13.9 Contractor shall ensure timely submission of correct invoice(s)/e-invoice(s), as per GST rules/ regulation, with all required supporting document(s) within a period specified in Contract to enable TFL to avail input credit of GST (CGST & SGST/UTGST or IGST). Further, returns and details required to be filled under GST laws & rules should be timely

filed by Contractor with requisite details.

If input tax credit is not available to TFL for any reason not attributable to TFL, then TFL shall not be obligated or liable to pay or reimburse GST (CGST & SGST/UTGST or IGST) claimed in the invoice(s) and shall be entitled to deduct/ setoff/ recover such GST amount (CGST & SGST/UTGST or IGST) or Input Tax Credit amount together with penalties and interest, if any, against any amounts paid or becomes payable by TFL in future to the Contractor under this contract or under any other contract

13.10 **Anti-profiteering clause**

As per Clause 171 of GST Act it is mandatory to pass on the benefit due to reduction in rate of tax or from input tax credit to the consumer by way of commensurate reduction in prices. The Contractor may note the above and quote their prices accordingly.

13.11 In case the GST rating of Contractor on the GST portal / Govt. official website is negative / black listed, then the bids may be rejected by TFL. Further, in case rating of bidder is negative / black listed after award of work, then TFL shall not be obligated or liable to pay or reimburse GST to such Contractor and shall also be entitled to deduct / recover such GST along with all penalties / interest, if any, incurred by TFL.

13.12 GST (CGST & SGST/UTGST or IGST) is implemented w.e.f. 01.07.2017 which subsumed various indirect taxes and duties applicable before 01.07.2017. Accordingly, the provisions of General Condition of Contract relating to taxes and duties which are subsumed in GST are modified to aforesaid provisions mentioned in clause no. 12 and 13 of ITB.

13.13 GST, as quoted by the bidder in Schedule of Rates, shall be deemed as final and binding for the purpose of bid evaluation (applicable for tenders where bidder quotes the GST rates). In case a bidder enters “zero/blank” GST or an erroneous GST, the bid evaluation for finalizing the L1 bidder will be done considering the “Zero” or quoted GST rate GST rate, as the case may be. No request for change in GST will be entertained after submission of bids. In case GST column is left blank in the SOR, the quoted prices shall be considered as “Inclusive of GST” and evaluation shall be done accordingly.

In cases where the successful bidder quotes a wrong GST rate, for releasing the order, the following methodology will be followed:

- In case the actual GST rate applicable is lower than the quoted GST rate, the actual GST rate will be added to the quoted basic prices. The final cash outflow will be based on actual GST rate.

- In case the actual GST rate applicable is more than the quoted GST rate, the basic prices quoted will be reduced proportionately, keeping the final cash outflow the same as the overall quoted amount.

Based on the Total Cash Outflow calculated as above, TFL shall place orders.

13.14 Wherever TDS under GST Laws has been deducted from the invoices raised / payments made to the Contractors , as per the provisions of the GST law / Rules, Contractors should accept the corresponding GST-TDS amount populated in the relevant

screen on GST common portal (www.gst.gov.in). Further, Vendors should also download the GST TDS certificate from GST common portal (reference path: Services>User Services> View/Download Certificates option).

13.15 **Provision w.r.t. E- Invoicing requirement as per GST laws:** Supplier who is required to comply with the requirements of E-invoice for B2B transactions as per the requirement of GST Law will ensure the compliance of requirement of E Invoicing under GST law. If the invoice issued without following this process, such invoice can-not be processed for payment by TFL as no ITC is allowed on such invoices.

Therefore, all the payments to such supplier who is liable to comply with e-invoice as per GST Laws shall be made against the proper e-invoice(s) only. Further, returns and details required to be filled under GST laws & rules against such e-invoices should be timely filed by Supplier of Goods with requisite details.

If input tax credit is not available to TFL for any reason attributable to supplier (both for E-invoicing cases and non-E-invoicing cases), then TFL shall not be obligated or liable to pay or reimburse GST (CGST & SGST/UTGST or IGST) claimed in the invoice(s) and shall be entitled to deduct / setoff / recover such GST amount (CGST & SGST/UTGST or IGST) or Input Tax Credit amount together with penalties and interest, if any, by adjusting against any amounts paid or becomes payable in future to the contractor under this contract or under any other supplier .

To ensure compliance, undertaking in requisite format is to be submitted by supplier as per format enclosed at Form F-21 along with documents for release of payment.

13.16 **New Taxes & duties:** Any new taxes & duties, if imposed by the State/ Central Govt. of India after the due date of bid submission but before the Contractual Completion Date, shall be reimbursed to the Service Provider on submission of copy of notification(s) issued from State/ Central Govt. Authorities along with documentary evidence for proof of payment of such taxes & duties, but only after ascertaining it's applicability with respect to the Contract.

13.17 The amount of statutory levies like, CGST, SGST & IGST will be released when the same will appear in the GSTR-2A of OWNER, in the common portal of GST and Bidder has filed the valid return in accordance with the provisions of the GST act and the rules made thereunder. If, input tax credit is not available to OWNER for any reason attributable to the bidder, then OWNER shall not be obligatory or liable to pay or reimburse GST claimed in invoice and shall be entitled to deduct /setoff/ recover such GST together with all the penalty and interest if any, against any amount paid or payable to bidder. Further in this case, OWNER reserves the right to upload the name of such defaulter on the Company website and may also consider for putting under Holiday list of OWNER for period of six months as mentioned in Procedure for Evaluation of Performance of Vendors/ Suppliers/ Contractors/Bidders.

14 BID CURRENCIES:

Bidders must submit bid in Indian Rupees only.

15 BID VALIDITY

15.1 Bids shall be kept valid for period specified in BDS from the final Due date of submission of bid'. A Bid valid for a shorter period may be rejected by TFL as 'non-responsive'.

15.2 In exceptional circumstances, prior to expiry of the original 'Bid Validity Period', the Employer may request the Bidders to extend the 'Period of Bid Validity' for a specified additional period. The request and the responses thereto shall be made in writing or by email. A Bidder may refuse the request without forfeiture of his EMD / Bid Security.

A Bidder agreeing to the request will not be required or permitted to modify his Bid, but will be required to extend the validity of its EMD for the period of the extension and in accordance with "ITB: Clause-16" in all respects.

16 EARNEST MONEY DEPOSIT

Not applicable.

16.1 DECLARATION FOR BID SECURITY

Earnest Money Deposit/Bid Security is not applicable.

However, all the bidder (including MSEs, Startups) is required to submit Declaration for Bid Security in bid as per proforma at Form F-2.

17 PRE-BID MEETING (IF APPLICABLE)

17.1 The Bidder(s) or his designated representative are invited to attend a "Pre-Bid Meeting" which will be held at address specified in IFB. It is expected that a bidder shall not depute more than 02 representatives for the meeting.

17.2 Purpose of the meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage and give hands-on e-tendering.

17.3 Text of the questions raised and the responses given, together with any responses prepared after the meeting, will be uploaded on Central Public Procurement (CPP) Portal (https://eprocure.gov.in/eprocure/app) websites. Any modification of the Contents of Bidding Documents listed in "ITB: Clause-7.1", that may become necessary as a result of the Pre-Bid Meeting shall be made by the Employer exclusively through the issue of an Corrigendum pursuant to "ITB: Clause-9", and not through the minutes of the Pre-Bid Meeting.

17.4 Non-attendance of the Pre-Bid Meeting will not be a cause for disqualification of Bidder.

18 FORMAT AND SIGNING OF BID

18.1 The original and all copies of the Bid shall be typed or written in indelible ink [in the case of copies, photocopies are also acceptable] and shall be signed by a person or persons duly authorized to sign on behalf of the Bidder (as per POA). The name and position held by each person signing, must be typed or printed below the signature. All pages of the Bid except for unamendable printed literature where entry(s) or amendment(s) have been made shall be initialed by the person or persons signing the Bid.

18.2 The Bid shall contain no alterations, omissions, or additions, unless such corrections are initialed by the person or persons signing the Bid.

18.3 In case of e-tendering, digitally Digitally signed documents to be uploaded as detailed in addendum to ITB (Annexure-III of Section –III).

19 ZERO DEVIATION AND REJECTION CRITERIA

19.1 ZERO DEVIATION: Deviation to terms and conditions of "Bidding Documents" may lead to rejection of bid. TFL will accept bids based on terms & conditions of "Bidding Documents" only. Bidder may note TFL will determine the substantial responsiveness of each bid to the Tender documents pursuant to provision contained in clause 29 of ITB. For purpose of this, a substantially responsive bid is one which conforms to all terms and conditions of the Bidding Documents documents without deviations or reservations. TFL's determination of a bid's responsiveness is based on the content of the bid itself without recourse to extrinsic evidence. TFL reserves the right to raise technical and/or commercial query(s), if required, may be raised on the bidder(s). The response(s) to the same shall be in writing, and no change in the price(s) or substance of the bids shall be sought, offered or permitted. The substance of the bid includes but not limited to prices, completion, scope, technical specifications, etc. Bidders are requested to not to take any deviation/exception to the terms and conditions laid down in this "Tender Documents", and submit all requisite documents as mentioned in this "Tender Documents", failing which their offer will be liable for rejection. If a bidder does not reply to the queries in the permitted time frame, then its bid shall be evaluated based on the documents available in the bid.

19.2 **REJECTION CRITERIA:** Notwithstanding the above, deviation to the following clauses of Tender document shall lead to summarily rejection of Bid:

a) Bidder not meeting Bid Evaluation Criteria as per Tender Document
b) Firm Price
c) Declaration for Bid Security
d) Specifications &Scope of Work
e) Schedule of Rates / Price Schedule / Price Basis
f) Duration / Period of Contract/ Completion Period
g) Payment Terms
h) Period of Validity of Bid
i) Integrity Pact
j) Mutually Agreed Damages
k) Overall ceiling on total liability
l) Contract Performance Security
m) Guarantee / Defect Liability Period
n) Arbitration / Settlement of Dispute
o) Governing laws, language & measures
p) Force Majeure
q) Undertaking forms, Form I & II of Annexure VII for provision for procurement from a bidder which shares a land border with India
r) Bidder quoting less than 20% as minimum Local content (as per make in India PPLC policy)
s) Any other condition specifically mentioned in the tender document elsewhere that non-compliance of the clause lead to rejection of bid

Note: Further, it is once again reminded not to mention any condition in the Bid which is

contradictory to the terms and conditions of Tender document.

20 E-PAYMENT

OWNER has initiated payments to Contractors electronically, and to facilitate the payments electronically through **'e-banking'**

[D] – SUBMISSION OF BIDS

21 SUBMISSION, SEALING AND MARKING OF BIDS

21.1 In case of e-tendering, bids shall be submitted through e-tender in the manner specified elsewhere in tender document. No Manual/ Hard Copy (Original) offer shall be acceptable. Physical documents shall be addressed to the owner at address specified in IFB.

21.2 Deleted

21.3 Bids submitted under the name of AGENT/ REPRESENTATIVE /RETAINER/ ASSOCIATE etc. on behalf of a bidder/affiliate shall not be accepted.

22 DEADLINE FOR SUBMISSION OF BIDS

22.1 In case of e-bidding, the bids must be submitted through e-tender mode not later than the date and time specified in the tender document/BDS (Bidding Data Sheet).

22.2 Deleted.

22.3 TFL may, in exceptional circumstances and at its discretion, extend the deadline for submission of Bids (clause 8 and/or 9 of ITB refers). In which case all rights and obligations of TFL and the Bidders, previously subject to the original deadline will thereafter be subject to the deadline as extended. Notice for extension of due date of submission of bid will be uploaded on website only as mentioned in Clause No. 2.0(G) of IFB.

23 LATE BIDS

23.1 Any bids received after the notified date and time of closing of tenders will be treated as late bids.

23.2 In case of e-tendering, e-tendering system of CPP Portal (eprocure.gov.in) shall close immediately after the due date for submission of bid and no bids can be submitted thereafter.

23.3 Physical documents received to address other than one specifically stipulated in the Tender Document will not be considered for evaluation/opening/award if not received to the specified destination within stipulated date & time.

23.4 Unsolicited Bids or Bids received to address other than one specifically stipulated in the tender document will not be considered for evaluation/opening/award if not received to the specified destination within stipulated date & time.

24 MODIFICATION AND WITHDRAWAL OF BIDS

24.1 Modification and withdrawal of bids shall be as follows:-

24.1.1 IN CASE OF E- TENDERING

The bidder may withdraw or modify its bid after bid submission but before the due date and time for submission as per tender document.

24.1.2 IN CASE OF MANUAL BIDDING

Deleted.

[E] – BID OPENING AND EVALUATION

25 EMPLOYER'S RIGHT TO ACCEPT ANY BID AND TO REJECT ANY OR ALL BIDS

TFL reserves the right to accept or reject any Bid, and to annul the Bidding process and reject all Bids, at any time prior to award of Contract, without thereby incurring any liability to the affected Bidder or Bidders or any obligations to inform the affected Bidder or Bidders of the ground for TFL's action. However, Bidder if so desire may seek the reason (in writing) for rejection of their Bid to which TFL shall respond quickly.

26 BID OPENING

26.1 **Unpriced Bid Opening:**

TFL/ PDIL will open bids in the presence of bidders' designated representatives who choose to attendant date, time and location stipulated in the BDS. The bidders'' representatives, who are present shall sign a bid opening register evidencing their attendance.

26.2 **Priced Bid Opening**:

26.2.1 TFL will open the price bids of those bidders who meet the qualification requirement and whose bids is determined to be technically and commercially responsive. Bidders selected for opening of their price bids shall be informed about the date of price bid opening.

Bidders may depute their authorized representative to attend the bid opening. The bidders' representatives, who are present shall sign a register evidencing their attendance and may be required to be present even on a short notice.

26.2.2 The price bids of those Bidders who were not found to be techno-commercially responsive shall not be opened.

In case of bids invited under the single bid system, bid shall be opened on the specified date & time.

26.3 **Reverse Auction**

26.3.1 OWNER shall finalize tender after conducting reverse auction except in those cases where less than four techno-commercially acceptable offers are available.

In case, after techno commercial evaluation, number of technically & commercially acceptable offers are less than 04 (four), then no reverse auction will be conducted (but the OWNER/CONSULTANT shall take appropriate decision regarding conducting offline price negotiation, if required).

Accordingly, the decision to conduct reverse auction shall be communicated to shortlisted bidders prior to opening of price bid. The due date and time of conducting the event of Reverse Auction (if conducted) shall be intimated well in advance to the techno-commercially acceptable bidders, through email.

26.3.2 **Detailed methodology of Reverse Auction**

With the assistance of RA system provider, training to all eligible bidders on the Online Reverse Auction process shall be facilitated prior to conduct of Online Reverse Auction.

a) Computerized Reverse Auction shall be conducted by PDIL through M/s e-Procurement Technologies Limited, on pre-specified date, while the bidders shall be quoting from their own offices/ place of their choice.

b) The due date and time of conducting the event of Reverse Auction shall be intimated at least 2 (two) days in advance to the techno-commercially acceptable bidders, through email / letter. For better understanding of Reverse Auction by the bidders, one day online training shall be conducted by M/s e-Procurement Technologies Limited i.e. the agency conducting the Reverse Auction, for all the techno-commercially qualified bidders. Reverse Auction Training and Demo auction shall be conducted through Video conferencing only.

c) A user-ID and a password shall be created for each techno-commercially qualified bidder by the M/s e-Procurement Technologies Limited and the same shall be communicated to the bidders during the training process. A Valid Digital Signature Certificate is required to take part in Reverse Bidding process.

d) Display of Details during Reverse Auction(RA)

The bidder will be able to view the following details on their screen during RA:

1) “Total basic Price” (i.e. Total Price excluding GST)

2) “Loading factor”

3) “Total Evaluated Price” (i.e. Total Basic Price x Loading factor, calculated by system)

4) “Rank of the bidder” (i.e. present rank, auto updated by system)

5) “L1 price” (i.e. Present Lowest Total Evaluated Price, auto updated by system)

The “Total basic Price”, Loading factor and the “Total Evaluated Price” before RA shall be informed to individual bidders shortly after completion of the RA training. The “Total basic Price” before RA shall be the “Start price” of each bidder. During RA, the bidder will be able to reduce only the “Total Basic Price”. The “Total Evaluated Price” will be automatically

calculated by the system and system will then compare it with “Total Evaluated Price” of other bidders to arrive at Rank and L1 price after every price change during the RA.

After completion of RA, the “Total Evaluated Price” of the lowest bidder shall be considered as the L-1 price after RA.

However, at no point of time will any bidder see names of other bidders, or prices of bidders other than the lowest bid. The Bidder has to out-bid his own previous price & try to reach Number-1 rank.

The tender shall be processed further for award or otherwise based on L-1 prices received at the end of Online Reverse Auction. Price reasonableness will still need to be established by PDIL/TFL even though the bidding is through Online Reverse Auction and TFL will reserve the right to negotiate with the L1 bidder as per CVC guidelines.

e) All timings of the online bid shall be based on the time indicated by the Server hosting the Auction Engine which would reflect as closely as possible the Indian Standard Time (IST) i.e. GMT+05:30 hrs. However, in the event of any deviations between the Server Time and the Indian Standard Time, the functioning of the Auction Engine (launch, operation and closure) would be guided by the Server time. Bidders should be advised to refresh the window of the Auction module and check the exact server Time.

f) The start price of bidders will be automatically populated by system at the time of start of Reverse Auction. The same will be considered as participation by bidder in Online Reverse Auction process. In case any bidder emerges lowest bidder after RA based on their start price(s), the same will be considered as their final price(s) taking into consideration respective loading factor (to arrive at “Total Evaluated Price”) for award of contract/ order irrespective of whether bidder had actually logged in RA portal or not. In case bidder does not accept the same, such bidder will be considered as errant bidder and action will be taken against bidder as per provision in this regard.

g) During Reverse Auction, a bidder can reduce his prices repeatedly. The minimum percentage reduction in each step namely, the bid decrement’ shall not be less than 0.5% of the last bid of the respective bidder. Bidders are allowed to submit/accept first price without decrement amount but afterwards participation in reverse auction is allowed only with minimum decrement amount /percentage.

h) The process of Online Reverse Auction shall initially be held for a period of 30 minutes. In the event of a bid received in the last 5 minutes resulting in a change of prevailing L1 price, the period of the auction shall get extended automatically by 8 minutes from the time of submission of such bid. This process will continue till no change in L-1 price takes place in last 5 minutes after which the auction will close. All bidders regardless of their previous position can submit their bid during the extended period also.

i) In case of a tie during auction i.e. two bidders entering same lowest price, the bidder who enters the prices first in the system would be taken as L-1 and the other bidder would see their ranking as L-2.

j) Internet connectivity shall have to be ensured by bidders themselves. Bidders are requested to make all the necessary arrangements/ alternatives whatever required so that they are able to circumvent such situation and still be able to participate in the Reverse Auction successfully.

k) Bidders in their own interest should ensure uninterrupted internet connectivity at their end during the reverse auction with necessary backups to take care of any connectivity problem. No request for any extension of RAP due to internet connectivity issues or for any other reason at bidders end shall be entertained by PDIL/TFL.

l) In case of disruption of service at the service provider's end i.e. M/s e-Procurement Technologies Limited while the RAP (Reverse Auction Process) is online, due to any technical snag or otherwise attributable to the system failure at the server end, the RAP process will start all over again, through a fresh RAP (hereinafter referred to as “Restarted RAP”), the time and date of which will be intimated in writing to all bidders. In such a situation, the last recorded lowest price of prematurely ended RAP, will be the 'Start Bid Price’ for the “Re-started RAP”. The prices quoted in the prematurely ended RAP will be binding on all the bidders for consideration. All the time stipulations of normal RAP will be applicable to the “Restarted RAP”.

m) Communication with any official with service provider/PDIL/TFL when the RAP is online is strictly prohibited. Bidders in their own interest will have to get themselves satisfied on any queries that they may have during the RAP training session. No query when the RAP is online will be entertained.

n) Upon completion of reverse auction, rate of individual items of SOR shall be worked out applying uniform reduction (reduction being derived from the original Total Evaluated Price & final Total Evaluated Price after RA).

o) While working out rate of individual items, unit rate upto two decimals only will be considered and the figures beyond two decimals shall be ignored without rounding off (e.g. if item rates after applying uniform reduction works out to 10.910 or 10.912 or 10.915 or 10.919, the rate will be considered as 10.91). Above prices shall be the final prices of lowest bidder against the tender for all the purposes and the original quoted prices against tender shall no more be valid for tender for which Reverse Auction was held.

26.3.3 Preferences: Purchase Preference shall be applicable as defined in tender document.

27 CONFIDENTIALITY

Information relating to the examination, clarification, evaluation and comparison of Bids, and recommendations for the award of a Contract, shall not be disclosed to Bidder(s) or any other persons not officially concerned with such process.

28 CONTACTING THE EMPLOYER

28.1 From the time of Bid opening to the time of award of Contract, if any Bidder wishes to contact the Employer on any matter related to the Bid, it should do so in writing.

28.2 Any effort by the Bidder to influence the Employer in the Employer's 'Bid Evaluation', 'Bid Comparison', or 'Contract Award' decisions may result in the rejection of the Bidder's Bid and action shall be initiated as per procedure for action in case Corrupt / Fraudulent / Collusive / Coercive practices in this regard, apart from forfeiture of EMD/ Bid Security, if any.

29 EXAMINATION OF BIDS AND DETERMINATION OF RESPONSIVENESS

29.1 The employer's determination of a bid's responsiveness is based on the content of the bid only. Prior to the detailed evaluation of Bids, the Employer will determine whether each Bid:

(a) Meets the "Bid Evaluation Criteria" of the Bidding Documents ;
(b) Has been properly signed;
(c) Is accompanied by the required ~~'Earnest Money / Bid Security /~~ Bid Security Declaration'
(d) Is substantially responsive to the requirements of the Bidding Documents ; and
(d) Provides any clarification and/or substantiation that the Employer may require to determine responsiveness pursuant to "ITB: Clause-29.2"

29.2 A substantially responsive Bid is one which conforms to all the terms, conditions and specifications of the Bidding Documents without material deviations or reservations or omissions for this purpose employer defines the foregoing terms below:

a) "Deviation" is departure from the requirement specified in the tender documents.
b) "Reservation" is the setting of limiting conditions or withholding from complete acceptance of the requirement in the tender documents.
c) "Omission" is the failure to submit part or all of the information or documentation required in the tender document for evaluation of bid.

29.3 A material deviation, reservation or omission is one that,

a) If accepted would,
   i) Affect in any substantial way the scope, quality, or performance of the job as specified in tender documents.
   ii) Limit, in any substantial way, inconsistent with the Tender Document, the Employer's rights or the tenderer's obligations under the proposed Contract.
b) If rectified, would unfairly affect the competitive position of other bidders presenting substantially responsive bids.

29.4 The employer shall examine all aspects of the bid to confirm that all requirements have been met without any material deviation, reservation or omission.

29.5 If a Bid is not substantially responsive, it may be rejected by the Employer and may not subsequently be made responsive by correction or withdrawal of the of material deviation, reservation or omission.

30 CORRECTION OF ERRORS-

Not Applicable.

31 CONVERSION TO SINGLE CURRENCY FOR COMPARISON OF BIDS

Not Applicable. All bids submitted must be in the currency specified at clause 14 of ITB.

32 EVALUATION AND COMPARISON OF BIDS

Bid shall be evaluated as per evaluation criteria mentioned in Section-II of bidding documents on lowest bid basis.

In case of a tie at the lowest bid (L1) position between two or more bidders, the order/LoA will be placed on the bidder who has higher/ highest turnover in last audited financial year.

In case there is a tie at the lowest bid (L1) position between only startup bidders and none of them has past turnover, the order/LoA will be placed on the startup who is registered earlier with Department for Promotion of Industry and Internal Trade.

33 COMPENSATION FOR EXTENDED STAY [FOR APPLICABILITY OF THIS CLAUSE REFER BDS]:

Not Applicable

34 PURCHASE PREFERENCE

Purchase preference to Local Content (PP-LC) bidders/Domestically manufactured Telecom Products (DMTP) shall be allowed as per Government instructions in vogue, as applicable from time to time

The policy for providing Purchase Preference (linked with Local content) is enclosed as Annexure V to ITB herewith.

[F] – AWARD OF CONTRACT

35 AWARD

Subject to "ITB: Clause-29", Owner will award the Contract to the successful Bidder whose Bid has been determined to be substantially responsive and has been determined as the lowest provided that bidder, is determined to be qualified to satisfactorily perform the Contract.

"TFL intends to place the contract directly on the address from where Goods are produced / dispatched or Services are rendered. In case, bidder wants contract at some other address or supply of Goods/ Services from multiple locations, bidder is required to provide in their bid address on which order is to be placed."

TFL will place the Contract directly on the successful bidder from whom the bid has been received & evaluated and will not place order on other entities such as subsidiary, business associate or partner, dealer/distributor etc. of the Bidder.

36 NOTIFICATION OF AWARD / FAX OF ACCEPTANCE

36.1 Prior to the expiry of 'Period of Bid Validity', Notification of Award for acceptance of the Bid will be intimated to the successful Bidder by TFL either by E-mail /Letter or like means defined as the "Fax of Acceptance (FOA)". The Contract shall enter into force on the date of FOA and the same shall be binding on TFL and successful Bidder (i.e. Contractor). The Notification of Award/FOA will constitute the formation of a Contract. The detailed Letter of Acceptance shall be issued thereafter incorporating terms & conditions of Tender Document, Corrigendum, Clarification(s), Bid and agreed variation(s)/acceptable deviation(s), if any. TFL may choose to issue Notification of Award in form of detailed

Letter of Acceptance without issuing FOA and in such case the Contract shall enter into force on the date of Detailed Letter of Acceptance only.

36.2 Contract period shall commence from the date of "Notification of Award" or as mentioned in the Notification of Award. The "Notification of Award" will constitute the formation of a Contract, until the Contract has been effected pursuant to signing of Contract as per "ITB: Clause-37".

36.3 Upon the successful Bidder's / Contractor's furnishing of 'Contract Performance Security / Security Deposit', pursuant to "ITB: Clause-38", TFL will promptly discharge his 'Earnest Money Deposit / Bid Security (if applicable)', pursuant to "ITB: Clause-16"

36.4 The Order/ contract value mentioned above is subject to Mutually Agreed Damages clause.

36.5 TFL will award the Contract to the successful Bidder, who, within 'fifteen [15] days' of receipt of the same, shall sign and return the acknowledged copy to TFL.

37 SIGNING OF AGREEMENT

The successful Bidder/Contractor shall be required to execute an ' Agreement' in the proforma given in this Bidding Document) on a 'non-judicial stamp paper' of appropriate value [cost of the 'stamp-paper' shall be borne by the successful Bidder/Contractor] and of 'state of India' specified in Bidding Data Sheet (BDS) only, within 'fifteen [15] days' of receipt of the " Fax of Acceptance (FOA)" of the Tender by the successful Bidder/Contractor failure on the part of the successful Bidder/Contractor to sign the 'Agreement' within the above stipulated period, shall constitute sufficient grounds for Action as per Bid Security declaration.

38 CONTRACT PERFORMANCE SECURITY / SECURITY DEPOSIT ((CPS/SD)

38.1 Within 30 days of the receipt of the notification of Award/ Fax of Acceptance (FOA) by from TFL, the successful bidder shall furnish the Contract Performance Security (CPS) in accordance with of General Conditions of the Contract. The CPS shall be in the form of either Banker's Cheque or Demand Draft or Bank Guarantee or Letter of Credit and shall be in the currency of the Contract. However, CPS shall not be applicable in cases wherein the individual ~~order/~~ contract value as specified in Notification of Award is less than INR 5 Lakh (exclusive of GST).

38.2 The CONTRACT PERFORMANCE SECURITY shall be for an amount equal specified in Bidding Data Sheet (BDS) towards faithful performance of the contractual obligations and performance of equipment. For the purpose of CPS, Contract/order value shall be exclusive of **GST (CGST & SGST/UTGST or IGST)** .

Bank Guarantee towards CPS shall be from any Indian scheduled bank or a branch of an International bank situated in India and registered with Reserve Bank of India as scheduled foreign bank . However, in case of bank guarantees from banks other than the Nationalized Indian banks, the bank must be a commercial bank having net worth in excess of Rs 100 crores and a declaration to this effect should be made by such commercial bank either in the Bank Guarantee itself or separately on its letterhead.

38.3 Failure of the successful bidder to comply with the requirements of this article shall constitute sufficient grounds for consideration of the annulment of the award and ~~Forefeiture of EMD~~/action as per declaration of Bid Security.

38.4 The CPS has to cover the entire contract value including extra works/services also. As long as the CPS submitted at the time of award take cares the extra works/services executed and total executed value are within the awarded contract price, there is no need for additional CPS. As soon as the total executed value is likely to burst the ceiling of awarded contract price, the contractor should furnish additional CPS.

38.5 Further, Ministry of Finance (MOF) Department of financial service has issued direction for submission of Bank Guarantee through online vide letter ref number F.No.7/112/2011-BOA dated 17th July 2012. The successful bidder can submit CPS online through issuing bank to TFL directly as per the above direction including its revisions, if any. In such cases confirmation will not be sought from issuing banker by TFL.

38.6 In addition to existing specified form (i.e. Demand Draft (DD)/ Banker's Cheque/ Bank Guarantee/Letter of Credit) mentioned in tender documents for submission of Security Deposit/ Contract Performance Security, the successful bidder can also submit the Security Deposit/ Contract Performance Security through online banking transaction i.e. IMPS/NEFT/RTGS/SWIFT etc. For this purpose, the details of TFL's Bank Account is mentioned in BDS. Further, in case a successful Bidder is willing to furnish CPS through SWIFT, the details may be obtained from Purchase Officer immediately after receipt of FOA.

While remitting such online transaction, the bidder must indicate "**Security Deposit/ Contract Performance Securityagainst FOA/DLOA no. __(contractor to specify the FOA/DLOA No.)**" under remarks column of such transaction of respective bank portal. The contractor/vendor shall be required to submit the successful transaction details to the dealing officer immediately through email/letter and necessarily within 30 days from the date of Fax of Acceptance.

38.7 In case of forfeiture of Contract Performance Security/ Security Deposit in terms of GCC, the forfeited amount will be considered inclusive of tax and tax invoice will be issued by TFL. The forfeiture amount will be subject to final decision of TFL based on other terms and conditions of order/ contract.

38.8 The Contractor will also submit covering letter along with CPS as per format at F-4.

38.9 CPBG/Security Deposit will not be accepted in case the same has reference of 'remitter'/'financer' other than bidder on the aforementioned financial instrument of CPBG/ Security Deposit submitted by the Contractor.

39 PROCEDURE FOR ACTION IN CASE CORRUPT/FRAUDULENT/COLLUSIVE/ COERCIVE PRACTICES

39.1 Procedure for action in case Corrupt/ Fraudulent/Collusive/Coercive Practices is enclosed at Annexure-I.

39.4 **NON-APPLICABILITY OF ARBITRATION CLAUSE IN CASE OF BANNING OF VENDORS/ SUPPLIERS / CONTRACTORS/ BIDDERS/ CONSULTANTS INDULGED IN**

FRAUDULENT/ COERCIVE PRACTICES

Notwithstanding anything contained contrary in GCC and other "CONTRACT DOCUMENTS", in case it is found that the Contractors/Bidders indulged in fraudulent/ coercive practices at the time of bidding, during execution of the contract etc. and/or on other grounds as mentioned in OWNER's "Procedure for action in case Corrupt/Fraudulent/Collusive/Coercive Practices" (Annexure-I to Section-III), the contractor/bidder shall be banned (in terms of aforesaid procedure) from the date of issuance of such order by TFL, to such Contractors/Bidders.

The Contractor/ Bidder understands and agrees that in such cases where Contractor/ Bidder has been banned (in terms of aforesaid procedure) from the date of issuance of such order by TFL , such decision of TFL shall be final and binding on such Contractor/ Bidder and the 'Arbitration clause' in the GCC and other "CONTRACT DOCUMENTS" shall not be applicable for any consequential issue /dispute arising in the matter.

40 PUBLIC PROCUREMENT POLICY FOR MICRO AND SMALL ENTERPRISES

40.1 Government of India, vide Gazette of India No. 503 dated 26.03.2012 proclaimed the Public Procurement Policy for Micro and Small Enterprises (MSEs). The following benefit is available in case of work contract also:

i) Issue of tender document to MSEs free of cost.
ii) Exemption to MSEs from payment of EMD/Bid Security .

40.2 In case bidder is a Micro or Small Enterprise the bidder shall submit the following:

i. Ministry of MSME vide Gazette notification no. CG-DL-E-26062020-220191 dated 26.06.2020 had notified certain criteria for classifying the enterprises as Micro, Small and Medium Enterprises and specified, form and procedure for filing the memorandum (Udyam Registration) w.e.f. 01.07.2020 (for complete details of policy refer website of Ministry of MSME i.e. https://msme.gov.in/)

   Accordingly, Micro and Small Enterprises (MSEs) shall be required to submit Udyam Registration Certificate for availing benefit under Public Procurement Policy for MSEs-2012

ii. An enterprise registered prior to 30.06.2020 and who is not re-registered with Udyam Registration, shall continue to be valid for a period upto 31.12.2021. Such enterprise shall submit EM Part-II or Udyog Aadhaar Memorandum (UAM) for availing benefits of PPP-2012.

The above documents submitted by the bidder shall be duly certified by the Chartered Accountant (not being an employee or a Director or not having any interest in the bidder's company/firm) and notary public with legible stamp.

If the bidder does not provide the above confirmation or appropriate document or any evidence, then it will be presumed that they do not qualify for any preference admissible in the Public Procurement Policy (PPP) 2012.

Further, MSEs who are availing the benefits of the Public Procurement Policy (PPP) 2012 get themselves registered with MSME Data Bank being operated by NSIC, under SME Division, M/o MSME, in order to create proper data base of MSEs which are making supplies to CPSUs.

40.3 If against an order placed by TFL , successful bidder(s) (other than Micro/Small Enterprise) is procuring material/services from their sub-vendor who is a Micro or Small Enterprise as per provision mentioned at clause no.40.2 with prior consent in writing of the purchasing authority/Engineer-in-charge, the details like Name, Registration No., Address, Contact No. details of material & value of procurement made, etc. of such Enterprises shall be furnished by the successful bidder at the time of submission of invoice/Bill.

40.4 The benefit of policy are not extended to the traders/dealers/ Distributors /Stockiest/Wholesalers.

40.5 NSIC has initiated a scheme of "Consortia and Tender Marketing Scheme" under which they are assisting the Micro & Small enterprises to market their products and services through tender participation on behalf of the individual unit or through consortia.

Accordingly, if the MSEs or the consortia, on whose behalf the bid is submitted by NSIC, is meeting the BEC and other terms and conditions of tender their bid will be considered for further evaluation. Further, in such cases a declaration is to be submitted by MSE/ consortia on their letter head (s) that all the terms and conditions of tender document shall be acceptable to them.

40.6 Interest payment on delayed payments to MSME is payable in line with Micro, Small and Medium Enterprises Development Act, 2006

41 AHR ITEMS

Not applicable.

42 VENDOR PERFORMANCE EVALUATION

Shall be as stipulated Annexure II to ITB herewith.

43 INCOME TAX & CORPORATE TAX

43.1 Income tax deduction shall be made from all payments made to the contractor as per the rules and regulations in force and in accordance with the Income Tax Act prevailing from time to time.

43.2 Corporate Tax liability, if any, shall be to the contractor's account.

43.3 **TDS**

(i) TDS, wherever applicable, shall be deducted as per applicable act/law/rule.

(ii) **Higher rate of TDS for non-filers of ITR**

As per Section 206AB of Income Tax Act, 1961, in case of any vendor/customer who does not filed their Income Tax Return for both of the two previous years preceding to current year and aggregate amount of TDS is more than or equal to

50,000/- in each of those previous two years (or limit defined by Govt. from time to time), then TDS will be deducted at the higher of following rates:

(I) Twice the rate mentioned in relevant TDS section.
(II) Twice the rate or rates in force
(III) 5%

43.4 **MENTIONING OF PAN NO. IN INVOICE/BILL**

As per CBDT Notification No. 95/2015 dated 30.12.2015, mentioning of PAN no. is mandatory for procurement of goods / services/works/consultancy services exceeding Rs. 2 Lacs per transaction or as amended from time to time.

Accordingly, contractor should mention their PAN no. in their invoice/ bill for any transaction exceeding Rs. 2 lakhs or as amended from time to time. As provided in the notification, in case contractor do not have PAN no., they have to submit declaration in Form 60 along with invoice/ bill for each transaction.

Payment of contractor shall be processed only after fulfillment of above requirement.

44. DISPUTE RESOLUTION MECHANISM

44.1 QUARTERLY CLOSURE OF THE CONTRACT

During execution of orders, various issues may arise. In order to timely detect and to address the contractual issue(s) during the execution of contracts, TFL has introduced a mechanism of Quarterly Closure of the contract, under which all the related issues /disputes will be monitored and addressed on quarterly basis for resolution. Vendor (hereinafter referred 'Vendor')should first refer any issues/disputes to Engineer-in-Charge(EIC) for LOA/contracts/ Dealing C&P Executive for Purchase Orders and co-operate them for smooth execution of the contract and to timely address the issues, if any. For applicability of 'Quarterly Closure', please refer BDS.

44.2 ARBITRATION

All issue(s)/dispute(s) excluding the matters that have been specified as excepted matters and listed at clause no. 2.6 and which cannot be resolved through Conciliation, such issue(s)/dispute(s) shall be referred to arbitration for adjudication by Sole Arbitrator.

The party invoking the Arbitration shall have the option to either opt for Ad-hoc Arbitration as provided at Clause 2.1 below or Institutionalized Arbitration as provided at Clause 2.2 below, the remaining clauses from 2.3 to 2.7 shall apply to both Ad-hoc and Institutional Arbitration:-

2.1 On invocation of the Arbitration clause by either party, TFL shall suggest a panel of three independent and distinguished persons (Retd Supreme Court & High Court Judges only) to the other party from the Panel of Arbitrators maintained by 'Delhi International Arbitration Centre (DIAC) to select any one among them to act as the Sole Arbitrator. In the event of failure of the other party to select the Sole Arbitrator

within 30 days from the receipt of the communication from TFL suggesting the panel of arbitrators, the right of selection of the sole arbitrator by the other party shall stand forfeited and TFL shall appoint the Sole Arbitrator from the suggested panel of three Arbitrators for adjudication of dispute(s). The decision of TFL on the appointment of the sole arbitrator shall be final and binding on the other party. The fees payable to Sole Arbitrator shall be governed by the fee Schedule of ‘‘Delhi International Arbitration Centre’.

OR

2.2 If a dispute arises out of or in connection with this contract, the party invoking the Arbitration shall submit that dispute to any one of the Arbitral Institutions i.e ICADR/ICA/DIAC/SFCA and that dispute shall be adjudicated in accordance with their respective Arbitration Rules. The matter shall be adjudicated by a Sole Arbitrator who shall necessarily be a Retd. Supreme Court/High Court Judge to be appointed/nominated by the respective institution. The cost/expenses pertaining to the said Arbitration shall also be governed in accordance with the Rules of the respective Arbitral Institution. The decision of the party invoking the Arbitration for reference of dispute to a specific Arbitral institution for adjudication of that dispute shall be final and binding on both the parties and shall not be subject to any change thereafter. The institution once selected at the time of invocation of dispute shall remain unchanged.

2.3 The cost of arbitration proceedings shall be shared equally by the parties.

2.4 The Arbitration proceedings shall be in English language and the seat, venue and place of Arbitration shall be New Delhi, India only.

2.5 Subject to the above, the provisions of Arbitration & Conciliation Act 1996 and any amendment thereof shall be applicable. All matter relating to this Contract and arising out of invocation of Arbitration clause are subject to the exclusive jurisdiction of the Court(s) situated at New Delhi.

2.6 List of Excepted matters:

a) Dispute(s)/issue(s) involving claims below Rs 25 lakhs and above Rs 25 crores.
b) Dispute(s)/issue(s) relating to indulgence of Contractor/Vendor/Bidder in corrupt/fraudulent/collusive/coercive practices and/or the same is under investigation by CBI or Vigilance or any other investigating agency or Government.
c) Dispute(s)/issue(s) wherein the decision of Engineer-In-Charge/owner/TFL has been made final and binding in terms of the Contract.

2.7. Disputes involving claims below Rs 25 Lakhs and above Rs. 25 crores:- Parties mutually agree that dispute(s)/issue(s) involving claims below Rs 25 Lakhs and above Rs 25 crores shall not be subject matter of Arbitration and are subject to the exclusive jurisdiction of the Court(s) situated at New Delhi.

44.3 GOVERNING LAW AND JURISDICTION:

The Contract shall be governed by and construed in accordance with the laws in force in India. The Parties hereby submit to the exclusive jurisdiction of the Courts situated at New

Delhi for adjudication of disputes, injunctive reliefs, actions and proceedings, if any, arising out of this Contract.

45. DISPUTES BETWEEN CPSE'S/ GOVERNMENT DEPARTMENT'S / ORGANIZATIONS

Subject to conciliation as provided above, in the event of any dispute (other than those related to taxation matters) or difference relating to the interpretation and application of the provisions of commercial contract(s) between Central Public Sector Enterprises (CPSEs)/ Port Trusts inter se and also between CPSEs and Government Departments /Organizations , such dispute or difference shall be taken up by either party for resolution only through AMRCD as mentioned in OPE OM No. 4(1)/2013-DPE(GM)/FTS-1835 dated 22-05-2018.

Any party aggrieved with the decision of the Committee at the First level (tier) may prefer an appeal before the Cabinet Secretary at the Second level (tier) within 15 days from the date of receipt of decision of the Committee at First level, through it's administrative Ministry/Department, whose decision will be final and binding on all concerned.

The above provisions mentioned at clause no. 44 & 45 shall supersede provisions relating to Conciliation, Arbitration, Governing Law & Jurisdiction and Disputes between CPSE's/ Government Department's/ Organizations mentioned in General Conditions of Contract (GCC) and elsewhere in tender document.

46 INAM-PRO (PLATFORM FOR INFRASTRUCTURE AND MATERIALS PROVIDERS)

INAM-Pro (Platform for infrastructure and materials providers) is a web based platform for infrastructure provides and materials suppliers and was developed by Ministry of Road Transport and Highways (MoRT&H) with a view to reduce project execution delays on account of supply shortages and inspire greater confidence in contractors to procure cement to start with directly from the manufacturers. Presently, numerous cement companies are registered in the portal and offering cement for sale on the portal with a commitment period of 3 years. These companies have bound themselves by ceiling rates for the entire commitment period, wherein they are allowed to reduce or increase their cement rates any number of times within the ceiling rate, but are not permitted to exceed the said ceiling rate.

MoRT&H is expanding the reach of this web-portal by increasing both the product width as well as the product depth. They are working on incorporating 60 plus product categories. The product range will span from large machineries like Earth Movers and Concrete Mixers, to even the smallest items like road studs. MoRT&H intend to turn it into a portal which services every infrastructure development related need of a modern contractor.

TFL's contractors may use this innovative platform, wherever applicable. The usage of web – Portal is a completely voluntary exercise. The platform, however, can serve as a benchmark for comparison of offered prices and products.

47 PROMOTION OF PAYMENT THROUGH CARDS AND DIGITAL MEANS

To promote cashless transactions, the onward payments by Contractors to their employees, service providers, sub-contractors and suppliers may be made through Cards

and Digital means to the extent possible

48 **CONTRACTOR TO ENGAGE CONTRACT MANPOWER BELONGING TO SCHEDULED CASTES AND WEAKER SECTIONS OF THE SOCIETY**

While engaging the contractual manpower, Contractors are required to make efforts to provide opportunity of employment to the people belonging to Scheduled Castes and weaker sections of the society also in order to have a fair representation of these sections.

49 PROVISIONS FOR STARTUPS (AS DEFINED IN GAZETTENOTIFICATION NO. D.L-33004/99 DATED 18.02.2016 AND 23.05.2017 OF MINISTRY OF COMMERCE AND INDUSTRY AND AS AMENDED FROM TIME TO TIME) [FOR APPLICABLITY REFER BDS]

As mentioned in Section-II, Technical and Financial BEC shall be applicable for all Startups [whether Micro & Small Enterprises (MSEs) or otherwise].

Further, the Startups are also exempted from submission of EMDs (if applicable).

If a Startup emerge lowest bidder, the LoA on such Startup shall be placed for entire tendered quantity/group/item/part (as the case may be). However, during the Kick of Meeting monthly milestones/ check points would be drawn. Further, the performance of such contractor/ service provider will be reviewed more carefully and action to be taken as per provision of contract in case of failure/ poor performance.

50 PROVISION REGARDING INVOICE FOR REDUCED VALUE OR CREDIT NOTE TOWARDS MAD

MAD is the reduction in the consideration / contract value for the / services covered under this contract. In case of delay in execution of service provider should raise invoice for reduced value as per MAD) clause. If service provider has raised the invoice for full value, then service provider should issue Credit Note towards the applicable MAD amount with applicable taxes.

In such cases if service provider fails to submit the invoice with reduced value or does not issue credit note as mentioned above, TFL will release the payment to service provider after giving effect of the MAD clause with corresponding reduction of taxes charged on service provider's invoice, to avoid delay in payment .

In case any financial implication arises on TFL due to issuance of invoice without reduction in price or non-issuance of Credit Note, the same shall be to the account of service provider. TFL shall be entitled to deduct / setoff / recover such GST amount (CGST & SGST/UTGST or IGST) together with penalties and interest, if any, against any amounts paid or becomes payable by OWNER in future to the service provider's under this contract or under any other contract.

51. UNIQUE DOCUMENT IDENTIFICATION NUMBER BY PRACTICING CHARTERED ACCOUNTANTS

Practicing Chartered Accountants shall generate Unique Document Identification Number (UDIN) for all certificates issued by them as per provisions of Tender Document.

However, UDIN may not be required for documents being attested by Chartered Accountants in terms of provisions of Tender Document

52. PROVISION FOR PROCUREMENT FROM A BIDDER WHICH SHARES A LANDBORDER WITH INDIA.

The clause regarding provision for procurement from a bidder which shares aland 2with India is enclosed as Annexure-VII to ITB herewith.

Annexure-I to Section-III

PROCEDURE FOR ACTION IN CASE CORRUPT/FRAUDULENT/COLLUSIVE/COERCIVE PRACTICES

Annexure-I

A Definitions:

A.1 "Corrupt Practice" means the offering, giving, receiving or soliciting, directly or indirectly, anything of value to improperly influence the actions in selection process or in contract execution.

"Corrupt Practice" also includes any omission for misrepresentation that may mislead or attempt to mislead so that financial or other benefit may be obtained or an obligation avoided.

A2 "Fraudulent Practice" means and include any act or omission committed by a agency or with his connivance or by his agent by misrepresenting/ submitting false documents and/ or false information or concealment of facts or to deceive in order to influence a selection process or during execution of contract/ order.

A3 "Collusive Practice amongst bidders (prior to or after bid submission)" means a scheme or arrangement designed to establish bid prices at artificial non-competitive levels and to deprive the Employer of the benefits of free and open competition.

A.4 "Coercive practice" means impairing or harming or threatening to impair or harm directly or indirectly, any agency or its property to influence the improperly actions of an agency, obstruction of any investigation or auditing of a procurement process.

A.5 "Vendor/Supplier/Contractor/Consultant/Bidder" is herein after referred as "Agency"

A.6 "Appellate Authority" shall mean Committee of Directors consisting of Director (Finance) and Director (BD) for works centers under Director (Projects). For all other cases committee of Directors shall consist of Director (Finance) & Director (Projects).

A.7 "Competent Authority" shall mean the authority, who is competent to take final decision for Suspension of business dealing with an Agency/ (ies) and Banning of business dealings with Agency/ (ies) and shall be the "Director" concerned.

A.8 "Allied Agency" shall mean all the concerns within the sphere of effective influence of banned/ suspended agencies. In determining this, the following factors may be taken into consideration:

(a) Whether the management is common;

(b) Majority interest in the management is held by the partners or directors of banned/ suspended firm.

(c) substantial or majority shares are owned by banned/ suspended agency and by virtue of this it has a controlling voice.

A.9 "Investigating Agency" shall mean any department or unit of TFL investigating into the conduct of Agency/ party and shall include the Vigilance Department of the TFL, Central Bureau of Investigation, State Police or any other agency set up by the Central or state government having power to investigate.

B Actions against bidder(s) indulging in corrupt /fraudulent/ collusive/ coercive practice

B.1 Irregularities noticed during the evaluation of the bids :

If it is observed during bidding process/ bids evaluation stage that a bidder has indulged in corrupt/fraudulent /collusive/coercive practice, the bid of such Bidder (s) shall be rejected and its Earnest Money Deposit (EMD) shall be forfeited.

Further, such agency shall be banned for future business with TFL for a period specified in para B 2.2 below from the date of issue of banning order.

B.2 Irregularities noticed after award of contract

(i) **During execution of contract:**

If an agency, is found to have indulged in corrupt/fraudulent/ collusive/coercive practices, action shall be initiated for putting the agency on banning list.

After conclusion of process and issuance of Speaking order for putting party on banning list, the order (s)/ contract (s) where it is concluded that such irregularities have been committed shall be terminated and Contract cum Performance Bank Guarantee (CPBG) submitted by agency against such order (s)/ contract (s) shall also be forfeited. Further such order/ contract will be closed following the due procedure in this regard.

The amount that may have become due to the contractor on account of work already executed by him shall be payable to the contractor and this amount shall be subject to adjustment against any amounts due from the contractor under the terms of the contract. No risk and cost provision will be enforced in such cases.

Suspension of order/ contract:

Further, only in the following situations, the concerned order (s)/ contract(s) (where Corrupt/Fraudulent/ Collusive/ Coercive Practices are observed) and payment shall be suspended after issuance of Suspension cum Show Cause Notice:

(i) Head of Corporate Vigilance Department/CVO based on the investigation by them, recommend for specific immediate action against the agency.
(ii) Head of Corporate Vigilance Department/CVO based on the input from investigating agency, forward for specific immediate action against the agency.

Suspension cum Show Cause Notice being issued in above cases after approval of the competent authority (as per provisions mentioned under Clause no. D) shall also include the provision for suspension of Order (s)/ Contract (s) and payment. Accordingly, after issuance of Suspension cum Show Cause Notice, the formal communication for suspension of Order (s)/ Contract (s) and payment with immediate effect will be issued by the concerned person of TFL.

During suspension, Contractor/ Service Providers will be allowed to visit the plant/ site for upkeep of their items/ equipment, TFL's issued materials (in case custody of same is not taken over), demobilizing the site on confirmation of EIC, etc.

(ii) After execution of contract and during Defect liability period (DLP)/ Warranty/Guarantee Period:

If an agency is found to have indulged in corrupt/fraudulent/ collusive/coercive practices, after execution of contract and during DLP/ Warranty/Guarantee Period, the agency shall be banned for future business with TFL for a period specified in para B 2.2 below from the date of issue of banning order.
Further, the Contract cum Performance Bank Guarantee (CPBG)/Contract Performance Security (CPS) submitted by agency against such order (s)/ contract (s) shall be forfeited.

(iii) After expiry of Defect liability period (DLP)/ Warranty/Guarantee Period

If an agency is found to have indulged in corrupt/fraudulent/ collusive/coercive practices, after expiry of Defect liability period (DLP)/ Warranty/Guarantee Period, the agency shall be banned for future business with TFL for a period specified in para B 2.2 below from the date of issue of banning order.

B.2.2 Period of Banning

The period of banning of agencies indulged in Corrupt/Fraudulent/Collusive/Coercive Practices shall be as under and to be reckoned from the date of banning order:

S. No.	Description	Period of banning from the date of issuance of Banning order
1	Misrepresentation/False information other than pertaining to BEC of tender but having impact on the selection process. For example, if an agency confirms not being in holiday in TFL/PSU's PMC or banned by PSUs/ Govt. Dept., liquidation, bankruptcy & etc. and subsequently it is found otherwise, such acts shall be considered in this category.	02 years
2 2.1	Corrupt/Fraudulent (except mentioned sl. no. 1 above) /Collusive/Coercive Practices If an agency again commits Corrupt/Fraudulent (except mentioned sl. no. 1 above) /Collusive/ Coercive Practices in subsequent cases after their banning, such situation of repeated offense to be dealt with more severity and following shall be the period of banning: (v) Repeated once	03 years 7 years (in

	(vi) Repeated twice or more	addition to the period already served) 15 years (in addition to the period already served)
3	Indulged in unauthorized disposal of materials provided by TFL	7 years
4	If act of vendor/ contractor is a threat to the National Security	15 years

C Effect of banning on other ongoing contracts/ tenders

C.1 If an agency is put on Banning, such agency should not be considered in ongoing tenders/future tenders.

C.2 However, if such an agency is already executing other order (s)/ contract (s) where no corrupt/fraudulent/ collusive/coercive practice is found, the agency should be allowed to continue till its completion without any further increase in scope except those incidental to original scope mentioned in the contract.

C.3 If an agency is put on the Banning List during tendering and no irregularity is found in the case under process:

C.3.1 after issue of the enquiry /bid/tender but before opening of Technical bid, the bid submitted by the agency shall be ignored.

C.3.2 after opening Technical bid but before opening the Price bid, the Price bid of the agency shall not be opened and BG/EMD submitted by the agency shall be returned to the agency.

C.3.3 after opening of price, BG/EMD made by the agency shall be returned; the offer of the agency shall be ignored & will not be further evaluated. If the agency is put on banning list for fraud/ mis-appropriation of facts committed in the same tender/other tender where errant agency emerges as the lowest (L1), then such tender shall also be cancelled and re-invited.

D. Procedure for Suspension of Bidder

D.1 Initiation of Suspension

Action for suspension business dealing with any agency/(ies) shall be initiated by Corporate C&P Department when

(i) Corporate Vigilance Department based on the fact of the case gathered during investigation by them recommend for specific immediate action against the agency.

(ii) Corporate Vigilance Department based on the input from Investigating agency, forward for specific immediate action against the agency.

(iii) Non performance of Vendor/Supplier/Contractor/Consultant leading to termination of Contract/ Order.

D.2 Suspension Procedure:

D.2.1 The order of suspension would operate initially for a period not more than six months and is to be communicated to the agency and also to Corporate Vigilance Department. Period of suspension can be extended with the approval of the Competent Authority by one month at a time with a ceiling of six months pending a conclusive decision to put the agency on banning list.

D.2.2 During the period of suspension, no new business dealing may be held with the agency.

D.2.3 Period of suspension shall be accounted for in the final order passed for banning of business with the agency.

D.2.4 The decision regarding suspension of business dealings should also be communicated to the agency.

D.2.5 If a prima-facie, case is made out that the agency is guilty on the grounds which can result in banning of business dealings, proposal for issuance of suspension order and show cause notice shall be put up to the Competent Authority. The suspension order and show cause notice must include that (i) the agency is put on suspension list and (ii) why action should not be taken for banning the agency for future business from TFL.
The competent authority to approve the suspension will be same as that for according approval for banning.

D 3 Effect of Suspension of business:

Effect of suspension on other on-going/future tenders will be as under:

D.3.1 No enquiry/bid/tender shall be entertained from an agency as long as the name of agency appears in the Suspension List.

D.3.2 If an agency is put on the Suspension List during tendering:

D.3.2.1 after issue of the enquiry /bid/tender but before opening of Technical bid, the bid submitted by the agency shall be ignored.

D.3.2.2 after opening Technical bid but before opening the Price bid, the Price bid of the agency shall not be opened and BG/EMD submitted by the agency shall be returned to the agency.

D.3.2.3 after opening of price, BG/EMD made by the agency shall be returned; the offer of the agency shall be ignored & will not be further evaluated. If the agency is put on Suspension list for fraud/ mis-appropriation of facts conducted in the sametender/other tender where errant agency emerges as the lowest (L1), then such tender shall also be cancelled and re-invited.

D.3.3 The existing contract (s)/ order (s) under execution shall continue.

D.3.4 Tenders invited for procurement of goods, works and services shall have provision that the bidder shall submit a undertaking to the effect that (i) neither the bidder themselves nor their allied agency/(ies) are on banning list of TFL and(ii) bidder is not banned by any Government department/ Public Sector.

F. Appeal against the Decision of the Competent Authority:

F.1 The agency may file an appeal against the order of the Competent Authority for putting the agency on banning list. The appeal shall be filed to Appellate Authority. Such an appeal shall be preferred within one month from the of receipt of banning order.

F.2 Appellate Authority would consider the appeal and pass appropriate order which shall be communicated to the party as well as the Competent Authority.

F.3 Appeal process may be completed within 45 days of filing of appeal with the Appellate Authority.

G. Wherever there is contradiction with respect to terms of ‘Integrity pact’ , GCC and ‘Procedure for action in case of Corrupt/Fraudulent/ Collusive/Coercive Practice’, the provisions of ‘Procedure for action in case of Corrupt/Fraudulent/ Collusive/Coercive Practice’ shall prevail.

Annexure-II to Section III

PROCEDURE FOR EVALUATION OF PERFORMANCE OF VENDORS/ SUPPLIERS/ CONTRACTORS/ CONSULTANTS

1.0 GENERAL

A system for evaluation of Vendors/ Suppliers/Contractors/ Consultants and their performance is a key process and important to support an effective purchasing & contracting function of an organization.
Performance of all participating Vendors/ Suppliers/Contractors/ Consultants need to be closely monitored to ensure timely receipt of supplies from a Vendor, completion of an assignment by a Consultant or complete execution of order by a contractor within scheduled completion period. For timely execution of projects and meeting the operation & maintenance requirement of operating plants, it is necessary to monitor the execution of order or contracts right from the award stage to completion stage and take corrective measures in time.

2.0 OBJECTIVE

The objective of Evaluation of Performance aims to recognize, and develop reliable Vendors/ Suppliers/Contractors/ Consultants so that they consistently meet or exceed expectations and requirements.
The purpose of this procedure is to put in place a system to monitor performance of Vendors/ Suppliers/Contractors/ Consultants associated with TFL so as to ensure timely completion of various projects, timely receipt of supplies including completion of works & services for operation and maintenance of operating plants and quality standards in all respects.

3.0 METHODOLOGY

i) Preparation of Performance Rating Data Sheet
Performance rating data Sheet for each and every Vendor/ Supplier/Contractor/Consultant for all orders/Contracts with a value of Rs. 50 Lakhs and above is recommended to be drawn up. Further, Performance rating data Sheet for orders/contracts of Vendor/Supplier/Contractor/ Consultant who are on watch list/holiday list/ banning list shall be prepared irrespective of order/ contract value. These data sheets are to be separately prepared for orders/ contracts related to Projects and O&M. Format, Parameters, Process, responsibility for preparation of Performance Rating Data Sheet are separately mentioned.

ii) Measurement of Performance
Based on the parameters defined in Data Sheet, Performance of concerned Vendor/ Supplier/Contractor/ Consultant would be computed and graded accordingly. The measurement of the performance of the Party would be its ability to achieve the minimum scoring of 60% points in the given parameters.

iii) Initiation of Measures:
Depending upon the Grading of Performance, corrective measures would be initiated by taking up the matter with concerned Vendor/ Supplier/Contractor/ Consultant. Response of Vendor/ Supplier/Contractor/ Consultant would be considered before deciding further course of action.

iv) Implementation of Corrective Measures:

Based on the response of Vendor/ Supplier/Contractor/ Consultant, concerned Engineer-in-Charge for the Projects and/or OIC in case of O&M would recommend for continuation or discontinuation of such party from the business of TFL.

v) Orders/contracts placed on Proprietary/OEM basis for O&M will be evaluated and, if required, corrective action will be taken for improvement in future.

4.0 **EXCLUSIONS:**

The following would be excluded from the scope of evaluation of performance of Vendors/ Suppliers/Contractors/ Consultants :

i) Orders/Contracts below the value of Rs. 50 Lakhs if Vendor/ Supplier/Contractor/ Consultant is not on watch list/ holiday list/ banning list.

ii) Orders for Misc./Administrative items/ Non stock Non valuated items (PO with material code ending with 9).

However, concerned Engineer-in-Charge /OICs will continue to monitor such cases so as to minimize the impact on Projects/O&M plants due to non performance of Vendors/ Suppliers/Contractors/ Consultants in all such cases.

5.0 **PROCESS OF EVALUATION OF PERFORMANCE OF VENDORS/ SUPPLIERS/ CONTRACTORS/ CONSULTANTS**

5.1 FOR PROJECTS

i) Evaluation of performance of Vendors/ Suppliers/Contractors/ Consultants in case of PROJECTS shall be done immediately with commissioning of any Project.

ii) On commissioning of any Project, EIC (Engineer-in-charge)/ Project-in-charge shall prepare a Performance Rating Data Sheet (Format at Annexure-1) for all Orders and Contracts.

iii) Depending upon the Performance Rating, following action shall be initiated by Engineer-in-charge/Project-in-charge:

Sl.No.	Performance Rating	Action
1	POOR	Seek explanation for Poor performance
2	FAIR	Seek explanation for Fair performance
3	GOOD	Letter to the concerned for improving performance in future
4	VERY GOOD	No further action

iv) Reply from concerned Vendor/ Supplier/Contractor/ Consultant shall be examined. In case of satisfactory reply, Performance Rating data Sheet to be closed with a letter to the concerned for improving performance in future.

v) When no reply is received or reasons indicated are unsatisfactory, the following actions need to be taken:

A) Where performance rating is “POOR” (as per Performance Rating carried out after execution of Order/ Contract and where no reply/ unsatisfactory reply is received from party against the letter seeking the explanation from Vendor/Supplier/Contractor/ Consultant along with sharing the performance rating)

Recommend such defaulting Vendor / Supplier / Contractor / Consultant for the following action:

1. Poor Performance on account of Quality (if marks obtained against Quality parameter is less than 20):
   (a) First Instance: Holiday (Red Card) for Two Years
   (b) Subsequent instance (s) in other ongoing order (s)/ contract (s) or new order (s) /contact (s) on such Vendor/ Supplier/ Contractor/ Consultant: Holiday (Red Card) for Three Years

2. Poor Performance on account of other than Quality (if marks obtained against Quality parameter is more than 20):
   (a) **First such instance:Advisory notice(Yellow Card)** shall be issued and Vendor/Supplier/Contractor/ Consultantshall be put on watch list for a period of Three (3) Years.
   (b) Second such instance in other ongoing order (s)/ contract (s) or new order (s) /contact (s) on such Vendor/ Supplier/ Contractor/ Consultant: Putting on Holiday (Red Card) for a period of One Year
   (c) Subsequent instances (more than two) in other ongoing order (s)/ contract (s) or new order (s) /contact (s) on such Vendor/ Supplier/ Contractor/ Consultant: Putting on Holiday (Red Card) for a period of Three Years.

B) Where Poor/Non-Performance leading to termination of contract or Offloading of contract due to poor performance attributable to Vendor/Supplier/ Contractor/Consultant (under clause no. 34.2.3 of GCC)

(a) First instance: **Advisory notice (Yellow Card)** shall be issued and Vendor/Supplier/Contractor /Consultantshall be put on watch list for a period of Three (3) Years.
Further such vendor will not be allowed to participate in the re-tender of the same supply/work/services of that location which has terminated / offloaded. Moreover, it will be ensured that all other action as per provision of contract including forfeiture of Contract Performance Security (CPS) etc. are undertaken.
However, such vendor will be allowed to participate in all other tenders and to execute other ongoing order/ contract (s) or new contract/ order (s).
The Yellow card will be automatically revoked after a period of three years unless the same is converted into Red Card due to subsequence instances of poor/ non-performance in other ongoing order (s)/ contract (s) or new order (s) /contact (s) on such Vendor/ Supplier/ Contractor/ Consultant.

(b) Second instances in other ongoing order (s)/ contract (s) or new order (s) /contact (s) on such Vendor/ Supplier/ Contractor/ Consultant: **Holiday (Red Card)** for period of One Year and they shall also to be considered for Suspension.

(c) **Subsequent instances (more than two)** in other ongoing order (s)/ contract (s) or new order (s) /contact (s) on such Vendor/ Supplier/ Contractor/ Consultant: **Holiday (Red Card) for period of Three Years and they shall also to be considered for Suspension.**

(C) Where Performance rating is "FAIR":
Issuance of warning to such defaulting Vendor/ Supplier/Contractor/ Consultant to improve their performance.

5.2 FOR CONSULTANCY JOBS

Monitoring and Evaluation of consultancy jobs will be carried out in the same way as described in para 5.1 for Projects.

5.3 FOR OPERATION & MAINTENANCE

i) Evaluation of performance of Vendors/ Suppliers/Contractors/ Consultants in case of Operation and Maintenance shall be done immediately after execution of order/ contract.

ii) After execution of orders a Performance Rating Data Sheet (Format at Annexure-2) shall be prepared for Orders by Site C&P and for Contracts/Services by respective Engineer-In-Charge.

iii) Depending upon Performance Rating, following action shall be initiated by EIC:

Sl. No.	Performance Rating	Action
1	**POOR**	Seek explanation for Poor performance
2.	**FAIR**	Seek explanation for Fair performance
3	**GOOD**	Letter to the concerned for improving performance in future.
4	**VERY GOOD**	No further action

iv) Reply from concerned Vendor/ Supplier/Contractor/ Consultant shall be examined. In case of satisfactory reply, Performance Rating data Sheet to be closed with a letter to the concerned for improving performance in future.

v) When no reply is received or reasons indicated are unsatisfactory, the following actions need to be taken:

A) Where performance rating is "POOR" (as per Performance Rating carried out after execution of Order/ Contract and where no reply/ unsatisfactory reply is received from party against the letter seeking the explanation from Vendor/Supplier/Contractor/ Consultant along with sharing the performance rating)

Recommend such defaulting Vendor / Supplier / Contractor / Consultant for the following action:

1. Poor Performance on account of Quality (if marks obtained against Quality parameter is less than 20):
   (a) **First Instance: Holiday (Red Card) for Two Years**
   (b) **Subsequent instance (s) in other ongoing order (s)/ contract (s) or new order (s) /contact (s) on such Vendor/**

Supplier/ Contractor/ Consultant: Holiday (Red Card) for Three Years

2. Poor Performance on account of other than Quality (if marks obtained against Quality parameter is more than 20):

(a) **First such instance:Advisory notice(Yellow Card)** shall be issued and Vendor/Supplier/Contractor/ Consultantshall be put on watch list for a period of Three (3) Years.

(b) **Second such instance in other ongoing order (s)/ contract (s) or new order (s) /contact (s) on such Vendor/ Supplier/ Contractor/ Consultant: Putting on Holiday (Red Card) for a period of One Year**

(c) **Subsequent instances (more than two) in other ongoing order (s)/ contract (s) or new order (s) /contact (s) on such Vendor/ Supplier/ Contractor/ Consultant**: **Putting on Holiday (Red Card) for a period of Three Years.**

B) Where Poor/Non-Performance leading to termination of contract or Offloading of contract due to poor performance attributable to Vendor/Supplier/ Contractor/Consultant (under clause no. 34.2.3 of GCC)

(a) **First instance**: **Advisory notice (Yellow Card)** shall be issued and Vendor/Supplier/Contractor /Consultantshall be put on watch list for a period of Three (3) Years.

Further such vendor will not be allowed to participate in the re-tender of the same supply/work/services of that location which has terminated / offloaded. Moreover, it will be ensured that all other action as per provision of contract including forfeiture of Contract Performance Security (CPS) etc. are undertaken.

However, such vendor will be allowed to participate in all other tenders and to execute other ongoing order/ contract (s) or new contract/ order (s).

The Yellow card will be automatically revoked after a period of three years unless the same is converted into Red Card due to subsequence instances of poor/ non-performance in other ongoing order (s)/ contract (s) or new order (s) /contact (s) on such Vendor/ Supplier/ Contractor/ Consultant.

(b) **Second instances** in other ongoing order (s)/ contract (s) or new order (s) /contact (s) on such Vendor/ Supplier/ Contractor/ Consultant: **Holiday (Red Card)** for period of One Year and they shall also to be considered for Suspension.

(c) **Subsequent instances (more than two)** in other ongoing order (s)/ contract (s) or new order (s) /contact (s) on such Vendor/ Supplier/ Contractor/ Consultant: **Holiday (Red Card) for period of Three Years and they shall also to be considered for Suspension.**

(C) Where Performance rating is “FAIR”

Issuance of warning to such defaulting Vendors/Contractors/Consultants to improve their performance.

6.0 REVIEW & RESTORATION OF PARITES PUT ON HOLIDAY

6.1 An order for Holiday passed for a certain specified period shall deemed to have been automatically revoked on the expiry of that specified period and it will not be necessary to issue a specific formal order of revocation.

Further, in case Vendor/ Supplier/Contractor/ Consultant is put on holiday due to quality, and new order is placed on bidder after restoration of Vendor/ Supplier/Contractor/ Consultant, such order will be properly monitored during execution stage by the concerned site.

7.0 EFFECT OF HOLIDAY

7.1 If a Vendor/ Supplier/Contractor/ Consultant is put on Holiday, such Vendor/ Supplier/Contractor/ Consultant shall not be considered in ongoing tenders/future tenders.

7.2 However, if such Vendor/ Supplier/Contractor/ Consultant is already executing any other order/ contract and their performance is satisfactory in terms of the relevant contract, should be allowed to continue till its completion without any further increase in scope except those incidental to original scope mentioned in the contract. In such a case CPBG will not be forfeited and payment will be made as per provisions of concerned contract. However, this would be without prejudice to other terms and conditions of the contract.

7.3. Effect on other ongoing tendering:

7.3.1 after issue of the enquiry /bid/tender but before opening of Technical bid, the bid submitted by the party shall be ignored.

7.3.2 after opening Technical bid but before opening the Price bid, the Price bid of the party shall not be opened and BG/EMD submitted by the party shall be returned to the party.

7.3.3 after opening of price, BG/EMD made by the party shall be returned; the offer of the party shall be ignored & will not be further evaluated. If errant party emerges as the lowest (L1), then such tender shall also be cancelled and re-invited.

8.0 While putting the Vendor/ Supplier/Contractor/ Consultant on holiday as per the procedure, the holding company, subsidiary, joint venture, sister concerns, group division of the errant Vendor/ Supplier/Contractor/ Consultant shall not be considered for putting on holiday list. Any bidder, put on holiday, will not be allowed to bid through consortium route also in new tender during the period of holiday.

9.0 If an unsuccessful bidder makes any vexatious, frivolous or malicious complaint against the tender process with the intention of delaying or defeating any procurement or causing loss to TFL or any other bidder, such bidder will be put on holiday for a period of six months, if such complaint is proved to be vexatious, frivolous or malicious, after following the due procedure.

10. APPEAL AGAINST THE DECISION OF THE COMPETENT AUTHORITY:

(a) The party may file an appeal against the order of the Competent Authority for putting the party on Holiday list. The appeal shall be filed to Appellate Authority. Such an appeal shall be preferred within one month from the of receipt of Holiday order.

(b) Appellate Authority would consider the appeal and pass appropriate order which shall be communicated to the party as well as the Competent Authority.

(c) Appeal process may be completed within 45 days of filing of appeal with the Appellate Authority.

(d) “Appellate Authority” shall mean Committee of Directors consisting of Director (Finance) and Director (BD) for works centers under Director (Projects). For all

other cases committee of Directors shall consist of Director (Finance) & Director (Projects).

11. **ERRANT BIDDER**

In case after price bid opening the lowest evaluated bidder (L1) is not awarded the job for any mistake committed by him in bidding or withdrawal of bid or modification of bid or varying any term in regard thereof leading to re-tendering, TFL shall forfeit EMD if paid by the bidder and such bidders shall be debarred from participation in retendering of the same job(s)/item(s).
Further, such bidder will be put on Watch List (Yellow Card) for a period of three years after following the due procedure. However, during the period in watch list such vendor will be allowed to participate in all other tenders and to execute other ongoing order/ contract (s) or new contract/ order (s).

In case of subsequent instances of default in other tender(s) during aforesaid watch list period, the action shall be initiated as per provision of sl. no. 2 of para A of Clause no. 5.1 (v) and 5.3 (v).

The Yellow card will be automatically revoked after specified period unless the same is converted into Red Card

12. In case CBIC (Central Board of Indirect Taxes and Customs)/ any tax authority / any equivalent government agency brings to the notice of TFL that the Supplier has not remitted the amount towards GST (CGST & SGST/UTGST or IGST) collected from TFL to the government exchequer, then, that Supplier shall be put under Holiday list of TFL for period of six months after following the due procedure. This action will be in addition to the right of recovery of financial implication arising on TFL.

Annexure-1

TALCHER FERTITIZERS LIMITED
PERFORMANCE RATING DATA SHEET
(FOR PROJECTS/ CONSULTANCY JOBS)

i) Project/Work Centre :
ii) Order/ Contract No. & date :
iii) Brief description of Items Works/Assignment :
iv) Order/Contract value (Rs.) :
v) Name of Vendor/Supplier/ Contractor/ Consultant :
vi) Contracted delivery/ Completion Schedule :
vii) Actual delivery/ Completion date :

Performance Parameter	Delivery/ Completion Performance	Quality Performance	Reliability Performance#	Total
Maximum Marks	40	40	20	100
Marks Allocated				

Note:
Remarks (if any)

PERFORMANCE RATING (**)

Note :
(#) Vendor/Supplier/Contractor/Consultant who seek repeated financial assistance or deviation beyond contract payment term or seeking direct payment to the sub-vendor/sub-contractor due to financial constraints, then '0' marks should be allotted against Reliability Performance.
(*) Allocation of marks should be as per enclosed instructions
(**) Performance rating shall be classified as under :

Sl. No.	Range (Marks)	Rating
1	60 & below	POOR
2	61-75	FAIR
3	76-90	GOOD
4	More than 90	VERY GOOD

Signature of Authorised Signatory:

Name:

Designation:

Instructions for allocation of marks

1. Marks are to be allocated as under :

1.1 DELIVERY/ COMPLETION PERFORMANCE **40 Marks**

Delivery Period/ Completion Schedule	Delay in Weeks	Marks
a) Upto 3 months	Before CDD	40
	Delay upto 4 weeks	35
	" 8 weeks	30
	" 10 weeks	25
	" 12 weeks	20
	" 16 weeks	15
	More than 16 weeks	0
b) Above 3 months	Before CDD	40
	Delay upto 4 weeks	35
	" 8 weeks	30
	" 10 weeks	25
	" 16 weeks	20
	" 20 weeks	15
	" 24 weeks	10
	More than 24 weeks	0

1.2 QUALITY PERFORMANCE **40 Marks**

For Normal Cases : No Defects/ No Deviation/ No failure: 40 marks

i) Rejection/Defects	Marks to be allocated on prorata basis for acceptable quantity as compared to total quantity for normal cases	10 marks
ii) When quality failure endanger system integration and safety of the system	Failure of severe nature	0 marks
	- Moderate nature	5 marks
	- low severe nature	10-25 marks
iii) Number of deviations	1. No deviation	5 marks
	2. No. of deviations $\leq$ 2	2 marks
	3. No. of deviations > 2	0 marks

1.3 RELIABILITY PERFORMANCE **20 Marks**

A.	**FOR WORKS/CONTRACTS**	
i)	Submission of order acceptance, agreement, PBG, Drawings and other documents within time	4 marks
ii)	Mobilization of resources as per Contract and in time	4 marks
iii)	Liquidation of Check-list points	4 marks

iv)	Compliance to statutory and HS&E requirements or Reliability of Estimates/Design/Drawing etc. in case of Consultancy jobs	4 marks
v)	Timely submission of estimates and other documents for Extra, Substituted & AHR items	4 marks
B.	**FOR SUPPLIES**	
i)	Submission of order acceptance, PBG, Drawings and other documents within time	5 marks
ii)	Attending complaints and requests for after sales service/ warranty repairs and/ or query/ advice (upto the evaluation period).	5 marks
iii)	Response to various correspondence and conformance to standards like ISO	5 marks
iv)	Submission of all required documents including Test Certificates at the time of supply	5 marks

Annexure-2

TALCHER FERTILIZERS LIMITED
PERFORMANCE RATING DATA SHEET
(FOR O&M)

i)	Location	:
ii)	Order/ Contract No. & date	:
iii)	Brief description of Items Works/Assignment	:
iv)	Order/Contract value (Rs.)	:
v)	Name of Vendor/Supplier/ Contractor/ Consultant	:
vi)	Contracted delivery/ Completion Schedule	:
vii)	Actual delivery/ Completion date	:

Performance Parameter	Delivery Performance	Quality Performance	Reliability Performance#	Total
Maximum Marks	40	40	20	100
Marks Allocated (*)				

Remarks (if any)

PERFORMANCE RATING (**)

Note :

(#) Vendor/Supplier/Contractor/Consultant who seek repeated financial assistance or deviation beyond contract payment term or seeking direct payment to the sub-vendor/sub-contractor due to financial constraints, then '0' marks should be allotted against Reliability Performance

(*) Allocation of marks should be as per enclosed instructions

(**) Performance rating shall be classified as under :

Sl. No.	Range (Marks)	Rating
1	60 & below	POOR
2	61-75	FAIR
3	76-90	GOOD
4	More than 90	VERY GOOD

Signature of
Authorised Signatory:

Name:

Designation:

Instructions for allocation of marks (For O&M)

1. Marks are to be allocated as under :

1.1 DELIVERY/ COMPLETION PERFORMANCE **40 Marks**

Delivery Period/ Completion Schedule	**Delay in Weeks**	**Marks**
a) Upto 3 months	Before CDD	40
	Delay upto 4 weeks	35

	” 8 weeks	30
	” 10 weeks	25
	” 12 weeks	20
	” 16 weeks	15
	More than 16 weeks	0
b) Above 3 months	Before CDD	40
	Delay upto 4 weeks	35
	” 8 weeks	30
	” 10 weeks	25
	” 16 weeks	20
	” 20 weeks	15
	” 24 weeks	10
	More than 24 weeks	0

1.2 QUALITY PERFORMANCE **40 Marks**

For Normal Cases : No Defects/ No Deviation/ No failure: 40 marks

i) Rejection/Defects	Marks to be allocated on prorata basis for acceptable quantity as compared to total quantity for normal cases	10 marks
ii) When quality failure endanger system integration and safety of the system	Failure of severe nature	0 marks
	- Moderate nature	5 marks
	- low severe nature	10-25 marks
iii) Number of deviations	1. No deviation	5 marks
	2. No. of deviations $\leq$ 2	2 marks
	3. No. of deviations > 2	0 marks

1.3 RELIABILITY PERFORMANCE **20 Marks**

A.	**FOR WORKS/CONTRACTS**	
i)	Submission of order acceptance, agreement, PBG, Drawings and other documents within time	4 marks
ii)	Mobilization of resources as per Contract and in time	4 marks
iii)	Liquidation of Check-list points	4 marks
iv)	Compliance to statutory and HS&E requirements or Reliability of Estimates/Design/Drawing etc. in	4 marks

	case of Consultancy jobs	
v)	Timely submission of estimates and other documents for Extra, Substituted & AHR items	4 marks
B.	**FOR SUPPLIES**	
i)	Submission of order acceptance, PBG, Drawings and other documents within time	5 marks
ii)	Attending complaints and requests for after sales service/ warranty repairs and/ or query/ advice (upto the evaluation period).	5 marks
iii)	Response to various correspondence and conformance to standards like ISO	5 marks
iv)	Submission of all required documents including Test Certificates at the time of supply	5 marks

Annexure-III

INSTRUCTIONS FOR SUBMISSION OF BID ONLINE THROUGH CPP PORTAL

1. The bidders are required to submit soft copies of their bids electronically on the CPP Portal, using valid Digital Signature Certificates. The instructions given below are meant to assist the bidders in registering on the CPP Portal, prepare their bids in accordance with the requirements and submitting their bids online on the CPP Portal.
   More information useful for submitting online bids on the CPP Portal may be obtained at: https://eprocure.gov.in/eprocure/app.

2. REGISTRATION
   i. Bidders are required to enroll on the e-Procurement module of the Central Public Procurement Portal (URL: https://eprocure.gov.in/eprocure/app) by clicking on the link “Online bidder Enrollment” on the CPP Portal which is free of charge.
   ii. As part of the enrollment process, the bidders will be required to choose a unique username and assign a password for their accounts.
   iii. Bidders are advised to register their valid email address and mobile numbers as part of the registration process. These would be used for any communication from the CPP Portal.
   iv. Bidders are advised to make ensure the accessibility & availability of java software in their system (PC) either download & install the latest version of java software or click on the below link to install the java in their system prior to proceed further.
   https://www.oracle.com/technetwork/java/javase/downloads/index.html
   v. Upon enrollment, the bidders will be required to register their valid Digital Signature Certificate (Class III Certificates with signing key usage) issued by any Certifying Authority recognized by CCA India (e.g. Sify / nCode / eMudhra etc.), with their profile.
   vi. Only one valid DSC should be registered by a bidder. Please note that the bidders are responsible to ensure that they do not lend their DSC’s to others which may lead to misuse.
   vii. Bidder then logs in to the site through the secured log-in by entering their user ID / password and the password of the DSC / e-Token.

3. SEARCHING FOR TENDER DOCUMENTS
   i. There are various search options built in the CPP Portal, to facilitate bidders to search active tenders by several parameters. These parameters could include Tender ID, Organization Name, Location, Date, Value, etc. There is also an option of advanced search for tenders, wherein the bidders may combine a number of search parameters such as Organization Name, Form of Contract, Location, Date, Other keywords etc. to search for a tender published on the CPP Portal.

ii. Once the bidders have selected the tenders they are interested in, they may download the required documents / tender schedules. These tenders can be moved to the respective 'My Tenders' folder. This would enable the CPP Portal to intimate the bidders through SMS / email in case there is any corrigendum issued to the tender document.

iii. The bidder should make a note of the unique Tender ID assigned to each tender, in case they want to obtain any clarification / help from the Helpdesk.

4. PREPARATION OF BIDS

i. Bidder should take into account any corrigendum published on the tender document before submitting their bids.

ii. Please go through the tender advertisement and the tender document carefully to understand the documents required to be submitted as part of the bid. Please note the number of covers in which the bid documents have to be submitted, the number of documents - including the names and content of each of the document that need to be submitted. Any deviations from these may lead to rejection of the bid.

iii. Bidder, in advance, should get ready the bid documents to be submitted as indicated in the tender document / schedule and generally, they can be in PDF / XLS / RAR / DWF/JPG formats. Bid documents may be scanned with 100 dpi with black and white option which helps in reducing size of the scanned document.

iv. To avoid the time and effort required in uploading the same set of standard documents which are required to be submitted as a part of every bid, a provision of uploading such standard documents (e.g. PAN card copy, annual reports, auditor certificates etc.) has been provided to the bidders. Bidders can use "My Space" or ''Other Important Documents'' area available to them to upload such documents. These documents may be directly submitted from the "My Space" area while submitting a bid, and need not be uploaded again and again. This will lead to a reduction in the time required for bid submission process.

Note: My Documents space is only a repository given to the Bidders to ease the uploading process. If Bidder has uploaded his Documents in My Documents space, this does not automatically ensure these Documents being part of Technical Bid.

5. SUBMISSION OF BIDS

i. Bidder should log into the site well in advance for bid submission so that they can upload the bid in time i.e. on or before the bid submission time. Bidder will be responsible for any delay due to other issues.

ii. The bidder has to digitally sign and upload the required bid documents one by one as indicated in the tender document.

iii. Bidder should submit Declaration for Bid security strictly as per format Form F-2 provided in the NIT.. Otherwise the uploaded bid will be rejected.

iv. Bidders are requested to note that they should necessarily submit their financial bids in the format provided and no other format is acceptable. If the price bid has been given as a standard SOR format with the tender document, then the same is to be downloaded and to be filled by all the bidders. Bidders are required to download the SOR file, open it and complete the white coloured (unprotected) cells with their respective financial quotes and other details (such as name of the bidder). No other cells should be changed. Once the details have been completed, the bidder should save it and submit it online, without changing the filename. If the SOR file is found to be modified by the bidder, the bid will be rejected.

v. The server time (which is displayed on the bidders' dashboard) will be considered as the standard time for referencing the deadlines for submission of the bids by the bidders, opening of bids etc. The bidders should follow this time during bid submission.

vi. All the documents being submitted by the bidders would be encrypted using PKI encryption techniques to ensure the secrecy of the data. The data entered cannot be viewed by unauthorized persons until the time of bid opening. The confidentiality of the bids is maintained using the secured Socket Layer 128 bit encryption technology. Data storage encryption of sensitive fields is done. Any bid document that is uploaded to the server is subjected to symmetric encryption using a system generated symmetric key. Further this key is subjected to asymmetric encryption using buyers/bid opener's public keys. Overall, the uploaded tender documents become readable only after the tender opening by the authorized bid openers.

vii. The uploaded tender documents become readable only after the tender opening by the authorized bid openers.

viii. Upon the successful and timely submission of bids (i.e. after Clicking "Freeze Bid Submission" in the portal), the portal will give a successful bid submission message & a bid summary will be displayed with the bid no. and the date & time of submission of the bid with all other relevant details.

ix. The bid summary has to be printed and kept as an acknowledgement of the submission of the bid. This acknowledgement may be used as an entry pass for any bid opening meetings.

6. <u>ASSISTANCE TO BIDDERS</u>

i. Any queries relating to the tender document and the terms and conditions contained therein should be addressed to the Tender Inviting Authority for a tender or the relevant contact person indicated in the tender.

ii. Any queries relating to the process of online bid submission or queries relating to CPP Portal in general may be directed to the 24x7 CPP Portal Helpdesk.

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ANNEXURE-IV

BIDDING DATA SHEET (BDS)

ITB TO BE READ IN CONJUNCTION WITH THE FOLLOWING:

A. GENERAL	
ITB clause	**Description**
1.2	The Invitation for Bid/ Tender is for **UREA (Neem Coated) HANDLING & BAGGING PACKAGE** AT TALCHER, ODISHA (INDIA)
1.1	The Employer/Owner is: The Employer/Owner is: Talcher Fertilizers Limited
2.1	The name of the Works/Services to be performed is: "Urea Handling & Bagging Package-Urea (Neem Oil Coated) Handling System, Bagging & Stitching Machine , Scraper Reclaimer, Bagging System including Filled Bags Stacking/ Loading to Wagon & Truck) and use of existing Silo" on LSTK basis.
3	BIDS FROM CONSORTIUM/ JOINT VENTURE: APPLICABLE ✗ NOT APPLICABLE ✓
B. BIDDING DOCUMENT	
ITB clause	**Description**
8.1	For **clarification purposes** only, the communication address is: M/s Projects & Development India Limited, P.D.I.L Bhawan, A-14, Sector-1, Noida, (PIN 201301) Dist. GautamBudh Nagar (UP). (India) Kind Attention: Mr. P.R.Sahu, Addl. General Manager (M.M) Fax no. : +91-120-2529801 Tel no. : +91-120-2544063 E-mail : prsahu@pdilin.com anjali@pdilin.com tanzin@pdilin.com
C. PREPARATION OF BIDS	
ITB clause	**Description**
11.1.1 (r)	Additional documents to be submitted by the Bidder with its Part-I (Techno-commercial/ Unpriced bid) : as per SCC/Scope of Work.

<table>
<tr><td>12 & 13</td><td>Whether TFL will be able to avail input tax credit in the instant tender

<table><tr><td>YES</td><td>✓</td></tr><tr><td>NO</td><td>✗</td></tr></table>
Details of Buyer:
<table><tr><td>Services to be rendered at</td><td>M/s Talcher Fertilizers Ltd. (TFL),
Administrative Building,
Talcher, Post: Vikrampur,
Dist: Angul, Pincode-759106,
Odisha</td></tr><tr><td>PAN No.</td><td>AAFCT8667A</td></tr><tr><td>GST no.</td><td>21AAFCT8667A1ZH</td></tr><tr><td>TFL Bank details</td><td>Account No.: 37088269547
Bank & Branch Name: SBI, CAG-II, New Delhi
IFSC Code: SBIN0017313</td></tr></table></td></tr>
<tr><td>14</td><td>The currency of the Bid shall be INR</td></tr>
<tr><td>15</td><td>The bid validity period shall be Six (6) Months from final 'Bid Due Date'.</td></tr>
<tr><td>~~16.1, 16.10~~ and 38.6</td><td>In case ~~'Earnest Money / Bid Security' or~~ “Contract Performance Security” is in the form of 'Demand Draft' or 'Banker's Cheque', the same should be favor of TFL (India) Limited, payable at _____

In case of submission through online banking transaction i.e. IMPS / NEFT / RTGS / SWIFT, etc, the details of TFL ’s Bank account are as under:
Account Holder’s Name:……
Account No.: 37088269547
Bank & Branch Name: SBI, CAG-II, New Delhi
IFSC Code: SBIN0017313
Bidder to mention reference no. “CPS/…….” in narration while remitting the CPS amount in TFL’s Bank Account.</td></tr>
<tr><td colspan="2">D. SUBMISSION AND OPENING OF BIDS</td></tr>
<tr><td>ITB clause</td><td>Description</td></tr>
<tr><td>18</td><td>In addition to the original of the Bid, the number of copies required is one. Not applicable in case of e-tendering.</td></tr>
</table>

<table>
<tr><td>4.0 of IFB</td><td>The submission of physical document as per clause no. 4.0 of IFB shall at following address: :
M/s Projects & Development India Limited,
P.D.I.L Bhawan, A-14, Sector-1,
Noida, (PIN 201301)
Dist. Gautam Budh Nagar (UP). (India)

Kind Attention:
Mr. P.R.Sahu, Addl. General Manager (M.M)
Fax no. : +91-120-2529801
Tel no. : +91-120-2544063</td></tr>
<tr><td colspan="2">E. EVALUATION, AND COMPARISON OF BIDS</td></tr>
<tr><td>ITB clause</td><td>Description</td></tr>
<tr><td>32</td><td>Evaluation Methodology is mentioned in Section-II.</td></tr>
<tr><td>33</td><td><table><tr><td>Compensation for Extended Stay: APPLICABLE</td><td>✗</td></tr><tr><td>NOT APPLICABLE</td><td>✓</td></tr></table></td></tr>
<tr><td colspan="2">F. AWARD OF CONTRACT</td></tr>
<tr><td>ITB clause</td><td>Description</td></tr>
<tr><td>37</td><td>State of India of which stamp paper is required for Contract Agreement: Uttar Pradesh.</td></tr>
<tr><td>38</td><td>Contract Performance Security/ Security Deposit

<table><tr><td>APPLICABLE</td><td>✓</td></tr><tr><td>NOT APPLICABLE</td><td>✗</td></tr></table>
<u>The value/ amount of Contract Performance Security/ Security Deposit:</u>

CPS/SD @ 3% of Total Order / Contract value</td></tr>
<tr><td>41</td><td>Provision of AHR Item :

<table><tr><td>APPLICABLE</td><td>✗</td></tr><tr><td>NOT APPLICABLE</td><td>✓</td></tr></table></td></tr>
</table>

<table>
<tr><td>44.1</td><td>Quarterly Closure of Contract:

<table><tr><td>APPLICABLE</td><td>✓</td></tr><tr><td>NOT APPLICABLE</td><td>✗</td></tr></table></td></tr>
<tr><td>49</td><td>Applicability of BEC relaxation relating to Startups:

<table><tr><td>APPLICABLE</td><td>✗</td></tr><tr><td>NOT APPLICABLE</td><td>✓</td></tr></table></td></tr>
</table>

Annexure-V

PUBLIC PROCUREMENT

(PREFERENCE TO MAKE IN INDIA), ORDER 2017

Annexure - V

No. P-45021/2/2017-PP (BE-II)
Government of India
Ministry of Commerce and Industry
Department for Promotion of Industry and Internal Trade
(Public Procurement Section)

Udyog Bhawan, New Delhi
Dated: 16th September, 2020

To

All Central Ministries/Departments/CPSUs/All concerned

ORDER

Subject: Public Procurement (Preference to Make in India), Order 2017– Revision; regarding.

Department for Promotion of Industry and Internal Trade, in partial modification [Paras 2, 3, 5, 10 & 13] of Order No.P-45021/2/2017-B.E.-II dated 15.6.2017 as amended by Order No.P-45021/2/2017-B.E.-II dated 28.05.2018, Order No.P-45021/2/2017-B.E.-II dated 29.05.2019 and Order No.P-45021/2/2017-B.E.-II dated 04.06.2020, hereby issues the revised 'Public Procurement (Preference to Make in India), Order 2017" dated 16.09.2020 effective with immediate effect.

Whereas it is the policy of the Government of India to encourage 'Make in India' and promote manufacturing and production of goods and services in India with a view to enhancing income and employment, and

Whereas procurement by the Government is substantial in amount and can contribute towards this policy objective, and

Whereas local content can be increased through partnerships, cooperation with local companies, establishing production units in India or Joint Ventures (JV) with Indian suppliers, increasing the participation of local employees in services and training them,

Now therefore the following Order is issued:

1. This Order is issued pursuant to Rule 153 (iii) of the General Financial Rules 2017.

2. **Definitions**: For the purposes of this Order:

   'Local content' means the amount of value added in India which shall, unless otherwise prescribed by the Nodal Ministry, be the total value of the item procured (excluding net domestic indirect taxes) minus the value of imported content in the item (including all customs duties) as a proportion of the total value, in percent.

   'Class-I local supplier' means a supplier or service provider, whose goods, services or works offered for procurement, meets the minimum local content as prescribed for 'Class-I local supplier' under this Order.

.....Contd. p/2

'Class-II local supplier' means a supplier or service provider, whose goods, services or works offered for procurement, meets the minimum local content as prescribed for 'Class-II local supplier' but less than that prescribed for 'Class-I local supplier' under this Order.

'Non - Local supplier' means a supplier or service provider, whose goods, services or works offered for procurement, has local content less than that prescribed for 'Class-II local supplier' under this Order.

'L1' means the lowest tender or lowest bid or the lowest quotation received in a tender, bidding process or other procurement solicitation as adjudged in the evaluation process as per the tender or other procurement solicitation.

'Margin of purchase preference' means the maximum extent to which the price quoted by a "Class-I local supplier" may be above the L1 for the purpose of purchase preference.

'Nodal Ministry' means the Ministry or Department identified pursuant to this order in respect of a particular item of goods or services or works.

'Procuring entity' means a Ministry or department or attached or subordinate office of, or autonomous body controlled by, the Government of India and includes Government companies as defined in the Companies Act.

'Works' means all works as per Rule 130 of GFR- 2017, and will also include *'turnkey works'*.

3. Eligibility of 'Class-I local supplier'/ 'Class-II local supplier'/ 'Non-local suppliers' for different types of procurement

(a) In procurement of all goods, services or works in respect of which the Nodal Ministry / Department has communicated that there is sufficient local capacity and local competition, only 'Class-I local supplier', as defined under the Order, shall be eligible to bid irrespective of purchase value.

(b) Only 'Class-I local supplier' and 'Class-II local supplier', as defined under the Order, shall be eligible to bid in procurements undertaken by procuring entities, except when Global tender enquiry has been issued. In global tender enquiries, 'Non-local suppliers' shall also be eligible to bid along with 'Class-I local suppliers' and 'Class-II local suppliers'. In procurement of all goods, services or works, not covered by sub-para 3(a) above, and with estimated value of purchases less than Rs. 200 Crore, in accordance with Rule 161(iv) of GFR, 2017, Global tender enquiry shall not be issued except with the approval of competent authority as designated by Department of Expenditure.

(c) For the purpose of this Order, works includes Engineering, Procurement and Construction (EPC) contracts and services include System Integrator (SI) contracts.

.....Contd. p/3

3A. Purchase Preference

(a) Subject to the provisions of this Order and to any specific instructions issued by the Nodal Ministry or in pursuance of this Order, purchase preference shall be given to 'Class-I local supplier' in procurements undertaken by procuring entities in the manner specified here under.

(b) In the procurements of goods or works, which are covered by para 3(b) above and which are divisible in nature, the 'Class-I local supplier' shall get purchase preference over 'Class-II local supplier' as well as 'Non-local supplier', as per following procedure:

i. Among all qualified bids, the lowest bid will be termed as L1. If L1 is 'Class-I local supplier', the contract for full quantity will be awarded to L1.

ii. If L1 bid is not a 'Class-I local supplier', 50% of the order quantity shall be awarded to L1. Thereafter, the lowest bidder among the 'Class-I local supplier' will be invited to match the L1 price for the remaining 50% quantity subject to the Class-I local supplier's quoted price falling within the margin of purchase preference, and contract for that quantity shall be awarded to such 'Class-I local supplier' subject to matching the L1 price. In case such lowest eligible 'Class-I local supplier' fails to match the L1 price or accepts less than the offered quantity, the next higher 'Class-I local supplier' within the margin of purchase preference shall be invited to match the L1 price for remaining quantity and so on, and contract shall be awarded accordingly. In case some quantity is still left uncovered on Class-I local suppliers, then such balance quantity may also be ordered on the L1 bidder.

(c) In the procurements of goods or works, which are covered by para 3(b) above and which are not divisible in nature, and in procurement of services where the bid is evaluated on price alone, the 'Class-I local supplier' shall get purchase preference over 'Class-II local supplier' as well as 'Non-local supplier', as per following procedure:

i. Among all qualified bids, the lowest bid will be termed as L1. If L1 is 'Class-I local supplier', the contract will be awarded to L1.

ii. If L1 is not 'Class-I local supplier', the lowest bidder among the 'Class-I local supplier', will be invited to match the L1 price subject to Class-I local supplier's quoted price falling within the margin of purchase preference, and the contract shall be awarded to such 'Class-I local supplier' subject to matching the L1 price.

iii. In case such lowest eligible 'Class-I local supplier' fails to match the L1 price, the 'Class-I local supplier' with the next higher bid within the margin of purchase preference shall be invited to match the L1 price and so on and contract shall be awarded accordingly. In case none of the 'Class-I local supplier' within the margin of purchase preference matches the L1 price, the contract may be awarded to the L1 bidder.

.....Contd. p/4

(d) "Class-II local supplier" will not get purchase preference in any procurement, undertaken by procuring entities.

3B. Applicability in tenders where contract is to be awarded to multiple bidders - In tenders where contract is awarded to multiple bidders subject to matching of L1 rates or otherwise, the 'Class-I local supplier' shall get purchase preference over 'Class-II local supplier' as well as 'Non-local supplier', as per following procedure:

a) In case there is sufficient local capacity and competition for the item to be procured, as notified by the nodal Ministry, only Class I local suppliers shall be eligible to bid. As such, the multiple suppliers, who would be awarded the contract, should be all and only 'Class I Local suppliers'.

b) In other cases, 'Class II local suppliers' and 'Non local suppliers' may also participate in the bidding process along with 'Class I Local suppliers' as per provisions of this Order.

c) If 'Class I Local suppliers' qualify for award of contract for at least 50% of the tendered quantity in any tender, the contract may be awarded to all the qualified bidders as per award criteria stipulated in the bid documents. However, in case 'Class I Local suppliers' do not qualify for award of contract for at least 50% of the tendered quantity, purchase preference should be given to the 'Class I local supplier' over 'Class II local suppliers'/ 'Non local suppliers' provided that their quoted rate falls within 20% margin of purchase preference of the highest quoted bidder considered for award of contract so as to ensure that the 'Class I Local suppliers' taken in totality are considered for award of contract for at least 50% of the tendered quantity.

d) First purchase preference has to be given to the lowest quoting 'Class-I local supplier', whose quoted rates fall within 20% margin of purchase preference, subject to its meeting the prescribed criteria for award of contract as also the constraint of maximum quantity that can be sourced from any single supplier. If the lowest quoting 'Class-I local supplier', does not qualify for purchase preference because of aforesaid constraints or does not accept the offered quantity, an opportunity may be given to next higher 'Class-I local supplier', falling within 20% margin of purchase preference, and so on.

e) To avoid any ambiguity during bid evaluation process, the procuring entities may stipulate its own tender specific criteria for award of contract amongst different bidders including the procedure for purchase preference to 'Class-I local supplier' within the broad policy guidelines stipulated in sub-paras above.

4. **Exemption of small purchases**: Notwithstanding anything contained in paragraph 3, procurements where the estimated value to be procured is less than Rs. 5 lakhs shall be exempt from this Order. However, it shall be ensured by procuring entities that procurement is not split for the purpose of avoiding the provisions of this Order.

5. **Minimum local content**: The 'local content' requirement to categorize a supplier as 'Class-I local supplier' is minimum 50%. For 'Class-II local supplier', the 'local content' requirement is minimum 20%. Nodal Ministry/ Department may prescribe only a higher

.....Contd. p/5

percentage of minimum local content requirement to categorize a supplier as 'Class-I local supplier'/ 'Class-II local supplier'. For the items, for which Nodal Ministry/ Department has not prescribed higher minimum local content notification under the Order, it shall be 50% and 20% for 'Class-I local supplier'/ 'Class-II local supplier' respectively.

6. **Margin of Purchase Preference**: The margin of purchase preference shall be 20%.

7. **Requirement for specification in advance**: The minimum local content, the margin of purchase preference and the procedure for preference to Make in India shall be specified in the notice inviting tenders or other form of procurement solicitation and shall not be varied during a particular procurement transaction.

8. **Government E-marketplace**: In respect of procurement through the Government E-marketplace (GeM) shall, as far as possible, specifically mark the items which meet the minimum local content while registering the item for display, and shall, wherever feasible, make provision for automated comparison with purchase preference and without purchase preference and for obtaining consent of the local supplier in those cases where purchase preference is to be exercised.

9. **Verification of local content**:

   a. The 'Class-I local supplier'/ 'Class-II local supplier' at the time of tender, bidding or solicitation shall be required to indicate percentage of local content and provide self-certification that the item offered meets the local content requirement for 'Class-I local supplier'/ 'Class-II local supplier', as the case may be. They shall also give details of the location(s) at which the local value addition is made.

   b. In cases of procurement for a value in excess of Rs. 10 crores, the 'Class-I local supplier'/ 'Class-II local supplier' shall be required to provide a certificate from the statutory auditor or cost auditor of the company (in the case of companies) or from a practicing cost accountant or practicing chartered accountant (in respect of suppliers other than companies) giving the percentage of local content.

   c. Decisions on complaints relating to implementation of this Order shall be taken by the competent authority which is empowered to look into procurement-related complaints relating to the procuring entity.

   d. Nodal Ministries may constitute committees with internal and external experts for independent verification of self-declarations and auditor's/ accountant's certificates on random basis and in the case of complaints.

   e. Nodal Ministries and procuring entities may prescribe fees for such complaints.

   f. False declarations will be in breach of the Code of Integrity under Rule 175(1)(i)(h) of the General Financial Rules for which a bidder or its successors can be debarred for up to two years as per Rule 151 (iii) of the General Financial Rules along with such other actions as may be permissible under law.

.....Contd. p/6

g. A supplier who has been debarred by any procuring entity for violation of this Order shall not be eligible for preference under this Order for procurement by any other procuring entity for the duration of the debarment. The debarment for such other procuring entities shall take effect prospectively from the date on which it comes to the notice of other procurement entities, in the manner prescribed under paragraph 9h below.

h. The Department of Expenditure shall issue suitable instructions for the effective and smooth operation of this process, so that:

   i. The fact and duration of debarment for violation of this Order by any procuring entity are promptly brought to the notice of the Member-Convenor of the Standing Committee and the Department of Expenditure through the concerned Ministry /Department or in some other manner;

   ii. on a periodical basis such cases are consolidated and a centralized list or decentralized lists of such suppliers with the period of debarment is maintained and displayed on website(s);

   iii. in respect of procuring entities other than the one which has carried out the debarment, the debarment takes effect prospectively from the date of uploading on the website(s) in the such a manner that ongoing procurements are not disrupted.

10. **Specifications in Tenders and other procurement solicitations**:

a. Every procuring entity shall ensure that the eligibility conditions in respect of previous experience fixed in any tender or solicitation do not require proof of supply in other countries or proof of exports.

b. Procuring entities shall endeavour to see that eligibility conditions, including on matters like turnover, production capability and financial strength do not result in unreasonable exclusion of 'Class-I local supplier'/ 'Class-II local supplier' who would otherwise be eligible, beyond what is essential for ensuring quality or creditworthiness of the supplier.

c. Procuring entities shall, within 2 months of the issue of this Order review all existing eligibility norms and conditions with reference to sub-paragraphs 'a' and 'b' above.

d. Reciprocity Clause

   i. When a Nodal Ministry/Department identifies that Indian suppliers of an item are not allowed to participate and/ or compete in procurement by any foreign government, due to restrictive tender conditions which have direct or indirect effect of barring Indian companies such as registration in the procuring country, execution of projects of specific value in the procuring country etc., it shall provide such details to all its procuring entities including CMDs/CEOs of PSEs/PSUs, State Governments and other procurement agencies under their administrative control and GeM for appropriate reciprocal action.

.....Contd. p/7

ii. Entities of countries which have been identified by the nodal Ministry/Department as not allowing Indian companies to participate in their Government procurement for any item related to that nodal Ministry shall not be allowed to participate in Government procurement in India for all items related to that nodal Ministry/ Department, except for the list of items published by the Ministry/ Department permitting their participation.

iii. The stipulation in (ii) above shall be part of all tenders invited by the Central Government procuring entities stated in (i) above. All purchases on GeM shall also necessarily have the above provisions for items identified by nodal Ministry/ Department.

iv. State Governments should be encouraged to incorporate similar provisions in their respective tenders.

v. The term 'entity' of a country shall have the same meaning as under the FDI Policy of DPIIT as amended from time to time.

e. Specifying foreign certifications/ unreasonable technical specifications/ brands/ models in the bid document is restrictive and discriminatory practice against local suppliers. If foreign certification is required to be stipulated because of non-availability of Indian Standards and/or for any other reason, the same shall be done only after written approval of Secretary of the Department concerned or any other Authority having been designated such power by the Secretary of the Department concerned.

f. "All administrative Ministries/Departments whose procurement exceeds *Rs.* 1000 Crore per annum shall notify/ update their procurement projections every year, including those of the PSEs/PSUs, for the next 5 years on their respective website."

10A. Action for non-compliance of the Provisions of the Order: In case restrictive or discriminatory conditions against domestic suppliers are included in bid documents, an inquiry shall be conducted by the Administrative Department undertaking the procurement (including procurement by any entity under its administrative control) to fix responsibility for the same. Thereafter, appropriate action, administrative or otherwise, shall be taken against erring officials of procurement entities under relevant provisions. Intimation on all such actions shall be sent to the Standing Committee.

11. **Assessment of supply base by Nodal Ministries**: The Nodal Ministry shall keep in view the domestic manufacturing / supply base and assess the available capacity and the extent of local competition while identifying items and prescribing the higher minimum local content or the manner of its calculation, with a view to avoiding cost increase from the operation of this Order.

12. **Increase in minimum local content**: The Nodal Ministry may annually review the local content requirements with a view to increasing them, subject to availability of sufficient local competition with adequate quality.

.....Contd. p/8

13. **Manufacture under license/ technology collaboration agreements with phased indigenization**: While notifying the minimum local content, Nodal Ministries may make special provisions for exempting suppliers from meeting the stipulated local content if the product is being manufactured in India under a license from a foreign manufacturer who holds intellectual property rights and where there is a technology collaboration agreement / transfer of technology agreement for indigenous manufacture of a product developed abroad with clear phasing of increase in local content.

13A. In procurement of all goods, services or works in respect of which there is substantial quantity of public procurement and for which the nodal ministry has not notified that there is sufficient local capacity and local competition, the concerned nodal ministry shall notify an upper threshold value of procurement beyond which foreign companies shall enter into a joint venture with an Indian company to participate in the tender. Procuring entities, while procuring such items beyond the notified threshold value, shall prescribe in their respective tenders that foreign companies may enter into a joint venture with an Indian company to participate in the tender. The procuring Ministries/Departments shall also make special provisions for exempting such joint ventures from meeting the stipulated minimum local content requirement, which shall be increased in a phased manner.

14. **Powers to grant exemption and to reduce minimum local content**: The administrative Department undertaking the procurement (including procurement by any entity under its administrative control), with the approval of their Minister-in-charge, may by written order, for reasons to be recorded in writing,

    a. reduce the minimum local content below the prescribed level; or
    b. reduce the margin of purchase preference below 20%; or
    c. exempt any particular item or supplying entities from the operation of this Order or any part of the Order.

    A copy of every such order shall be provided to the Standing Committee and concerned Nodal Ministry / Department. The Nodal Ministry / Department concerned will continue to have the power to vary its notification on Minimum Local Content.

15. **Directions to Government companies**: In respect of Government companies and other procuring entities not governed by the General Financial Rules, the administrative Ministry or Department shall issue policy directions requiring compliance with this Order.

16. **Standing Committee**: A standing committee is hereby constituted with the following membership:

    Secretary, Department for Promotion of Industry and Internal Trade—Chairman
    Secretary, Commerce—Member
    Secretary, Ministry of Electronics and Information Technology—Member
    Joint Secretary (Public Procurement), Department of Expenditure—Member
    Joint Secretary (DPIIT)—Member-Convenor

.....Contd. p/9

The Secretary of the Department concerned with a particular item shall be a member in respect of issues relating to such item. The Chairman of the Committee may co-opt technical experts as relevant to any issue or class of issues under its consideration.

17. **Functions of the Standing Committee**: The Standing Committee shall meet as often as necessary, but not less than once in six months. The Committee

    a. shall oversee the implementation of this order and issues arising therefrom, and make recommendations to Nodal Ministries and procuring entities.
    b. shall annually assess and periodically monitor compliance with this Order
    c. shall identify Nodal Ministries and the allocation of items among them for issue of notifications on minimum local content
    d. may require furnishing of details or returns regarding compliance with this Order and related matters
    e. may, during the annual review or otherwise, assess issues, if any, where it is felt that the manner of implementation of the order results in any restrictive practices, cartelization or increase in public expenditure and suggest remedial measures
    f. may examine cases covered by paragraph 13 above relating to manufacture under license/ technology transfer agreements with a view to satisfying itself that adequate mechanisms exist for enforcement of such agreements and for attaining the underlying objective of progressive indigenization
    g. may consider any other issue relating to this Order which may arise.

18. **Removal of difficulties**: Ministries /Departments and the Boards of Directors of Government companies may issue such clarifications and instructions as may be necessary for the removal of any difficulties arising in the implementation of this Order.

19. **Ministries having existing policies**: Where any Ministry or Department has its own policy for preference to local content approved by the Cabinet after 1st January 2015, such policies will prevail over the provisions of this Order. All other existing orders on preference to local content shall be reviewed by the Nodal Ministries and revised as needed to conform to this Order, within two months of the issue of this Order.

20. **Transitional provision**: This Order shall not apply to any tender or procurement for which notice inviting tender or other form of procurement solicitation has been issued before the issue of this Order.

(Rajesh Gupta)
Director
Tel: 23063211
rajesh.gupta66@gov.in

FORM – I of ANNEXURE V

CERTIFICATE FROM STATUTORY AUDITOR OR COST AUDITOR OF THE COMPANY (IN THE CASE OF COMPANIES) OR FROM A PRACTICING COST ACCOUNTANT OR PRACTICING CHARTERED ACCOUNTANT (IN RESPECT OF SUPPLIERS OTHER THAN COMPANIES) TOWARDS MINIMUM LOCAL CONTENT

(FOR SUPPLY OF GOODS/ SERVICES / WORKS / EPC / LSTK)

To,
M/s Talcher Fertilizers Limited

SUB:

TENDER NO:

Dear Sir

A. We……. the Statutory Auditor / Cost Auditor / Practicing Cost Accountant / Practicing Chartered Accountant) have verified relevant records of M/s ……. **(Name of the bidder)** and certify that M/s …… **(Name of the bidder)** meets the following:

Sl. No.	Description	Confirmation
a	Bidder meets the mandatory minimum Local content requirement of 20% for participating in the Bidding process under Public Procurement (Preference to Make in India) Policy. (In case bidder does not meet the minimum Local content requirement of 20%, such bidders are not allowed to participate in the Bidding process)	Confirmed.
b	The bidder meets mandatory minimum Local content requirement of 50% for claiming purchase preference under Public Procurement (Preference to Make in India) Policy	Confirmed / Not Confirmed

B. The **details of the location** at which the local value addition is made as follows:

Sl. No.	Item Description	Details of the Location(s) where the local value addition is made
1.		
2.		
3.		

Name of Audit Firm / Chartered Accountant: [Signature of Authorized Signatory]
Name:
Date: Designation:
Seal:

Membership No.:
UDIN:

FORM-II of ANNEXURE-V

Salient Points of Public Procurement (Preference to Make in India) Policy

Sr. No.	Description	Parameter / Document
1	**Minimum Local Content (LC) for Availing Preference under this Policy**	50%
2	**Margin of Purchase Preference**	20%
3	**Local Content (LC) % declared by bidder** (Documents to be submitted as per Sr. No. 4 below)	[Tick **(✓)** whichever is applicable] a) LC Equal to or more than 50% ☐ b) LC More than 20% but less than 50% ☐
4	**Documents to be submitted by bidder under this Policy**	Certificate from the statutory auditor or cost auditor of the company (in case of companies) or from a practicing cost accountant or practicing chartered accountant as per Form-I to be submitted by bidder.
5	**Whether tender is divisible or not divisible**	Not Divisible; Clause No. 3A (c) of revised Policy dated 16.09.2020 shall be applicable

Annexure-VI

PREAMBLE TO SCHEDULE OF RATES

1. The “Schedule of Rates (SOR)” will be in Excel format (password protected) and will be uploaded during tender creation. This will be downloaded by the bidder and bidder will quote price on this Excel file for entire scope of work as per NIT. Thereafter, the bidder will upload the same Excel file during bid submission.

2. The SOR format is provided in a spread sheet file (BoQ_xxxx.xls). The rates offered should be entered in the allotted space only and uploaded after filling the relevant columns. The SOR
template must not be modified / replaced by the bidder; else the bid submitted shall be rejected.

3. Bidder shall quote all Prices in INR only.

4. SOR consists of following two sheets:
   - Annexure A: Schedule of Rates containing Total Lumpsump Turnkey Price/ TOTAL CONTRACT PRICE & GST
   - Annexure-B: Guaranteed Consumption Figures

5. It is mandatory to quote prices in SOR and fill up figures in Annexure-A & Annexure-B listed in Para 4. It will be the responsibility of the contractor to quote for all Materials/ Equipments /Services/Civil & Structural Works etc. as per scope of work defined in NIT.

6. CONTRACTOR shall be responsible for payment of all taxes, duties and levies as applicable on performance of WORK under CONTRACT and shall be included in the quoted TOTAL LSTK PRICE /TOTAL CONTRACT PRICE.

7. A copy of SOR, with prices/figures completely blanked out but with the word “QUOTED” in all columns is to be uploaded along with the unpriced bid, as a confirmation of price/data quoted against each head.

Annexure-VII

PROCUREMENT FROM A BIDDER WHICH SHARES A LAND BORDER WITH INDIA

1. Order (Public Procurement No. 1) dated 23.07.2020, Order (Public Procurement No.2) dated 23.07.2020 and Order (Public Procurement No. 3) dated 24.07.2020, Department of Expenditure, Ministry of Finance, Govt. of India refers. The same are available at web-site https://doe.gov.in/procurement-policy-divisions.

2. Any bidder from a country which shares a land border with India will be eligible to bid in this tender only if the bidder is registered with the Competent Authority. For details of competent authority refer to Annexure I of Order (Public Procurement No. 1) dated 23.07.2020.

   Further the above will not apply to bidders from those countries (even if sharing a land border with India) to which the Government of India has extended lines of credit or in which the Government of India is engaged in development projects. Updated lists of countries to which lines of credit have been extended or in which development projects are undertaken are given in the website of the Ministry of External Affairs, Govt. of India

3. "Bidder" (including the term 'tenderer', 'consultant' 'vendor' or 'service provider' in certain contexts) for purpose of this provision means any person or firm or company, including any member of a consortium or joint venture (that is an association of several persons, or firms or companies), every artificial juridical person not falling in any of the descriptions of bidders stated hereinbefore, including any agency, branch or office controlled by such person, participating in a procurement process.

4. "Bidder from a country which shares a land border with India" for the purpose of this:

   a) An entity incorporated, established or registered in such a country; or
   b) A subsidiary of an entity incorporated, established or registered in such a country; or
   c) An entity substantially controlled through entities incorporated, established or registered in such a country; or
   d) An entity whose beneficial owner is situated in such a country; or
   e) An Indian (or other) agent of such an entity; or
   f) A natural person who is a citizen of such a country; or
   g) A consortium or joint venture where any member of the consortium or joint venture falls under any of the above

5. **"Beneficial owner"** for the purpose of above (4) will be as under:

   i) In case of a company or Limited Liability Partnership, the beneficial owner is the natural person(s), who, whether acting alone or together, or through one or more juridical person(s), has a controlling ownership interest or who

exercises control through other means.

Explanation-

a) "Controlling ownership interest" means ownership of, or entitlement to, more than twenty-five per cent of shares or capital or profits of the company;

b) "Control" shall include the right to appoint the majority of the directors or to control the management or policy decisions, including by virtue of their shareholding or management rights or shareholders agreements or voting agreements;

ii) In case of a partnership firm, the beneficial owner is the natural person(s) who, whether acting alone or together, or through one or more juridical person, has ownership of entitlement to more than fifteen percent of capital or profits of the partnership;

iii) In case of an unincorporated association or body of individuals, the beneficial owner is the natural person(s), who, whether acting alone or together, or through one or more juridical person, has ownership of or entitlement to more than fifteen percent of the property or capital or profits of such association or body of individuals;

iv) Where no natural person is identified under (i) or (ii) or (iii) above, the beneficial owner is the relevant natural person who holds the position of senior managing official;

v) In case of a trust, the identification of beneficial owner(s) shall include identification of the author of the trust, the trustee, the beneficiaries with fifteen percent or more interest in the trust and any other natural person exercising ultimate effective control over the trust through a chain of control or ownership.

6. **"Agent"** for the purpose of this Order is a person employed to do any act for another, or to represent another in dealings with third persons

7. **SUBMISSION OF CERTIFICATE IN BIDS:**

Bidder shall submit a certificate in this regard as Form-I to Annexure-VII.

If such certificate given by a bidder whose bid is accepted is found to be false, this would be a ground for immediate rejection of the bid/termination and further action as per "Procedure for Action in case of Corrupt/Fraudulent/ Collusive / Coercive Practices" of tender document.

8. The registration, wherever applicable, should be valid at the time of submission of bids and at the time of acceptance of bids. In respect of supply otherwise than by tender, registration should be valid at the time of placement of order. If the bidder was validly registered at the time of acceptance / placement of order, registration shall not be a relevant consideration during contract execution.

9. **PROVISION FOR WORKS CONTRACTS, INCLUDING TURNKEY CONTRACTS:**

The successful bidder shall not be allowed to sub-contract works to any contractor from a country which shares a land border with India unless such contractor is registered with the Competent Authority. The definition of "contractor from a country which shares a land border with India" shall be as in Para 4 herein above. A Certificate to this regard is to be submitted by bidder is placed at Form-II

Form-I to AnnexureVII

UNDERTAKING ON LETTERHEAD

To,
M/s Talcher Fertilizers LIMITED

_____

SUB:

TENDER NO:

Dear Sir

We have read the clause regarding Provisions for Procurement from a Bidder of a country which shares a land border with India and on sub-contracting to contractors from such countries; we certify that, bidder M/s_____ ***(Name of Bidder)*** is:

(i)	not from such a country	[ ]
(ii)	if from such a country, has been registered with the Competent Authority. (Evidence of valid registration by the Competent Authority shall be attached)	[ ]

(Bidder is to tick appropriate option (✓or X) above).

We further certify that bidder **M/s_____ (Name of Bidder)** will not sub-contract any work to a contractor from such countries unless such contractor is registered with the Competent Authority.

We hereby certify that bidder **M/s_____ (Name of Bidder)** fulfills all requirements in this regard and is eligible to be considered.

Place:
Date:

[Signature of Authorized Signatory of Bidder]
Name:
Designation:
Seal:

FORMS & FORMATS

LIST OF FORMS & FORMATS

Form No.	Description
F-1	BIDDER'S GENERAL INFORMATION
F-2	FORMAT OF " DECLARATION FOR BID SECURITY "
F-3	LETTER OF AUTHORITY
F-4	PROFORMA OF "BANK GUARANTEE" FOR "CONTRACT PERFORMANCE SECURITY / SECURITY DEPOSIT"
F-5	AGREED TERMS & CONDITIONS
F-6	ACKNOWLEDGEMENT CUM CONSENT LETTER
F-7	BIDDER'S EXPERIENCE
F-8	CHECKLIST
F-8(B)	CHECKLIST FOR BID EVALUATION CRITERIA (BEC) QUALIFYING DOCUMENTS
F-9	FORMAT FOR CERTIFICATE FROM BANKIF BIDDER'S WORKING CAPITAL IS INADEQUATE
F-10	FORMAT FOR CHARTERED ACCOUNTANT CERTIFICATE FOR FINANCIAL CAPABILITY OF THE BIDDER
F-11	FORMAT FOR CONSORTIUM AGREEMENT(ON NON- JUDICIAL STAMP PAPER OF APPROPRIATE VALUE)CONSORTIUM/ JV AGREEMENT- **NOT APPLICABLE**
F-12	BIDDER'S QUERIES FOR PRE BID MEETING
F-13	E-BANKING FORMAT
F-14	INTEGRITY PACT
F-15	INDEMNITY BOND
F-16	FREQUENTLY ASKED QUESTIONS (FAQS)
F-17	PROFORMA OF BANK GUARANTEE FOR MOBILISATIONS ADVANCE PAYMENT
F-18	PROFORMA OF BANK GUARANTEE FOR PAYMENTS TOWARDS PLACEMENT OF ALL PURCHASE ORDERS OF MAJOR TAGGED ITEMS
F-19	FORMAT OF LETTER OF NO DEVIATIONS
F-20	FORMAT FOR POWER OF ATTORNEY
F-21	UNDERTAKING REGARDING SUBMISSION OF ELECTRONIC INVOICE(E-INVOICE AS PER GST LAW)
F-22	UNDERTAKING REGARDING SUBMISSION CONTRACT PERFORMANCE SECURITY (CPS) / SECURITY DEPOSIT (SD) WITHIN STIPULATED TIME LINE

F-23	PROFORMA FOR CONTRACT AGREEMENT

F-1

BIDDER'S GENERAL INFORMATION

To,
M/s TALCHER FERTILIZERS LIMITED,
NOIDA

TENDER NO:

1	Bidder Name:	M/s…..
2	Status of Firm	Proprietorship Firm/Partnership firm/ Public Limited/ Pvt. Limited/ Govt. Dept. / PSU/ Others If Others Specify:_____ [Enclose relevant certificates / partnership deed/certificate of Registration, as applicable]
3	Name of Proprietor/ Partners/ Directors of the firm/company	1. 2. 3.
4	Name of Power of Attorney holders of bidder	
5	Number of Years in Operation	
6	Address of Registered Office	_____ City: _____ District: _____ State: _____ PIN~~/ZIP~~ :_____
7	Bidder's address where order/contract is to be placed	_____ City: _____ District: _____ State: _____ PIN~~/ZIP~~ :_____
8	Office responsible for executing the contract with GST no.(In case supply of works are from multiple locations, addresses and GST no. of all such locations are to be provided)	City: District: State: PIN~~/ZIP~~: GST No.:
9	Telephone Number & Contact Information of address where order is to be placed	_____ (Country Code) (Area Code) (Telephone Number) FAX No. : ……

		e-mail ID: ……
10	E-mail Address	
11	ISO Certification, if any {If yes, please furnish details}	
12	PAN No	[Enclose copy of relevant document]
13	GST No. (refer sl. no. 8 above)	[Enclose copy of relevant document]
14	EPF Registration No.	[Enclose copy of relevant document]
15	ESI code No.	[Enclose copy of relevant document]
16	Whether Micro or Small Enterprise	Yes / No (*If Yes, Bidder to submit requisite documents as specified it ITB: Clause No. 40*)
	Whether MSE is owned by SC/ST Entrepreneur(s)	Yes / No (*If Yes, Bidder to submit requisite documents as specifie it ITB: Clause No. 40*)
	Whether MSE is owned by Women	Yes / No (*If Yes, Bidder to submit requisite documents as specifie it ITB: Clause No. 40*)
17	Whether Bidder is Startups or not	Yes / No (*If Yes, Bidder to submit requisite documents as specifie it ITB: Clause No. 49*)
18	In case of Start-up confirm the following: (i) Date of its incorporation/ registration (ii) Whether turnover for any financial years since incorporation/ registration has exceeded Rs.100 Crores.	

Note: * *TFL intent to place the contract directly on the address from where Works are to be supplied. In case, bidder wants contract at some other address or Worksare to supplied from multiple locations, bidder is required to provide in their bid, the address on which contract is to be placed.*

Place:
Date:

[Signature of Authorized Signatory of Bidder]

Name:

Designation:

Seal:

FORMAT F-2

DECLARATION FOR BID SECURITY

(To be submitted on Letter head of Bidder)

To,

M/s TALCHER FERTILIZERS LIMITED

_____

SUB:

TENDER NO:

Dear Sir,

After examining / reviewing provisions of above referred tender documents (including all corrigendum/ Addenda), we M/s_____ (Name of Bidder) have submitted our offer/ bid no._____.

We, M/s_____ (Name of Bidder) hereby understand that, according to your conditions, we are submitting this Declaration for Bid Security.

We understand that we will be put on watch list/holiday/ banning list (as per polices of TALCHER FERTILIZERS LIMITED in this regard), if we are in breach of our obligation(s) as per following:

(a) have withdrawn/modified/amended, impairs or derogates from the tender, my/our Bid during the period of bid validity specified in the form of Bid; or

(b) having been notified of the acceptance of our Bid by the TALCHER FERTILIZERS LIMITED during the period of bid validity:
   (i) fail or refuse to execute the Contract, if required, or
   (ii) fail or refuse to furnish the Contract Performance Security, in accordance provisions of tender document.
   (iii) fail or refuse to accept 'arithmetical corrections' as per provision of tender document.

(c) having indulged in corrupt/fraudulent /collusive/coercive practice as per procedure.

Place:
Date:

[Signature of Authorized Signatory of Bidder]
Name:
Designation:

Seal

F-3

LETTER OF AUTHORITY

[Pro forma for Letter of Authority for Attending 'Pre-Bid Meetings' /'Un-priced Bid Opening' / 'Price Bid Opening']

Ref: Date:

To,
M/s TALCHER FERTILIZERS LIMITED,
NOIDA

SUB:
TENDER NO:

Dear Sir,
I/We, _____ hereby authorize the following representative(s) for attending any 'Meetings [Pre-Bid Meeting]', 'Un-priced Bid Opening' and 'Price Bid Opening' against the above Tender Documents:

[1] Name & Designation _____ Signature _____
Phone/Cell:

E-mail: …….. @ ……

[2] Name & Designation _____ Signature _____
Phone/Cell:

E-mail: …….. @ ……

We confirm that we shall be bound by all commitments made by aforementioned authorised representative(s).

Place: [Signature of Authorized Signatory of Bidder]
Date: Name:
Designation:
Seal:

(i) Note: This "Letter of Authority" should be on the **"letter head"** of the Bidder and should be signed by a person competent and having the 'Power of Attorney' to bind the Bidder. Not more than 'two [02] persons per Bidder' are permitted to attend 'Pre-Bid Meetings' /'Un-priced Bid Opening' / 'Price Bid Opening'..

(ii) Bidder's authorized representative is required to carry a copy of this authority letter while attending the 'Pre-Bid Meetings' /'Un-priced Bid Opening .

F-4

PROFORMA OF "BANK GUARANTEE" FOR "CONTRACT PERFORMANCE SECURITY / SECURITY DEPOSIT"
(ON NON-JUDICIAL STAMP PAPER OF APPROPRIATE VALUE)

To, M/s Talcher Fertilizers Limited, Noida	**Bank Guarantee No.**	
	Date of BG	
	BG Valid up to	
	Claim period up to (There should be three months gap between expiry date of BG & Claim period)	
	Stamp Sl. No./e-Stamp Certificate No.	

Dear Sir(s),

M/s. _____ having registered office at _____ (herein after called the "contractor" which expression shall wherever the context so require include its successors and assignees) have been placed/ awarded the job/work of _____ vide LOA /FOA No. _____dated_____ for Talcher Fertilizers LImited having registered office at Plot 2/H, Kalpana Area, BJB Nagar, Khorda, Bhubaneswar-751014, Odisha (herein after called the "TFL" which expression shall wherever the context so require include its successors and assignees).

The Contract conditions provide that the CONTRACTOR shall pay a sum of Rs. _____ (Rupees _____) as full Contract Performance Guarantee in the form therein mentioned. The form of payment of Contract Performance Guarantee includes guarantee executed by Nationalized Bank/Scheduled Commercial Bank, undertaking full responsibility to indemnify Talcher Fertilizers Limited, in case of default.

The said M/s._____ has approached us and at their request and in consideration of the premises we having our office at _____ have agreed to give such guarantee as hereinafter mentioned.

1. We_____ hereby undertake to give the irrevocable & unconditional guarantee to you that if default shall be made by M/s. _____ in performing any of the terms and conditions of the tender/order/contract or in payment of any money payable to Talcher Fertilizers Limited we shall on first demand pay without demur, contest, protest and/ or without any recourse to the contractor to TFL in such manner as TFL may direct the said amount of Rupees _____ only or such portion thereof not exceeding the said sum as you may require from time to time.

2. You will have the full liberty without reference to us and without affecting this guarantee, postpone for any time or from time to time the exercise of any of the powers and rights

conferred on you under the order/contract with the said M/s. _____ and to enforce or to forbear from endorsing any powers or rights or by reason of time being given to the said M/s._____ and such postponement forbearance would not have the effect of releasing the bank from its obligation under this debt.

3. Your right to recover the said sum of Rs. _____ (Rupees_____) from us in manner aforesaid is absolute & unequivocal and will not be affected or suspended by reason of the fact that any dispute or disputes have been raised by the said M/s. _____ and/or that any dispute or disputes are pending before any officer, tribunal or court or arbitrator or any other authority/forum and any demand made by you in the bank shall be conclusive and binding. The bank shall not be released of its obligations under these presents by any exercise by you of its liberty with reference to matter aforesaid or any of their or by reason or any other act of omission or commission on your part or any other indulgence shown by you or by any other matter or changed what so ever which under law would, but for this provision, have the effect of releasing the bank.

4. The guarantee herein contained shall not be determined or affected by the liquidation or winding up dissolution or changes of constitution or insolvency of the said contractor but shall in all respects and for all purposes be binding and operative until payment of all money due to you in respect of such liabilities is paid.

5. The bank undertakes not to revoke this guarantee during its currency without your previous consent and further agrees that the guarantee shall continue to be enforceable until it is discharged by TFL in writing. However, if for any reason, the contractor is unable to complete the work within the period stipulated in the order/contract and in case of extension of the date of delivery/completion resulting extension of defect liability period/guarantee period of the contractor fails to perform the work fully, the bank hereby agrees to further extend this guarantee at the instance of the contractor till such time as may be determined by TFL. If any further extension of this guarantee is required, the same shall be extended to such required period on receiving instruction from M/s. _____ (contractor) on whose behalf this guarantee is issued.

6. Bank also agrees that TFL at its option shall be entitled to enforce this Guarantee against the bank (as principal debtor) in the first instant, without proceeding against the contractor and notwithstanding any security or other guarantee that TFL may have in relation to the /contractor's liabilities.

7. The amount under the Bank Guarantee is payable forthwith without any delay by Bank upon the written demand raised by TFL. Any dispute arising out of or in relation to the said Bank Guarantee shall be subject to the exclusive jurisdiction of courts at New Delhi.

8. Therefore, we hereby affirm that we are guarantors and responsible to you on behalf of the Contractor up to a total amount of _____(amount of guarantees in words and figures) and we undertake to pay you, upon your first written demand declaring the Contractor to be in default under the order/contract and without caveat or argument, any sum or sums within the limits of (amounts of guarantee) as aforesaid, without your needing to prove or show grounds or reasons for your demand or the sum specified therein.

9. We have power to issue this guarantee in your favor under Memorandum and Articles of Association and the undersigned has full power to do under the Power of Attorney, dated _____ granted to him by the Bank.

10. Notwithstanding anything contained herein:

11.

a) The Bank's liability under this Guarantee shall not exceed (currency in figures) _____ (currency in words only) _____
b) This Guarantee shall remain in force upto _____ (this date should be expiry date of defect liability period of the Contract) and any extension(s) thereof; and
c) The Bank shall be released and discharged from all liability under this Guarantee unless a written claim or demand is issued to the Bank on or before the midnight of _____ (indicate date of expiry of claim period which includes minimum three months from the expiry of this Bank Guarantee) and if extended, the date of expiry of the last extension of this Guarantee. If a claim has been received by us within the said date, all the rights of TFL under this Guarantee shall be valid and shall not cease until we have satisfied that claim.

Yours faithfully,

_____

Bank by its Constituted Attorney

Signature of a person duly
Authorized to sign on behalf of the Bank

INSTRUCTIONS FOR FURNISHING
"CONTRACT PERFORMANCE SECURITY / SECURITY DEPOSIT" BY "BANK GUARANTEE"

1. The Bank Guarantee by successful Bidder(s) will be given on non-judicial stamp paper as per 'stamp duty' applicable. The non-judicial stamp paper should be in name of the issuing bank..

2. The Bank Guarantee by Bidders will be given from bank as specified in Cl no. 38.3 of ITB [Section-III] of Tender Document .

3. A letter from the issuing bank of the requisite Bank Guarantee confirming that said Bank Guarantee and all future communication relating to the Bank Guarantee shall be forwarded to Employer.

4. If a Bank Guarantee is issued by a commercial bank, then a letter to Employer and copy to Consultant (if applicable) confirming its net worth is more than Rs. 100,00,00,000.00 [Rupees One Hundred Crores] or its equivalent in foreign currency alongwith documentary evidence OR in the Bank Guarantee itself.

5. Contractor shall submit attached cover letter (Annexure) while submitting Contract Performance Security.

Form-4 (a)

MATTER TO BE MENTIONED IN COVERING LETTER TO BE SUBMITTED BY VENDOR ALONG WITH BANK GUARANTEE (BG)

<table>
<tr><td>1. Bank Guarantee No.</td><td></td></tr>
<tr><td>2. Vendor Name/ VENDOR CODE</td><td><table><tr><td>NAME</td><td></td></tr><tr><td>VENDOR CODE</td><td></td></tr></table></td></tr>
<tr><td>Bank GUARANTEE AMOUNT</td><td></td></tr>
<tr><td>PURCHASE ORDER/LOA</td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>1. Nature of Bank Guarantee [Please Tick (□) whichever is applicable]</td><td><table><tr><td>Performance Security (CPS)</td><td>SECURITY DEPOSIT</td><td>ADVANCE</td></tr></table></td></tr>
<tr><td colspan="2">2. BG ISSUING Bank DETAILS:</td></tr>
<tr><td>(A) E-MAIL ID</td><td></td></tr>
<tr><td>(B) ADDRESS</td><td></td></tr>
<tr><td>(C) Phone No. / Mobile No.</td><td></td></tr>
</table>

F-5

GREED TERMS & CONDITIONS

To,
M/s TALCHER FERTILIZERS LIMITED
NOIDA

SUB:
TENDER NO:

This Questionnaire duly filled in, signed & stamped must form part of Bidder's Bid and should be returned along with Un-priced Bid. Clauses confirmed hereunder need not be repeated in the Bid.

Sl.	DESCRIPTION	BIDDER'S CONFIRMATION
1	Bidder's name, Vendor Code of TFL (If any) and address	Bidder's Name: TFL's Vendor Code: Address:
2.	Bidder confirms the currency of quoted prices is in Indian Rupees	
3.	Bidder confirms quoted prices will remain firm and fixed till complete execution of the order (except where price escalation/variation is allowed in the Tender).	
4.	Bidder confirms that they have quoted **GST (CGST & SGST/ UTGST or IGST)** in Price Schedule / Schedule of Rates (SOR) of Price bid.	Confirmed
4.1	Whether in the instant tender services/works are covered in reverse charge rule of **GST (CGST & SGST/UTGST or IGST)** If yes, Bidder confirms that they have quoted rate of applicable GST (CGST & SGST/ UTGST or IGST**)** in Price Schedule / Schedule of Rates of Price Bid	
4.2	Indicate Harmonized System of Nomenclature (HSN)/Service Accounting Codes (SAC) .	HSN/SAC Code (as applicable): _____
4.3	Bidder hereby confirms that the quoted prices are in compliance with the Section 171 of CGST Act/ SGST Act as mentioned as clause no. 13.10 of ITB (Anti-profiteering clause).	
4.4	a. Whether bidder is liable to raise E-Invoice as per GST Act. b. If yes, bidder will raise E-Invoice and confirm compliance to provision of tender in this regard.	a. _____ b. _____
4.5	Whether bidder is liable to raise E-Invoice as per GST Act.	
	If yes, bidder will raise E-Invoice and confirm compliance to provision of tender in this regard.	
5.	Bidder confirms acceptance of relevant Terms of Payment specified in the Bid Document.	

Sl.	DESCRIPTION	BIDDER'S CONFIRMATION
5.1	Deleted	
6.	Bidder confirms that Contract Performance Security will be furnished as per Bid Document within 30 days of FOA in case of successful bidder..	
7.	Bidder confirms that Contract Performance Security shall be from any Indian scheduled bank or a branch of an International bank situated in India and registered with Reserve bank of India as scheduled foreign bank. However, in case of bank guarantees from banks other than the Nationalised Indian banks, the bank must be a commercial bank having net worth in excess of Rs 100 crores and a declaration to this effect shall be made by such commercial bank either in the Bank Guarantee itself or separately on its letterhead.	
8.	Bidder confirms compliance to Completion Schedule as specified in Bid document and the same shall be reckoned from the date of Fax of Acceptance.	
9.	(i) Bidder confirms acceptance of Mutually Agreed Damages for delay in completion schedule specified in Bid document. (ii) In case of delay, the bills/invoices shall be submitted after reducing the price reduction due to delay (refer MAD Clause).	
10.	a) Bidder confirms acceptance of all terms and conditions of Bid Document (all sections). b) Bidder confirms that printed terms and conditions of bidder are not applicable.	
11.	Bidder confirms that their offer is valid for period specified in BDS from Final/Extended due date of opening of Techno-commercial Bids.	
12.	Bidder have furnished Bid security Declaration	
13.	As per requirement of tender, bidder (having status as Pvt. Ltd. or Limited company) must upload bid duly digitally signed on e-portal through class-3B digital signature (DS). In case, class of DS or name of employee or name of employer is not visible in the digitally signed documents, the bid digitally signed as submitted by the person shall be binding on the bidder.	
14.	Bidder confirms that (i) none of Directors (in Board of Director) of bidder is a relative of any Director (in Board of Director) of TFL or (ii) the bidder is not a firm in which any Director (in Board of Director) of TFL or their relative is a partner.	Confirmed ☐ Not confirmed ☐
15.	All correspondence must be in ENGLISH language only	
16.	Bidder confirms the contents of this Tender Document have not been modified or altered by them. In case, it is found that the tender document has been modified / altered by the bidder, the bid submitted by them shall be liable for rejection.	
17.	Bidder confirms that all Bank charges associated with Bidder's Bank regarding release of payment etc. shall be borne by Bidder.	

Sl.	DESCRIPTION	BIDDER'S CONFIRMATION
18.	No Deviation Confirmation: It may be note that any 'deviation / exception' in any form may result in rejection of Bid. Therefore, Bidder confirms that they have not taken any 'exception / deviation' anywhere in the Bid. In case any 'deviation / exception' is mentioned or noticed, Bidder's Bid may be rejected.	
19.	If Bidder becomes a successful Bidder pursuant to the provisions of the Tender Document, the following Confirmation shall be automatically become enforceable: "We agree and acknowledge that the Employer is entering into the Contract/Agreement solely on its own behalf and not on behalf of any other person or entity. In particular, it is expressly understood & agreed that the Government of India is not a party to the Contract/Agreement and has no liabilities, obligations or rights thereunder. It is expressly understood and agreed that the Purchaser is authorized to enter into Contract/Agreement, solely on its own behalf under the applicable laws of India. We expressly agree, acknowledge and understand that the Purchaser is not an agent, representative or delegate of the Government of India. It is further understood and agreed that the Government of India is not and shall not be liable for any acts, omissions, commissions, breaches or other wrongs arising out of the Agreement. Accordingly, we hereby expressly waive, release and forego any and all actions or claims, including cross claims, VIP claims or counter claims against the Government of India arising out of the Agreement and covenants not to sue to Government of India as to any manner, claim, cause of action or things whatsoever arising of or under the Agreement."	
20.	Bidder to ensure all documents as per tender including clause 11 of Section III and all Formats are included in their bid.	
21.	Bidder understands that Tender Document is not exhaustive. In case any activity though specifically not covered in description of 'Schedule of Rates' but is required to complete the work as per Scope of Work, Conditions of Contract, or any other part of Bidding document, the quoted rates will deemed to be inclusive of cost incurred for such activities unless otherwise specifically excluded. Bidder confirms to perform for fulfilment of the contract and completeness of the supplies in all respect within the scheduled time frame and quoted price.	
22.	Bidder hereby confirms that they are not on 'Holiday' by OWNER or any of the JV partners of TFL (viz. GAIL, RCF, CIL, FCIL) or Public Sector Project Management Consultant (like PDIL, EIL, Mecon only due to "poor performance" or "corrupt and fraudulent practices") or banned by Government department/ Public Sector on due date of submission of bid. Further, Bidder confirms that neither they nor their allied agency/(ies) (as defined in the Procedure for Action in case of Corrupt/Fraudulent/Collusive/ Coercive Practices) are on banning	

Sl.	DESCRIPTION	BIDDER'S CONFIRMATION
	list of TFL or any of the JV partner of TFL viz. GAIL, RCF, CIL, FCIL.(or the Ministry of Petroleum and Natural Gas/ Ministry of Chemicals and Fertilizers). Bidder also confirms that they are not under any liquidation, court receivership or similar proceedings or 'bankruptcy'. In case it comes to the notice of TFL/PDIL that the bidder has given wrong declaration in this regard, the same shall be dealt as 'fraudulent practices' and action shall be initiated as per the Procedure for action in case of Corrupt/Fraudulent/Collusive/Coercive Practices. Further, Bidder also confirms that in case there is any change in status of the declaration prior to award of contract, the same will be promptly informed to TFL/PDIL by them.	
	Bidder certifies that they would adhere to the Fraud Prevention Policy of TFL [available on TFL's website (www. https://tflonline.co.in/)] and shall not indulge themselves or allow others (working in TFL) to indulge in fraudulent activities and that they would immediately apprise TFL of the fraud/suspected fraud as soon as it comes to their notice. Concealment of facts regarding their involvement in fraudulent activities in connection with the business transaction(s) of TFL is liable to be treated as crime and dealt with by the procedures of TFL as applicable from time to time.	
23	Bidder confirmsthat (i) any variation in GST at the time of supplies for any reasons, other than statutory, including variations due to turnover, shall be borne by them and (ii) any error of interpretation of applicability of rate of GST (CGST & SGST/ UTGST or IGST) on components of an item and/or various items of tender by them shall be dealt as per clause no. 13.13 of Section-III.	
24	Bidders confirm to submit signed copy of Integrity Pact (wherever included in tender). If Bidder is a partnership concern or a consortium, this agreement must be signed by all partners or consortium members.	
23.	Bidder confirms that, in case of contradiction between the confirmations provided in this format and to the terms & conditions mentioned elsewhere in the offer, the confirmations given in this format shall prevail.	

Place:
Date:

[Signature of Authorized Signatory of Bidder]
Name:
Designation:
Seal:

F-6

ACKNOWLEDGEMENT CUM CONSENT LETTER

(On receipt of tender document/information regarding the tender, Bidder shall acknowledge the receipt and confirm his intention to bid or reason for non-participation against the enquiry /tender through e-mail to concerned executive in TFL/PDIL issued the tender, by filling up the Format)

To,
M/s TALCHER FERTILIZERS LIMITED
NOIDA

SUB:
TENDER NO:

Dear Sir,

We hereby acknowledge receipt of a complete set of bidding documents along with enclosures for subject item/job and/or the information regarding the subject tender.

- We intend to bid as requested for the subject item/job and furnish following details with respect to our quoting office:

  Postal Address with Pin Code : .....
  Telephone Number : .....
  Contact Person : .....
  E-mail Address : .....
  Mobile No. : .....
  Date : .....
  Seal/Stamp : .....

- We are unable to bid for the reason given below:

  Reasons for non-submission of bid:

Agency's Name : .....
Signature : .....
Name : .....
Designation : .....
Date : .....
Seal/Stamp : .....

F-7
BIDDER'S EXPERIENCE

To,

M/s TALCHER FERTILIZERS LIMITED
NOIDA

SUB:
TENDER NO:

Sl. No	Detailed Description of Job	LOA /WO No. and date	Full Postal Address & phone nos. of Client. *Name, designation and address of Engineer/ Officer-in-Charge*	Capacity	Value of Contract/ Order (*Specify* Currency Amount)	Date of Commencement	Scheduled Completion Time (Months)	Date of Actual Completion	Reasons for delay in execution, if any	Details of satisfactory operation from the date of Acceptance
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)

Place:
Date:

[Signature of Authorized Signatory of Bidder]

Name:
Designation:

Seal:

F-8(A)
CHECK LIST

Bidders are requested to duly fill in the checklist. This checklist gives only certain important items to facilitate the bidder to make sure that the necessary data/information as called for in the bid document has been submitted by them along with their offer. This, however, does not relieve the bidder of his responsibilities to make sure that his offer is otherwise complete in all respects.

Please ensure compliance and tick (√) against following points:

S. No.	DESCRIPTION	CHECK BOX
1.0	Digitally Signing (in case of e-bidding)/ Signing and Stamping (in case of manual bidding) on each sheet of offer, original bidding document including SCC, ITB,GCC, SOR DRAWINGS Corrigendum (if any)	
2.0	Confirm that the following details have been submitted in the Un-priced part of the bid	
i	Covering Letter, Letter of Submission	
ii	Declaration for Bid Security as per provisions of Tender	
iii.	Digitally signed (in case of e-tendering) or 'signed & stamped (in case of Manual tender) tender document along with drawings and addendum (if any)	
iv	Power of Attorney in the name of person signing the bid.	
v	Confirm submission of document alongwith unpriced bidas per bid requirement (including cl.no.11.1.1 of Section-III).	
3.0	Confirm that all format duly filled in are enclosed with the bid duly Digitally Signed (in case of e-bidding)/ / Signed and Stamped (in case of manual bidding) by authorised person(s)	
4.0	Confirm that the price part as per Price Schedule format submitted with Bidding Document/uploaded in case of e-bid.	
5.0	Confirm that Undertaking as per *Form-II to Annexure-V to Section-III* and Certification from the statutory auditor or cost auditor of the company (in the case of companies) or from a practicing cost accountant or practicing chartered accountant (in respect of other than companies) as per *Form-III to Annexure-V to Section-II I*are submitted.	
6.0	Confirm that Undertaking as per Form-1to Annexure-VII have been submitted by the bidder (Guidelines from Procurement from a Country sharing a Land Border with India)	
7.0	Confirm submission of Checklist against Bid Evaluation Criteria as per format F-8(B)	

Place:
Date:

[Signature of Authorized Signatory of Bidder]

Name:
Designation:

F-8(B)

CHECKLIST FOR BID EVALUATION CRITERIA (BEC) QUALIFYING DOCUMENTS

(refer Section II of Tender document)

BEC Clause No.	Description	Documents required for qualification	Documents Submitted by Bidder	Documents attested as per Section-II of Tender	Reference Page No. of the Bid submitted
	Technical BEC				
1.	**Experience**	*(a)* Copy of Detailed Letter of *Acceptance (DLOA) / Work Order /relevant extract of work Order/ Contract Agreement along with detailed scope of work and Completion / Acceptance Certificate.* *(b) Where bidder does not have experience of Scrapper Reclaimer system, Bidder must submit copy of MOU(s) between bidder and concerned supplier of Scraper Reclaimer system. In addition, copy of Detailed Letter of Acceptance (DLOA) / Work Order /relevant extract of work Order/ Contract Agreement along with detailed scope of work and Completion / Acceptance Certificate for providing Design, Engineering, Supply, Erection/ installation of minimum 50 TPH Scrapper Reclaimer system by the said supplier/vendor must also be submitted..* *(c) Bidder should also give an undertaking that in case they emerge as successful bidder, they will execute the Scraper Reclaimer system only through the Supplier/vendor as per submitted MOU/MOU's.* (d) *Any other documents as per BEC requirement*.		Yes/No	

2.	**Job executed for Subsidiary / Fellow subsidiary/ Holding company.**	Tax paid invoice(s) duly certified by statutory auditor of the bidder towards payment of statutory tax in support of the job executed for Subsidiary / Fellow subsidiary/ Holding company.		Yes/No	
3.	**Any other technical criteria in BEC**	a) Bidder shall submit affidavit from the domestic manufacturers of such Iron & steel products as per the Form-I enclosed with the policy documents. A bidder who is not manufacturer of Iron & Steel product and is unable to submit the Affidavit from domestic manufacturers at bidding stage, such bidder can submit the Affidavit issued by domestic manufacturers after placement of order. In this case bidder along with his bid shall submit an undertaking as per prescribed formatAny other documents as per BEC requirement		Yes/No	
	Financial BEC				
1.	**Annual Turn Over**	Audited Financial Statements [including Auditor's Report, Balance sheet, Profit & Loss Accounts statements, Notes & schedules etc.] for last Audited Financial Year. [In case the Annual Turnover criteria is not met in last Audited Financial Year, then the Audited Financial Statements for previous two years of last Audited Financial Year is to be submitted]	Submitted (*Mention specific year……*)	Yes/No	
2.	**Net Worth**	Audited Financial Statements [including Auditor's Report, Balance sheet, Profit & Loss Accounts statements, Notes & schedules etc.] for last Audited Financial Year.	Submitted (M*ention specific year ……*)	Yes/No	
3.	**Working Capital**	Audited Financial Statements [including Auditor's Report, Balance sheet, Profit & Loss Accounts statements, Notes & schedules etc.] for last Audited Financial Year. 1.1.15 If the bidder's working capital is negative	Submitted (*Mention specific year……*)	Yes/No	

		or inadequate, the bidder shall submit a letter (in prescribed format) from their bank having net worth not less than Rs.100 Crores, confirming the availability of line of credit for at least working capital requirement as stated above.	Submitted/ Not Applicable *(Bidder to tick appropriate option)*		
4.	**Format for Details of financial capability of Bidder**	Bidder shall submit "Details of financial capability of Bidder" in prescribed format duly signed and stamped by a chartered accountant / Certified Public Accountant (CPA).	Submitted		

Place:
Date:

[Signature of Authorized Signatory of Bidder]
Name:
Designation:
Seal

F-9

FORMAT FOR CERTIFICATE FROM BANK
IF BIDDER'S WORKING CAPITAL IS INADEQUATE/NEGATIVE

(To be provided on Bank's letter head)

Date:

To,
M/s. TALCHER FERTILIZERS LIMITED
NOIDA

Dear Sir,

This is to certify that M/s …….. (name of the bidder with address) (hereinafter referred to as Customer) is an existing customer of our Bank.

The Customer has informed that they wish to bid for TFL's RFQ/Tender no. ..... dated …… for ……..(Name of the supply/work/services/consultancy) and as per the terms of the said RFQ/Tender they have to furnish a certificate from their Bank confirming the availability of line of credit.

Accordingly M/s …….. (name of the Bank with address) confirms availability of line of credit to M/s …….. (name of the bidder) for at least an amount of Rs. _____

It is also confirmed that the net worth of the Bank is more than Rs. 100 Crores (or Equivalent USD) and the undersigned is authorized to issue this certificate.

Yours truly

for …… (Name & address of Bank)

(Authorized signatory)
Name of the signatory:
Designation :
Stamp

F-10

FORMAT FOR CHARTERED ACCOUNTANT CERTIFICATE/ CERTIFIED PUBLIC ACCOUNTANT (CPA) FOR FINANCIAL CAPABILITY OF THE BIDDER

We have verified the Audited Financial Statements and other relevant records of M/s…… (Name of the bidder) and certify the following:

A. AUDITED ANNUAL TURNOVER* OF PRECEDING THREE FINANCIAL YEARS:

Year	Amount (Currency)
Year 1:	
Year 2:	
Year 3:	

B. NETWORTH* AS PER AUDITED FINANCIAL STATEMENT OF PRECEDING FINANCIAL YEAR:

Description	**Year _____**
	Amount (Currency)
1. Net Worth	

C. WORKING CAPITAL* AS PER AUDITED FINANCIAL STATEMENT OF PRECEDING FINANCIAL YEAR:

Description	**Year _____**
	Amount (Currency)
1. Current Assets	
2. Current Liabilities	
3. Working Capital (Current Assets-Current liabilities)	

Refer Instructions

Notes:

(i) It is further certified that the above mentioned applicable figures are matching with the returns filed with Registrar of Companies (ROC) [Applicable only in case of Indian Companies]

(ii) We confirm that above figures are after referring instructions at page 2 of 2 of Format F-10.

(iii) Practicing Chartered Accountants shall generate Unique Document Identification Number (UDIN) for all certificates issued by them.

Name of Audit Firm:
Chartered Accountant/CPA
Date:

[Signature of Authorized Signatory]
Name:
Designation:
Seal:
Membership No.:
UDIN

(Page 1 of 2)

Instructions for Format F-10:

1. The Separate Pro-forma shall be used for each member in case of JV/ Consortium(If applicable).
2.
3. The financial year would be the same as one normally followed by the bidder for its Annual Report.

4. The bidder shall provide the audited annual financial statements as required for this Tender document. Failure to do so would result in the Proposal being considered as non-responsive.

5. For the purpose of this Tender document:
   (i) **Annual Turnover** shall be "Sale Value/ Operating Income"
   (ii) **Working Capital** shall be "Current Assets less Current liabilities" and
   (iii) **Net Worth** shall be Paid up share capital plus Free Reserves & Surplus less accumulated losses, deferred expenditure and miscellaneous expenditure not written off, if any.

6. Above figures shall be calculated after considering the qualification, if any, made by the statutory auditor on the audited financial statements of the bidder including quantified financial implication.

7. This certificate is to be submitted on the letter head of Chartered Accountant/CPA.

FORMAT FOR CONSORTIUM AGREEMENT
(ON NON- JUDICIAL STAMP PAPER OF APPROPRIATE VALUE)
CONSORTIUM/JV AGREEMENT-

Not Applicable

F-12

BIDDER'S QUERIES FOR PRE BID MEETING

To,

M/s TALCHER FERTILIZERS LIMITED
NOIDA

SUB:

TENDER NO:

Sl. NO.	REFERENCE OF TENDER DOCUMENT				BIDDER'S QUERY	OWNER'S REPLY
	SEC. NO.	Page No.	Clause No	Subject		

NOTE: The Pre-Bid Queries may be sent by e-mail before due date for receipt of Bidder's queries.

SIGNATURE OF BIDDER: _____

NAME OF BIDDER**:** _____

F-13

E-Banking Mandate Form

(To be issued on vendors letter head)

1. Vendor/customer Name :

2. Vendor/customer Code:

3. Vendor /customer Address:

4. Vendor/customer e-mail id:

5. Particulars of bank account

   a) Name of Bank
   b) Name of branch
   c) Branch code:
   d) Address:
   e) Telephone number:
   f) Type of account (current/saving etc.)
   g) Account Number:
   h) RTGS IFSC code of the bank branch
   i) NEFT IFSC code of the bank branch
   j) 9 digit MICR code

I/We hereby authorize TFL to release any amount due to me/us in the bank account as mentioned above. I/We hereby declare that the particulars given above are correct and complete. If the transaction is delayed or lost because of incomplete or incorrect information, we would not hold the TFL responsible.

(Signature of vendor/customer)

BANK CERTIFICATE

We certify that ---------- has an Account no. ---------- with us and we confirm that the details given above are correct as per our records.
Bank stamp

Date (Signature of authorized officer of bank)

F-14

INTEGRITY PACT

INTEGRITY PACT

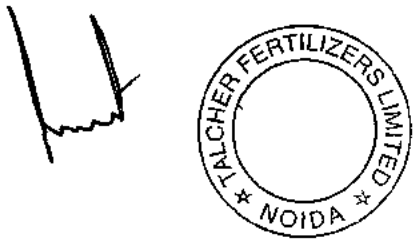
INTEGRITY PACT

INTRODUCTION:

TFL as one of its endeavour to maintain and foster most ethical and corruption free business environment, have decided to adopt the Integrity Pact, a tool developed by the Transparency International, to ensure that all activities and transactions between the Company (TFL) and its Counterparties (Bidders, Contractors, Vendors, Suppliers, Service Providers/Consultants etc.) are handled in a fair and transparent manner, completely free of corruption.

Considering the above, the details mentioned at attached Annexure-1 are applicable as stated in Instruction to Bidders of Bid Document in addition to the existing stipulation regarding Corrupt and Fraudulent Practices.

The attached copy of the Integrity Pact at Annexure - 2 shall be included in the Bid submitted by the bidder (to be executed by the bidder for all tenders of value Rs. 1 (One) crore and above). In case a bidder does not sign the Integrity Pact, his bid shall be liable for rejection.



ANNEXURE-1

Bidder is required to sign the Integrity Pact with TFL as per format & terms and conditions enclosed with tender. In case a bidder does not sign the Integrity Pact, his bid shall be liable for rejection.

I COMMITMENTS AND OBLIGATIONS OF THE "COUNTERPARTY"

a) The Counterparty, directly or indirectly (through agent, consultant, advisor, etc.), shall not pay any bribe/ influence or give undue/ unlawful benefit to anyone to gain undue advantage in dealing with TFL.

b) The Counterparty will not engage in collusion of any kind including price fixation etc. with other Counterparts.

c) The counterparty will not pass TFL's confidential information to any third party unless specifically authorized by TFL in writing.

d) The Counterparties shall promote and observe best ethical practices within their respective organizations.

e) The Counterparty shall inform the Independent External Monitor.
   i) If it received any demand, directly or indirectly, for a bribe/ favour or any illegal gratification/ payment / benefit;
   ii) If it comes to know of any unethical or illegal payment / benefit;
   iii) If it makes any payment to any TFL associate.

f) The Counterparty shall not make any false or misleading allegations against TFL or its associates.

II VIOLATIONS & CONSEQUENCES:

a) If a Counterparty commits a violation of its Commitments and Obligations under the Integrity Pact Programme during bidding process, their entire Earnest Money Deposit/ Bid Security, would be forfeited and in addition, action shall be taken as per "Procedure for action in case Corrupt /Fraudulent/ Collusive/Coercive Practices"

b) In case of violation of the Integrity pact by Counterparty after award of the Contract, TFL shall be entitled to terminate the Contract. Further, TFL would forfeit the security deposits/ Contract Performance Bank Guarantee and in addition, action shall be taken as per "Procedure for action in case Corrupt /Fraudulent/ Collusive/Coercive Practices"

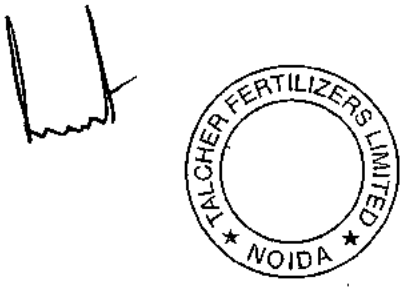
TALCHER FERTILIZERS LIMITED ★ NOIDA ★

INDEPENDENT EXTERNAL MONITORS (IEMS)

Presently the panel consisting of the following Independent External Monitors (IEMs) have been appointed by TFL, in terms of Integrity Pact (IP) which forms part of TFL Tenders / Contracts.

i) Shri Anjan Kumar Banerjee (Email ID: banerjeeanjan@gmail.com)
ii) Shri Atul Sobti (Email ID: sobtiatul@gmail.com)

This panel is authorised to examine / consider all references made to it under this tender. The bidder(s), in case of any dispute(s) / complaint(s) pertaining to this tender may raise the issue either with the designated tender issuing officer or Nodal Officer (presently Sh. S. Dasgupta, DGM (C&P) – Email: sdasgupta@gail.co.in) in TFL or directly with the IEMs on the panel or IEM c/o Chief Vigilance Officer, Rashtriya Chemicals and Fertilizers Ltd., Priyadarshini Building, Eastern Express Highway, Sion, Mumbai Maharashtra, 400022.



ANNEXURE-2

INTEGRITY PACT

(To be executed on plain paper)

Between TFL (India) Limited, a Government of India Public Sector, (here-in-after referred to as "Principal").

AND

_____(here-in-after referred to as "The Bidder/ Contractor").

(Principal and the Bidder / Contractor are here-in-after are referred to individually as "Party" or collectively as "Parties").

PREAMBLE

The Principal intends to award under laid down organizational procedures, contract/s for_____. The Principal values full compliance with all relevant laws of land rules, regulations, and economic use of resources and of fairness /transparency in its relations with its Bidder (s) and/or Contractor (s).

In order to achieve these goals, the Principal will appoint Independent External Monitors (IEMs) who will monitor the tender process and the execution of the contract for compliance with the principles mentioned above.

Section 1 – Commitments of the Principal

1. The Principal commits itself to take all measures necessary to prevent corruption and to observe the following Principles:-

   i) No employee of the Principal, personally or through family members, will in connection with the tender for, or the execution of a contract, demand, take a promise for or accept, for self or for a third person, any material or immaterial benefit which the person is not legally entitled to.

   ii) The Principal will, during the tender process treat all Bidder(s) with equity and reasons. The Principal will in particular, before and during the tender process, provide to all Bidder(s) the same information and will not provide to any Bidder(s) confidential / additional information through which the Bidder(s) could obtain an advantage in relation to the tender process or the contract execution.

TALCHER FERTILIZERS LIMITED ★ NOIDA ★

iii) The Principal will exclude from the process all known prejudiced persons.

2. If the Principal obtains information on the conduct of any of its employees which is a criminal offence under the Indian Penal Code (IPC) / Prevention of Corruption Act (PC Act), or if there be a substantive suspicion in this regard, the Principal will inform the Chief Vigilance Officers and in addition can initiate disciplinary actions.

Section 2 – Commitments of the Bidder (s)/Contractor (s)

1. The Bidder(s) / Contractor(s) commits themselves to take all measures necessary to prevent corruption. The Bidder(s) / Contractor(s) commits themselves to observe the following principles during participation in the tender process and during the contract execution:

i) The Bidder (s) / Contractor (s) will not, directly or through any other person or firm, offer, promise or give to any of the Principal's employees involved in the tender process or the execution of the contract or to any third person any material or other benefit which he / she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the tender process or during the execution of the contract.

ii) The Bidder (s) / Contractor (s) will not enter with other Bidders into any undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other action to restrict competitiveness or to introduce cartelisation in the bidding process.

iii) The Bidder (s) / Contractor (s) will not commit any offence under the relevant IPC/PC Act; further, the Bidder (s) / Contractor (s) will not use improperly, for purposes of competition or personal gain, or pass on to others, any information or document provided by the Principal as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.

iv) The Bidder (s)/ Contractor (s) of foreign origin shall disclose the name and address of the Agents/ representatives in India, if any. Similarly, the Bidder (s)/ Contractor (s) of Indian Nationality shall furnish the name and address of the foreign principals, if any. Further, all the payments made to the Indian agent/ representative have to be in India Rupees only.

v) The Bidder (s) / Contractor (s) will, when presenting their bid, disclose any and all payments made, is committed to or intends to make to agents,

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brokers or any other intermediaries in connection with the award of the contract.

vi) Bidder(s) / Contractor(s) who have signed the Integrity Pact shall not approach the Courts while representing the matter to IEMs and shall wait for their decision in the matter.

2. The Bidder(s)/ Contractor(s) shall not instigate third person to commit offences outlined above or be an accessory to such offences.

Section 3 – Disqualification from tender process and exclusion from future contracts

If the Bidder (s) / Contractor (s), before award or during execution has committed a transgression through a violation of Section 2, above or in any other form such as to put their reliability or credibility in question, the Principal is entitled to disqualify the Bidder (s) / Contractor (s) from the tender process or take action as per provisions of "Procedure for action in case Corrupt /Fraudulent/ Collusive/Coercive Practices".

Section 4 – Compensation for Damages

1. If the Principal has disqualified the Bidder (s) from the tender process prior to the award according to Section 3, the Principal is entitled to demand and recover the damages equivalent to Earnest Money Deposit / Bid Security.

2. If the Principal has terminated the contract according to Section 3, or if the Principal is entitled to terminate the contract according to Section 3, the Principal shall be entitled to demand and recover from the Contractor liquidated damages equal to the Contract Value or the amount equivalent to Performance Bank Guarantee.

Section 5 – Previous transgression

1. The Bidder declares that no previous transgression occurred in the last three years, with any other Company in any country conforming to the anti-corruption approach or with any Public Sector Enterprise in India that could justify his exclusion from the tender process.

2. If the Bidder makes incorrect statement on this subject, he can be disqualified from the tender process or actions can be taken as per provisions of "Procedure for action in case Corrupt /Fraudulent/ Collusive/Coercive Practices"

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Section 6 – Equal treatment to all Bidders / Contractors / Subcontractors

1. In case of sub-contracting, the Principal contractor shall take the responsibility of the adoption of IP by the sub-contractor. It is to be ensured by him that all sub-contractors also sign the IP.

2. The Principal will enter into agreements with identical conditions as this one with all Bidders and Contractors.

3. The Principal will disqualify from the tender process all bidders who do not sign this Pact or violate its provisions.

Section 7 – Criminal charges against violating Bidder (s) / Contractor (s) / Sub-contractor (s)

If the Principal obtains knowledge of conduct of a Bidder, Contractor or Subcontractor, or of an employee or a representative or an associate of a Bidder, Contractor or Subcontractor which constitutes corruption, or if the Principal has substantive suspicion in this regard, the Principal will inform the same to the Chief Vigilance Officer.

Section 8 –Independent External Monitor / Monitors

1. The Principal appoints competent and credible Independent External Monitor for this Pact after approval by Central Vigilance Commission. The task of the Monitor is to review independently and objectively, whether and to what extent the parties comply with the obligations under this agreement.

2. The Monitor is not subject to instructions by the representatives of the parties and performs his/her functions neutrally and independently. The Monitor would have access to all documents / records pertaining to the contract for which a complaint or issue is raised before them, as and when warranted. However, the documents / records / information having National Security implications and those documents which have been classified as Secret/Top Secret are not to be disclosed. It will be obligatory for him/her to treat the information and documents of the Bidders / Contractors as confidential. He / she reports to MD, TFL.

3. The Bidder (s)/ Contractor (s) accepts that the Monitor has the right to access without restriction to all Project documentation of the Principal including that provided by the Contractor. The Contractor will also grant the Monitor, upon his/her request and demonstration of a valid interest, unrestricted and unconditional access to their project documentation. The same is applicable to Sub-contractors.

4. The Principal will provide to the Monitor sufficient information about all meetings among the parties related to the Project provided such meetings could have an

TALCHER FERTILIZERS LIMITED ★ NOIDA ★

impact on the contractual relations between the Principal and the Contractor. The parties offer to the Monitor the option to participate in such meetings.

5. As soon as the Monitor notices, or believes to notice, a violation of this agreement, he/she will so inform the Management of the Principal and request the Management to discontinue or to take corrective action, or to take other relevant action. The monitor can in this regard submit non-binding recommendations. Beyond this, the Monitor has no right to demand from the parties that they act in a specific manner, refrain from action or tolerate action.

6. The Monitor will submit a written report to MD, TFL within 30 days from the date of reference or intimation to him by the 'Principal' and, should the occasion arise, submit proposals for correcting problematic situations.

7. If the Monitor has reported to MD, TFL, a substantiated suspicion of an offence under relevant IPC/PC Act, and MD, TFL has not, within reasonable time, taken visible action to proceed against such offence or reported it to the Chief Vigilance Officer, then, onlv in case of very serious issue having a specific verifiable Vigilance angle, the matter should be reported directly to the Central Vigilance Commission.

8. The word 'Monitor' would include both singular and plural.

9. In case of any complaints referred under IP Program, the role of IEMs is advisory and would not be legally binding and it is restricted to resolving the issues raised by an intending bidder regarding any aspect of the tender which allegedly restricts competition or bias towards some bidder.

10. After award of contract, the IEMs shall look into any issue relating to execution of contract, if specifically raised before them. As an illustrative example, if a contractor who has been awarded the contract, during the execution of contract, raises issue of delayed payment etc. before the IEMs, the same shall be examined by the panel of IEMs.

Section 9 – Pact Duration

This Pact begins when both parties have legally signed it. It expires for the Contractor 12 months after the last payment under the respective contract, and for all other Bidders 6 months after the contract has been awarded. Any violation to the same would entail disqualification of the bidders and exclusion from future business dealing.

If any claim is made / lodged during this time, the same shall be binding and continue to be valid despite the lapse of this pact as specified above, unless it is discharged/determined by MD, TFL.

Section 10 – Miscelleneous provisions

TALCHER FERTILIZERS LIMITED ★ NOIDA ★

1. This agreement is subject to Indian Law. Place of performance and exclusive jurisdiction is the Registered Office of the Principal, i.e. New Delhi.

2. Changes and supplements as well as termination notices, if any, need to be made in writing. Side agreements have not been made.

3. If the Contractor/Bidder is a Joint Venture or a partnership concern or a consortium, this agreement must be signed by all partners or consortium members.

4. Should one or several of the provisions of this agreement turn out to be invalid, the remainder of this agreement shall remain valid. In this case, the parties will strive to come to an agreement to their original intentions in such a case.

5. Issues like warranty / guarantee, etc. shall be outside the purview of IEMs.

6. In the event of any contradiction between the Integrity Pact and its Annexure, the Clause in Integrity Pact will prevail.

एस. दासगुप्ता / S. DASGUPTA
उप महाप्रबंधक (वित्त एवं लेखा)/Dy. General Manager (C&P)
टालचर फर्टिलाइजर्स लिमिटेड/ Talcher Fertilizers Ltd.
जीटीआई पीएआरसी बिल्डिंग/GTI PARC Building
प्लॉट नं० 24, सैक्टर-16ए, नोएडा-201301(उ.प्र.)
Plot No. 24, Sec.-16A, Noida-201 301(U.P.)

(For & on Behalf of Principal)

(Office Seal)

(For & on Behalf of
Bidder/Contractor)

(Office Seal)

Place ----------
Date ----------

Witness 1:
(Sign, Name & Address)
[FOR PRINCIPAL]

Geogam (SURA DEOGAM)
Talcher Fertilizers Limited (TFL), Plot No. 24,
Sector-16A, film City, Noida (U.P.)- 201301

Witness 2:
(Sign, Name & Address)
[FOR BIDDER / CONTRACTOR]

.....
.....
.....

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INDEMNITY BOND

WHEREAS TALCHER FERTILIZERS LIMITED (hereinafter referred to as "**TFL**") which expression shall, unless repugnant to the context include its successors and assigns, having its registered office at Plot 2/H, Kalpana Area, BJB Nagar, Khorda, Bhubaneswar – 751014 has entered into a contract with M/s*…… (hereinafter referred to as the "**Contractor"**) which expression shall unless repugnant to the context include its representatives, successors and assigns, having its registered office at *…….. and on the terms and conditions as set out, inter-alia in the ……. **[*mention the work order/LOA/Tender No*.]** and various documents forming part thereof, hereinafter collectively referred to as the '**CONTRACT'** which expression shall include all amendments, modifications and / or variations thereto.

TFL has also advised the Contractor to execute an Indemnity Bond in general in favour of TFL indemnifying TFL and its employees and Directors including Independent Directors from all consequences which may arise out of any prospective litigation or proceedings filed or may be initiated by any third party, including any Banker / financial institution / worker(s) /vendor(s)/ subcontractor(s) etc. who may have been associated or engaged by the Contractor directly or indirectly with or without consent of TFL for above works.

NOW, THEREFORE, in consideration of the promises aforesaid, the Contractor hereby irrevocably and unconditionally undertakes to indemnify and keep indemnified TFL and all its employees, Directors, including Independent Directors, from and against all/any claim(s), damages, loss, which may arise out of any litigations/ liabilities that may be raised by the Contractor or any third party against TFL under or in relation to this contract. The Contractor undertakes to compensate and pay to TFL and/or any of its employees, Directors including Independent Directors, forth with on demand without any protest the amount claimed by TFL for itself and for and on behalf of its employees, Directors including Independent Directors together with direct/indirect expenses including all legal expenses incurred by them or any of them on account of such litigation or proceedings.

AND THE CONTRACTOR hereby further agrees with TFL that:

(i) This Indemnity shall remain valid and irrevocable for all claims of TFL and/or any of its employees and Directors including Independent Directors arising out of said contract with respect to any such litigation / court case for which TFL and/or its employees and Directors including Independent Directors has been made party until now or here-in-after.

(ii) This Indemnity shall not be discharged/ revoked by any change/ modification/ amendment/ assignment of the contract or any merger of the Contractor with other entity or any change in the constitution/structure of the Contractor's firm/ Company or any conditions thereof including insolvency etc. of the Contractor, but shall be in all respects and for all purposes binding and operative until any/ all claims for payment of TFL are settled by the Contractor and/or TFL discharges the Contractor in writing from this Indemnity.

The undersigned has full power to execute this Indemnity Bond for and on behalf of the Contractor and the same stands valid.

SIGNED BY :
For *[Contractor]*

Authorised Representative
Place:
Dated:
Witnesses:1.
2

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FREQUENTLY ASKED QUESTIONS (FAQs)

SL.NO.	QUESTION	ANSWER
1.0	Can any vendor quote for subject Tender?	Yes. A Vendor has to meet Bid Evaluation Criteria given under Section II of Tender document in addition to other requirements.
2.0	Should the Bid Evaluation Criteria documents be attested?	Yes. Please refer Section II of Tender document
3.0	Is attending Pre Bid Meeting mandatory.	No. Refer Clause No. 17 of Instruction to Bidders of Tender Document. However attending Pre Bid Meeting is recommended to sort out any issue before submission of bid by a Bidder.
4.0	Can a vendor submit more than 1 offer?	No. Please refer Clause No. 4 of Instruction to Bidders of Tender Document.
5.0	Is there any Help document available for e-Tender.	Refer FAQs as available on CPP Portal e-Procurement).
6.0	Are there are any MSE (Micro & Small Enterprises) benefits available?	Refer Clause No. 40 of Instructions to Bidders of Tender Document.
7.0	Are there are any benefits available to Startups?	Refer Clause No. 49 of Instructions to Bidders of Tender Document.

All the terms and conditions of Tender remain unaltered.

Form F-17

PROFORMA OF BANK GUARANTEE FOR MOBILISATION ADVANCE
(ON NON-JUDICIAL PAPER OF APPROPRIATE VALUE)

To, M/s Talcher Fertilizers Limited, Noida	**Bank Guarantee No.**	
	Date of BG	
	BG Valid up to	
	Claim period up to (There should be three months gap between expiry date of BG & Claim period)	
	Stamp Sl. No. / e-Stamp Certificate No.	

Dear Sir(s),

In consideration of the Talcher Fertilizers Limited, hereinafter called the "Owner" which expression shall unless repugnant to the context or meaning thereof include its successors, executors, administrators and assignees, having awarded to M/s..... having its registered office at ..... hereinafter referred as the 'CONTRACTOR', which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assignees, a contract hereinafter referred to as the 'Contract' for related works..... referred to as the 'WORK' on terms and conditions set out, inter-alia in the Owner's Contract / DLOA / FOA No.....dated..... valued at..... (in words & figures) and as the Owner having agreed to make an advance payment (herein after referred as Mobilization advance) for the performance of the above contract to the CONTRACTOR amounting to.....(in words & figures) as an advance against Bank Guarantee to be furnished by the CONTRACTOR.

We..... hereinafter referred to as the BANK which expression shall, unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assignees having our office at..... do hereby undertake to give the irrevocable and unconditional guarantee and do hereby undertake to pay the OWNER on first demand without any demur, reservation, contest, recourse, protest and without reference to the CONTRACTOR any and all monies payable by the CONTRACTOR by reason of any breach by the said CONTRACTOR of any of the terms and conditions of the said Contract to the extent of..... till the said advance is adjusted as aforesaid at any time upto..... We agree that the guarantee herein contained shall continue to be enforceable till the sum due to the Owner on account of the said advance is adjusted/recovered in full as aforesaid or till the Owner discharges this guarantee **in writing.**

The OWNER shall have the fullest liberty without affecting in any way the liability of the BANK under this guarantee, from time to time to vary the advance or to extend the time for performance of the works by the CONTRACTOR. The BANK shall not be released from its liability under these presents by any exercise of the Owner of the liberty with reference to the matter aforesaid.

The Owner shall have the fullest liberty, without reference to CONTRACTOR and without affecting this guarantee to postpone for any time or from time to time the exercise of any powers vested in them or of any right which they might have against the CONTRACTOR, and to exercise the same at any time in any manner, and either to enforce or to forebear to enforce any power, covenants contained or implied in the Contract between the OWNER and the CONTRACTOR or any other course or remedy or security available to the OWNER and the BANK shall not be released of its obligations under these presents by any exercise by the OWNER of its liberty with reference to matters aforesaid or other acts of omission or commission on the part of the OWNER or any other law would, but for this provision, have the effect of releasing the BANK.

The right of the OWNER to recover the outstanding sum of advance upto Rs.....from the BANK in the manner aforesaid **is absolute and unequivocal and** will not be affected or suspended by reason of the fact that any dispute or disputes has or have been raised by the CONTRACTOR and/or that any dispute or disputes is or are pending before any officer, tribunal or court **or arbitrator or any other authority/forum** and any demand made by OWNER on the BANK shall be conclusive and binding.

The BANK further undertakes not to revoke this guarantee during its currency without previous consent of the OWNER and further agrees that the guarantee contained shall
continue to be enforceable **until it is discharged by TFL in writing.**

The BANK also agrees that the OWNER shall at its option be entitled to enforce this guarantee against the BANK as a principal debtor, in the first instance, notwithstanding any other security or guarantee that OWNER may have in relation to the CONTRACTOR's liabilities towards the said advance.

The amount under the Bank Guarantee is payable forthwith without any delay by Bank upon the written demand raised by TFL. Any dispute arising out of or in relation to the said Bank Guarantee shall be subject to the exclusive jurisdiction of courts at New Delhi.

Therefore, we hereby affirm that we are guarantors and responsible to you on behalf of the Contractor up to a total amount of _____(amount of guarantees in words and figures) and we undertake to pay you, upon your first written demand declaring the Contractor to be in default under the contract and without caveat or argument, any sum or sums within the limits of _____(amount of guarantee) as aforesaid, without your needing to prove or show grounds or reasons for your demand or the sum specified therein.
We have power to issue this guarantee in your favour under Memorandum and Articles of Association and the undersigned has full power to do so under the Power of Attorney/ resolution of the Board of Directors dated..... accorded to him by the BANK.

Notwithstanding anything contained herein:

a) The Bank's liability under this Guarantee shall not exceed (currency in figures) _____ (currency in words only) _____
b) This Guarantee shall remain in force upto _____ (three months beyond Completion Period) and any extension(s) thereof; and

c) The Bank shall be released and discharged from all liability under this Guarantee unless a written claim or demand is issued to the Bank on or before the midnight of_____ (indicate date of expiry of claim period which includes minimum three months from the expiry of this Bank Guarantee) and if extended, the date of expiry of the last extension of this Guarantee. If a claim has been received by us within the said date, all the rights of TFL under this Guarantee shall be valid and shall not cease until we have satisfied that claim.

Dated.....this.....day of.....20 .....

Signed by

(Person duly authorised by Bank)

Place:

WITNESS :

1..... (Signature)

..... (Printed Name)

..... (Designation)

2..... (Signature)

..... (Printed Name)

..... (Designation)
(Common Seal)

F-17 (A)
MATTER TO BE MENTIONED IN COVERING LETTER TO BE SUBMITTED BY VENDOR ALONG WITH BANK GUARANTEE (BG)

1. Bank Guarantee No.	
2. Vendor Name	
3. Nature of Bank Guarantee [Please Tick (□) whichever is applicable]	Contract Performance Security (CPS) □ Advance □
Purchase Order (PO) / Fax of Acceptance (FOA) / Detailed Letter of Acceptance (DLOA) No.	
Details of Bank issuing Bank Guarantee (BG)	
A. Name	
B. E-mail ID	
C. Address	
D. Phone No. / Mobile No.	

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PROFORMA FOR BANK GUARANTEE FOR PAYMENTS TOWARDS PLACEMENT OF ALL PURCHASE ORDERS OF MAJOR TAGGED ITEMS.

(To be submitted on Rs. 500/-(five hundred) non judicial stamp paper)

Ref.....
Bank Guarantee No.--------- Date.....

To,
M/s Talcher Fertilizers Limited
_____

Dear Sir(s),

In consideration of the Talcher Fertilizers Limited, hereinafter called the "Owner" which expression shall unless repugnant to the context or meaning thereof include its successors, executors, administrators and assignees, having awarded to M/s..... having its registered office at ..... hereinafter referred as the 'CONTRACTOR', which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assignees, a contract hereinafter referred to as the 'Contract' for related works..... referred to as the 'WORK' on terms and conditions set out, inter-alia in the Owner's Contract / DLOA / FOA No.....dated..... valued at..... (in words & figures) and as the Owner having agreed to make milestone payments (for the performance of the above contract to the CONTRACTOR amounting to.....(in words & figures) against Bank Guarantee to be furnished by the CONTRACTOR.

We..... hereinafter referred to as the BANK which expression shall, unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assignees having our office at..... do hereby undertake to give the irrevocable and unconditional guarantee and do hereby undertake to pay the OWNER on first demand without any demur, reservation, contest, recourse, protest and without reference to the CONTRACTOR any and all monies payable by the CONTRACTOR by reason of any breach by the said CONTRACTOR of any of the terms and conditions of the said Contract to the extent of.....We agree that the guarantee herein contained shall continue to be enforceable till the Owner discharges this guarantee **in writing.**

The OWNER shall have the fullest liberty without affecting in any way the liability of the BANK under this guarantee, from time to time to vary the amount or to extend the time for performance of the works by the CONTRACTOR. The BANK shall not be released from its liability under these presents by any exercise of the Owner of the liberty with reference to the matter aforesaid.

The Owner shall have the fullest liberty, without reference to CONTRACTOR and without affecting this guarantee to postpone for any time or from time to time the exercise of any powers vested in them or of any right which they might have against the CONTRACTOR, and to exercise the same at any time in any manner, and either to enforce or to forebear to enforce any power, covenants contained or implied in the Contract between the OWNER and the CONTRACTOR or any other course or remedy or security available to the OWNER and the BANK shall not be released of its obligations under these presents by any exercise by the OWNER of its liberty with reference to matters aforesaid or other acts of omission or commission on the part of the OWNER or any other law would, but for this provision, have the effect of releasing the BANK.

The right of the OWNER to recover the outstanding sum upto Rs..... from the BANK in the manner aforesaid **is absolute and unequivocal and** will not be affected or suspended by reason of the fact that any dispute or disputes has or have been raised by the CONTRACTOR and/or that any dispute or disputes is or are pending before any officer, tribunal or court **or arbitrator or any other authority/forum** and any demand made by OWNER on the BANK shall be conclusive and binding.

The BANK further undertakes not to revoke this guarantee during its currency without previous consent of the OWNER and further agrees that the guarantee contained shall continue to be enforceable **until it is discharged by TFL in writing.**

The BANK also agrees that the OWNER shall at its option be entitled to enforce this guarantee against the BANK as a principal debtor, in the first instance, notwithstanding any other security or guarantee that OWNER may have in relation to the CONTRACTOR's liabilities towards the said milestone payment .

The amount under the Bank Guarantee is payable forthwith without any delay by Bank upon the written demand raised by TFL. Any dispute arising out of or in relation to the said Bank Guarantee shall be subject to the exclusive jurisdiction of courts at New Delhi.

Therefore, we hereby affirm that we are guarantors and responsible to you on behalf of the Contractor up to a total amount of _____(amount of guarantees in words and figures) and we undertake to pay you, upon your first written demand declaring the Contractor to be in default under the contract and without caveat or argument, any sum or sums within the limits of _____(amount of guarantee) as aforesaid, without your needing to prove or show grounds or reasons for your demand or the sum specified therein.

Notwithstanding anything contained hereinabove, our liability under this guarantee is restricted to _____ and it will remain in force upto and including _____ (this date shall be initially 15 months from date of FOA) and shall be extended from time to time for such periods as may be advised by M/s_____ on whose behalf this guarantee has been given.

We have power to issue this guarantee in your favour under Memorandum and Articles of Association and the undersigned has full power to do so under the Power of Attorney/ resolution of the Board of Directors dated..... accorded to him by the BANK.

Notwithstanding anything contained herein:

9.

a) The Bank's liability under this Guarantee shall not exceed (currency in figures) _____ (currency in words only) _____
b) This Guarantee shall remain in force upto _____ (this date shall be initially 15 months from date of FOA) and any extension(s) thereof; and
c) The Bank shall be released and discharged from all liability under this Guarantee unless a written claim or demand is issued to the Bank on or before the midnight of _____ (indicate date of expiry of claim period which includes minimum three months from the expiry of this Bank Guarantee) and if extended, the date of expiry of the last extension of this Guarantee. If a claim has been received by us within the said date, all the rights of TFL under this Guarantee shall be valid and shall not cease until we have satisfied that claim.

Dated.....this.....day of.....20 .....

Signed by

(Person duly authorised by Bank)

Place:

WITNESS :
1..... (Signature)
..... (Printed Name)
..... (Designation)

2..... (Signature)
..... (Printed Name)
..... (Designation)

(Common Seal)

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FORMAT OF LETTER OF NO DEVIATIONS
(ON BIDDER'S LETTERHEAD)

(NIT NO : PNMM/PC-183/E-4010/NCB DATED …….)

We * hereby agree to fully comply with, abide by and accept without variation, deviation or reservation all technical, commercial and other condition whatsoever of the Bidding Documents and all Addenda / Corrigenda / Amendment/ Clarifications issued by OWNER.

We further hereby confirm that the bid is submitted in accordance of Tender Document and contains no deviation and the price bid submitted may be treated to conform to, in all respects, with the terms and conditions of the said tender documents including all Addenda / Corrigenda/ Amendment /Clarifications.

For and on behalf of* : …….....……

Stamp & Signature : ……**

Name : ……

Designation : ……

Date : ……

***Here fill in the name of bidder.**

****The Letter of *No Deviation* must be signed by the person (s) authorized to sign as per POA.**

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POWER OF ATTORNEY (POA)

(To be submitted on the Non-Judicial stamp paper / Company's Letter Head)

TENDER NO:

Description of work:

Name of Bidder:_____

"The undersigned _____ (Name of LEGAL PERSON, i.e. CEO/C&MD/Company Secretary/Partners) is lawfully authorized to issue this POA* on behalf of the company M/s _____ (Name of bidder) whose registered address is _____ and does hereby appoint Mr./Ms _____ (name of authorized person signing the bid document) _____ (Designation) of M/s _____ (Name of bidder) whose signature appears below to be the true and lawful attorney/(s) and authorize him/her to sign the bid (both physically & digitally on CPP Portal), conduct negotiation, sign contracts and execute all the necessary matter related thereto, in the name and on behalf of the company in connection with the tender no. _____.

The signature of the authorized person/(s) herein constitutes unconditional obligations of M/s _____ (Name of bidder).

This Power of Attorney (POA) shall remain valid and in full force and effect before we withdraw it in writing (by fax, or mail or post). All the documents signed (within the period of validity of the Power of Attorney) by the authorized person herein shall not be invalid because of such withdrawal.

(*) In case of a single Bidder, the Power of Attorney shall be issued as per the constitution of the bidder as below.

a) **In case of Proprietorship**: By Proprietor
b) **In case of Partnership**: by all Partners or Managing Partner.
c) **In case of Limited Liability Partnership**: by any bidder's employee authorized in terms of Deed of LLP.
d) **In case of Public /Limited Company**: POA in favour of authorized employee(s) by Board of Directors through Board Resolution or by the designated officer authorized by Board to do so. Such Board Resolution should be duly countersigned by Company Secretary / MD / CMD / CEO.

SIGNATURE OF THE LEGAL PERSON

_____
(Name of person with Company seal)

SIGNATURE OF THE AUTHORIZED PERSON
(FOR SIGNING THE BID)

_____
(Signature)
Name of person: _____
E-mail id: _____
DSC (Digital Signature Certificate) No.: _____

F-21

UNDERTAKING REGARDING SUBMISSION OF ELECTRONIC INVOICE (E-INVOICE AS PER GST LAWS)

(to be submitted on letter head along with documents for release of payment)

To,
M/s TALCHER FERTILIZERS LIMITED
_____

SUB:
LOA NO:
Dear Sir,

We _____ (Name of the Supplier/Contractor/Service Provider/ Consultant) hereby confirm that E-Invoice provision as per the GST Law is

(i) Applicable to us [ ]

(ii) Not Applicable to us [ ]

(Supplier/Contractor/Service Provider/ Consultant is to tick appropriate option (✓ or X) above).

In case, same is applicable to us, we confirm that we will submit E-Invoice after complying with all the requirements of GST Laws. If the invoice issued without following this process, such invoice can-not be processed for payment by TFL as no ITC is allowed on such invoices. We also confirm that If input tax credit is not available to TFL for any reason attributable to Supplier/Contractor/Service Provider/ Consultant (both for E-invoicing cases and non-E-invoicing cases), then TFL shall not be obligated or liable to pay or reimburse GST (CGST & SGST/UTGST or IGST) claimed in the invoice(s) and shall be entitled to deduct / setoff / recover such GST amount (CGST & SGST/UTGST or IGST) or Input Tax Credit amount together with penalties and interest, if any, by adjusting against any amounts paid or becomes payable in future to the Supplier/Contractor/Service Provider/ Consultant under this contract or under any other contract.

Place: [Signature of Authorized Signatory of Bidder]

Date: Name:
Designation:
Bidder Name:
Seal:

Form F-22

UNDERTAKING REGARDING SUBMISSION OF CONTRACT PERFORMANCE SECURITY (CPS)/ SECURITY DEPOSIT (SD) WITHIN STIPULATED TIME LINE

(to be submitted on letter head of bidder)

To,

M/s Talcher Fertilizers Limited

_____

SUB:

TENDER NO:

Dear Sir,

We hereby confirm that we have clearly understood the requirement of Contract Performance Security (CPS) / Security Deposit (SD) specified in the tender document.

We also hereby confirm that in case of award of contract / order, we will submit Contract Performance Security (CPS) / Security Deposit (SD) within 30 days from the date of issuance of Fax of Acceptance.

Place: [Signature of Authorized Signatory of Bidder]

Date: Name:

Designation:

Bidder Name:

Seal:

F-23
PROFORMA FOR CONTRACT AGREEMENT
(To be executed on non-judicial stamp paper of appropriate value)

DLOA No. ……. dated ……..

TFL's PAN No. …….

Contract Agreement for the work of ---------- of TALCHER FERTILIZERS LIMITED made on ---------- between (Name and Address)---------- , hereinafter called the "CONTRACTOR" (which term shall unless excluded by or repugnant to the subject or context include its successors and permitted assignees) of the one part and TALCHER FERTILIZERS LIMITED hereinafter called the "EMPLOYER" (which term shall, unless excluded by or repugnant to the subject or context include its successors and assignees) of the other part.

WHEREAS

A. The EMPLOYER being desirous of having provided and executed certain work mentioned, enumerated or referred to in the Tender Documents including Letter Inviting Tender, General Tender Notice, General Conditions of Contract, Special Conditions of Contract, Specifications, Drawings, Plans, Time Schedule of completion of jobs, Schedule of Rates, Agreed Variations, other documents has called for Tender.

B. The CONTRACTOR has inspected the SITE and surroundings of WORK specified in the Tender Documents and has satisfied himself by careful examination before submitting his tender as to the nature of the surface, strata, soil, sub-soil and ground, the form and nature of site and local conditions, the quantities, nature and magnitude of the work, the availability of labour and materials necessary for the execution of work, the means of access to SITE, the supply of power and water thereto and the accommodation he may require and has made local and independent enquiries and obtained complete information as to the matters and thing referred to, or implied in the tender documents or having any connection therewith and has considered the nature and extent of all probable and possible situations, delays, hindrances or interferences to or with the execution and completion of the work to be carried out under the CONTRACT, and has examined and considered all other matters, conditions and things and probable and possible contingencies, and generally all matters incidental thereto and ancillary thereof affecting the execution and completion of the WORK and which might have influenced him in making his tender.

C. The Tender Documents including the Notice Letter Inviting Tender, General Conditions of Contract, Special Conditions of Contract, Schedule of Rates, General Obligations, SPECIFICATIONS, DRAWINGS, PLANS, Time Schedule for completion of Jobs, Letter of Acceptance of Tender and any statement of agreed variations with its enclosures copies of which are hereto annexed form part of this CONTRACT though separately set out herein and are included in the expression "CONTRACT" wherever herein used.

AND WHEREAS

The EMPLOYER accepted the Tender of the CONTRACTOR for the provision and the execution of the said WORK at the rates stated in the schedule of quantities of the work and finally approved by EMPLOYER (hereinafter called the "Schedule of Rates") upon the terms and subject to the conditions of CONTRACT.

NOW THIS AGREEMENT WITNESSETH AND IT IS HEREBY AGREED AND DECLARED AS FOLLOWS:-

1. In consideration of the payment to be made to the CONTRACTOR for the WORK to be executed by him, the CONTRACTOR hereby covenants with EMPLOYER that the CONTRACTOR shall and will duly provide, execute and complete the said work and shall do and perform all other acts and things in the CONTRACT mentioned or described or which are to be implied there from or may be reasonably necessary for the completion of the said WORK and at the said times and in the manner and subject to the terms and conditions or stipulations mentioned in the contract.
2. In consideration of the due provision execution and completion of the said WORK, EMPLOYER does hereby agree with the CONTRACTOR that the EMPLOYER will pay to the CONTRACTOR the respective amounts for the WORK actually done by him and approved by the EMPLOYER at the Schedule of Rates and such other sum payable to the CONTRACTOR under provision of CONTRACT, such payment to be made at such time in such manner as provided for in the CONTRACT.

A N D

3. In consideration of the due provision, execution and completion of the said WORK the CONTRACTOR does hereby agree to pay such sums as may be due to the EMPLOYER for the services rendered by the EMPLOYER to the CONTRACTOR, such as power supply, water supply and others as set for in the said CONTRACT and such other sums as may become payable to the EMPLOYER towards the controlled items of consumable materials or towards loss, damage to the EMPLOYER'S equipment, materials construction plant and machinery, such payments to be made at such time and in such manner as is provided in the CONTRACT.

   It is specifically and distinctly understood and agreed between the EMPLOYER and the CONTRACTOR that the CONTRACTOR shall have no right, title or interest in the SITE made available by the EMPLOYER for execution of the works or in the building, structures or work executed on the said SITE by the CONTRACTOR or in the goods, articles, materials etc., brought on the said SITE (unless the same specifically belongs to the CONTRACTOR) and the CONTRACTOR shall not have or deemed to have any lien whatsoever charge for unpaid bills will not be entitled to assume or retain possession or control of the SITE or structures and the EMPLOYER shall have an absolute and unfettered right to take full possession of SITE and to remove the CONTRACTOR, their servants, agents and materials belonging to the CONTRACTOR and lying on the SITE.

   The CONTRACTOR shall be allowed to enter upon the SITE for execution of the WORK only as a licensee simpliciter and shall not have any claim, right, title or interest in the SITE or the structures erected thereon and the EMPLOYER shall be entitled to terminate such license at any time without assigning any reason.

   The materials including sand, gravel, stone, loose, earth, rock etc., dug up or excavated from the said SITE shall, unless otherwise expressly agreed under this CONTRACT, exclusively belong to the EMPLOYER and the CONTRACTOR shall have no right to claim over the same and such excavation and materials should be disposed off on account of the EMPLOYER according to the instruction in writing issued from time to time by the ENGINEER-IN-CHARGE.

In Witness whereof the parties have executed these presents in the day and the year first above written.

Signed and Delivered for and on on behalf of EMPLOYER	Signed and Delivered for and on behalf of the CONTRACTOR.
TALCHER FERTILIZERS LIMITED	NAME OF CONTRACTOR

_____ _____

Date :_____ Date :_____

Place:_____ Place:_____

IN PRESENCE OF TWO WITNESSES

1._____ 1. _____

2._____ 2. _____
_____ _____
_____ _____

SECTION – IV

GENERAL CONDITIONS OF CONTRACT

CONTENT

1.0 DEFINITION OF TERMS AND INTERPRETATION

In the **CONTRACT**, unless the context otherwise requires, the following expressions shall have the following meanings. The singular shall include the plural and the plural include the singular except where the context otherwise requires and the words 'he', 'him', and 'his' shall be taken to mean 'she', 'her' and 'hers' where appropriate.

1. 'APPROVAL' shall mean and include the written approval by the OWNER of documents, drawing or other particulars in relation to this CONTRACT.

2. 'BATTERY LIMIT' shall mean the outer limits of boundaries of the areas within which the Plants and associated facilities shall be located.

3. 'BID' shall mean the proposal/document that the BIDDER submits in the requested and specified form in response to this NIT.

4. 'BIDDER' shall mean the Sole Bidder who shall submit or who have submitted the Bid.

5. 'CHANGE ORDER / AMENDMENT TO ORDER' means an order given in writing by the OWNER to effect additions to or deletion or alteration to the original CONTRACT.

6. 'CODES' shall mean the following, including the latest amendments, and/or replacements, if any:
   a) All relevant Indian Acts, and Rules and Regulations made there under;
   b) ASME Codes
   c) IBR Codes
   d) AIEE Codes
   e) American Society of Testing of Materials (ASTM) Codes
   f) Other internationally applicable standards and/or Regulations the subject matter of the CONTRACT.
   g) Indian Employees Provident Fund Act,
   h) Pollution Control norms of INDIA
   i) Contract Labour
   j) Minimum Wages Act
   k) Any other labour laws of INDIA applicable during execution of contract.
   l) Any other codes/standards specified in the contract documents.

7. 'COMMERCIAL USE' shall mean that use of the PLANT which the CONTRACT contemplates or of which it is commercially capable.

8. 'COMMISSIONING' shall be as defined in Section-VI of Technical Part.

9. 'CONSULTANT/PROJECT MANAGEMENT CONSULTANT (PMC)' shall mean PROJECTS & DEVELOPMENT INDIA LIMITED, who are the consulting

engineer to the OWNER for this project and having registered office at PDIL Bhawan, A-14, Sector-1, Noida – 201301, Uttar Pradesh.

10. 'CONTRACT' shall mean the Agreement between the OWNER and the CONTRACTOR for the execution of the works including therein all contract documents.

11. 'CONTRACTOR' shall mean the successful Bidder whose bid has been accepted by the OWNER and who has been selected by the OWNER for the award of Works and shall include his heirs, legal representatives, successors and permitted assigns.

12. 'SCHEDULED/CONTRACTUAL COMPLETION PERIOD' shall mean the time period mentioned in the tender document by which CONTRACT shall be completed, including any time extension granted in writing by OWNER through a CHANGE ORDER/AMENDMENT. Time extensions, if any, shall be without prejudice to other terms and conditions of tender, unless as otherwise stated in CHANGE ORDER/AMENDMENT.

13. 'CONTRACTOR'S EQUIPMENT' means all equipment, construction plant, vehicles, temporary facilities, material, tools or things brought on to the Site by or on behalf of the Contractor for carrying out the Works but not for permanent incorporation in the Plant.

14. 'CONTRACTOR'S SOFTWARE' means standard Software owned by the CONTRACTOR.

15. 'CONTRACTOR'S WORKS' OR 'MANUFACTURER'S WORKS' shall mean the place or places of work used by the CONTRACTOR/SUB-CONTRACTOR/SUB-VENDOR or their collaborator(s) for the manufacture of EQUIPMENT or performance of WORKS.

16. 'COST' means the cost incurred by the Contractor in carrying out any of his obligations under the Contract, and 'Costs' shall be construed accordingly.

17. 'DAY' shall mean a day of 24 hours from midnight to midnight irrespective of the number of hours worked in that day.

    "WORKING DAY" means any day which is not declared to be holiday or rest day by the OWNER.

18. 'DEEMED ACCEPTANCE' shall be as defined in SPECIAL CONDITIONS OF CONTRACT.

19. 'DEFECT' means any work done or any Material or the Plant or any part of it which does not comply with the CONTRACT.

20. 'DEFECT LIABILITY PERIOD' shall be as defined in SPECIAL CONDITIONS OF CONTRACT.

21. 'DOCUMENT(S)/DOCUMENTATION' means any relevant documents in paper

or electronic form, including drawings, technical software, images, designs, manuals or records.

22. 'DRAWINGS' or 'PLAN' shall mean all
    a) Drawings furnished by the OWNER as a basis for proposals;
    b) Supplementary drawings furnished by the OWNER to clarify and to define in greater detail the intent of the CONTRACT;
    c) DRAWINGS submitted by the CONTRACTOR with his proposal provided such drawings are acceptable to the OWNER.
    d) DRAWING furnished by the OWNER to the CONTRACTOR during the progress of the works; and
    e) Engineering data and DRAWINGS submitted by the CONTRACTOR during the progress of the work provided such drawings are acceptable to the OWNER.

23. DLOA shall mean DETAILED LETTER OF ACCEPTANCE which shall be issued to successful bidder.

24. 'ENGINEER'S INSTRUCTIONS' shall mean any drawings and/or instructions in writing, details, directions and explanations issued by the OWNER from time to time to the CONTRACTOR/ SUB-CONTRACTOR for carrying out the WORK during the COMPLETION PERIOD

25. ENGINEER IN CHARGE" shall mean the person designated from time to time by the OWNER and shall include those who are expressly authorized by him to act for and on his behalf for operation of this CONTRACT.

26. 'EQUIPMENT' OR 'STORES' shall mean the equipment, machinery and structure of any kind which the CONTRACTOR is obliged to design, supply, deliver, unload, store at site, erect, set to work and test under the CONTRACT.

27. 'FINAL ACCEPTANCE' shall mean that date when all of the conditions set forth in Clause 19 of SPECIAL CONDITIONS OF CONTRACT have been satisfied, all liabilities and obligations under this CONTRACT have been discharged, except those specially to be continued or performed after FINAL ACCEPTANCE. .

28. 'FINAL ACCEPTANCE CERTIFICATE' shall mean that certificate issued by the ENGINEER-IN-CHARGE or OWNER to the CONTRACTOR subject to clause 19 of SPECIAL CONDITIONS OF CONTRACT at the end of the DEFECTS LIABILITY PERIOD.

29. 'FINAL COMPLETION' shall mean the completion of guarantee tests and handing over of the PLANTS and facilities to OWNER.

30. FINAL PROPOSAL means the Offer/Bid submitted by the Bidder against this tender including it's Amendments/Corrigendum/Addendum/etc.

31. 'FORCE MAJEURE' has the meaning stated in Sub-clause 35.0 of GCC.

32. 'FOA' means FAX OF ACCEPTANCE, which shall be issued to successful bidder.

33. GCC' or GENERAL CONDITIONS OF THE CONTRACT shall mean all the terms and conditions forming part of this agreement as defined in this Section.

34. 'INSPECTOR' shall mean the duly authorised representative of the OWNER for stage wise or final inspection of WORKS or of EQUIPMENT or MATERIALS to be supplied under the CONTRACT.

35. 'LEGISLATION' means all applicable laws, directives, codes, statutes, rules, ordinances, approvals, licences, decrees, authorizations, by-laws, regulations, standards and any other requirement of any governmental authority or agency whether international national, state, municipal, local or other government subdivision, having the force of law in any place where the WORKS or any part of the WORKS are being carried out.

36. 'MANUFACTURER' shall mean a person or firm who is the producer and supplier of material and/ or designer and/or fabricator of equipment to either the OWNER, the CONTRACTOR or both under the CONTRACT.

37. 'MATERIALS' means machinery, plant and other items of equipment and materials intended to form part of the PLANT and other things needed for its operation, to be supplied by the CONTRACTOR.

38. "MECHANICAL COMPLETION" shall be as defined in SPECIAL CONDITIONS OF CONTRACT.

39. 'MONTH' shall mean the calendar month.

40. 'NOTICE IN WRITING', 'WRITTEN NOTICE' shall mean a notice in written, typed or printed characters sent (unless delivered personally or otherwise proved to have been received) by registered post/ Speed Post to the last known private or business address or registered office of the addressee and shall be deemed to have been received when in the ordinary course of post it would have been delivered. Fax with Post copy confirmation. Further, emails addressed to designated official(s) of the Company shall also be accepted.

41. 'OTHER CONTRACTOR/OTHERS' shall mean any person(s) having a contract with the OWNER to design, supply, erect, set to work, or do any other thing to or in connection with any other plant and shall include their, heirs, legal representatives, successors and permitted assigns.

42. 'OWNER' shall mean M/s TALCHER FERTILIZERS LIMITED having its registered office at Plot 2/H, Kalpana Area Nagar, Khordha, Bhubaneshwar and Project office at GAIL Training Institute, PARC Building, Sector 16A, Film City, Noida – 201301 Uttar Pradesh and shall include their, heirs, legal representatives, successors and permitted assigns.

43. 'PERFORMANCE & GUARANTEE TESTS RUN (PGTR)' shall be as defined in

SPECIAL CONDITIONS OF CONTRACT.

44. 'PLANT' shall be as defined in the SPECIAL CONDITIONS OF CONTRACT.

45. 'PRELIMINARY ACCEPTANCE' shall be as defined in the SPECIAL CONDITIONS OF CONTRACT.

46. 'PRELIMINARY ACCEPTANCE CERTIFICATE' shall be as defined in the SPECIAL CONDITIONS OF CONTRACT.

47. "PRE-COMMISSIONING" shall be as defined in the SPECIAL CONDITIONS OF CONTRACT.

48. 'PROJECT' shall mean the Project specified in the Technical specification.

49. 'SCC' or SPECIAL CONDITIONS OF THE CONTRACT shall mean all the terms and conditions forming part of the CONTRACT as stipulated elsewhere in the tender document.

50. 'SITE' shall mean and include the land and other places on, into or through which the EQUIPMENT and related facilities shall be erected and any adjacent land, paths, streets or reservoirs which may be allocated or used by the OWNER or CONTRACTOR in the performance of the CONTRACT.

51. 'SOFTWARE' means all forms of software and firmware and their documentation.

52. 'SPECIFICATION' shall mean collectively all the terms and stipulations in the Technical Specifications, schedules, detailed descriptions, statement of Technical Data, performance characteristics, standards & codes etc., and subsequent addenda issued thereto before the date of closing of bid and all written agreements made or to be made pertaining to the method and manner of performing the Work or to the quantities and the qualities of the materials to be furnished under this CONTRACT.

53. 'SUB-CONTRACTOR/SUB-VENDOR' shall mean any person or persons, or firm(s) including his/their, heirs, legal representatives, successors and permitted assigns selected by the CONTRACTOR with prior written approval of the OWNER for undertaking any part of the Works under the CONTRACT or to whom any part of the CONTRACT is sublet by the CONTRACTOR with the consent in writing of the OWNER.

54. 'TAKING OVER' AND 'TAKEN OVER' shall mean OWNER taking possession of and use of the PLANT.

55. 'TEMPORARY WORKS' means all temporary works and structures of every kind constructed at the Site and required for the provision and construction of the PLANT.

56. 'THIRD PARTY SOFTWARE' means standard Software which is owned by a third party.

57. 'TOTAL LSTK PRICE/TOTAL CONTRACT PRICE" shall mean the sum accepted or the sum calculated in accordance with the prices accepted in tender and/or the CONTRACT rates as payable to the CONTRACTOR for the entire execution and full completion of the work, including CHANGE ORDER, if any.

58. 'WEEK' shall mean continuous period of 7 (Seven) DAYS.

59. 'WORK' OR 'WORKS' means the design, engineering and other services to be provided by the Contractor including, but not limited to, the provision and construction of the PLANT and any Temporary Works and the subsequent dismantling or removal of the Temporary Works when no longer required, and any other works to be carried out by the CONTRACTOR in accordance with the CONTRACT.

60. 'WRITING' shall include any manuscript, typewritten or printed statement, under or over signature and/or seal as the case may be.

61. 'NOTICE INVITING TENDER (NIT)/ BIDDING DOCUMENT' means Complete Bidding Document as originally issued and any Addendum /Corrigendum/ Amendment(s) issued thereafter.

62. 'MUTUALLY AGREED DAMAGES' (MAD) shall be as defined in SPECIAL CONDITIONS OF CONTRACT.

2.0 CONTRACT DOCUMENTS

The term 'Contract Documents' shall mean and include the following documents which shall constitute the Contract and shall be deemed to form an integral part of the Contract:

a) Contract Agreement
b) Detailed Letter of Acceptance (DLOA) and all Annexures
c) FAX of Acceptance (FOA)
d) Agreed variations , if any
e) Schedule of Rates
f) Corrigendum/Addendum/Amendment to tender
g) Complete Original Tender Document with all enclosures
h) Integrity Pact (IP) signed between the Owner and the Bidder/Contractor

The above documents are intended to be correlative, complementary and mutually explanatory. The Contract shall be read as a whole.

2.1 INTERPRETATION OF CONTRACT DOCUMENTS

2.1.1 Notwithstanding the sub-division of the CONTRACT document into these separate documents and/or volumes and/or heads, every part of each separate

section/volume/head shall be deemed to be supplementary of every other part and shall be read with and into the CONTRACT so far as it may be practicable to do so.

2.1.2 If in respect of any commercial term or condition, if any provision in the GENERAL CONDITIONS OF CONTRACT is repugnant to or at variance with any provision(s) of the SPECIAL CONDITIONS OF CONTRACT, the provision(s) of the SPECIAL CONDITIONS OF CONTRACT shall be deemed to override the provision(s) of GENERAL CONDITIONS OF CONTRACT, but only to the extent that such repugnancy in the GENERAL CONDITIONS OF CONTRACT cannot be reconciled with the SPECIAL CONDITIONS OF CONTRACT.

2.1.3 Without prejudice to the provisions of the GENERAL CONDITIONS OF CONTRACT, whenever in the Bidding documents it is mentioned or stated that the CONTRACTOR shall perform certain work or provide certain facilities, it is understood that the CONTRACTOR shall do so at his own cost and the TOTAL CONTRACT PRICE shall be deemed to have included the cost of such performance and/or provision, as the case may be.

2.1.4 The MATERIALS, design and workmanship shall satisfy the applicable relevant Indian standards, the job specifications contained herein and the codes referred to by expression or implication. Where the job specifications stipulate requirements in addition to those contained in the standard codes and specifications, these additional requirements shall also be satisfied. In the absence of any standard/specification/code of practice for detailed specifications covering any part of the work covered in this tender, the instructions/directions agreed between OWNER and CONTRACTOR based on good international engineering practice shall be binding on the CONTRACTOR.

2.1.5 The documents forming the Contract are to be read together and interpreted as mutually explanatory of one another. If there is a direct inconsistency in specific obligation(s), then for the purposes of interpretation, and unless otherwise provided in the Contract, the priority of the Contract Documents shall be in accordance with following sequence:

i. The Contract Agreement
ii. Detailed Letter of Acceptance (DLOA) along with its enclosures
iii. Fax of Acceptance (FOA)
iv. Schedule of Rates (SOR)
v. Scope of Works/ Job Specifications (specific to particular job only, wherever provided)
vi. Drawings
vii. Special Conditions of Contract (SCC)
viii. Technical Specifications (wherever applicable)
ix. Instructions to Bidders (ITB)
x. General Conditions of Contract (GCC)
xi. Other Documents

Any amendment / Corrigendum / Addendum to tender issued by PMC/Owner shall take precedence over respective clauses of the original tender document and its annexures.

Similarly, any amendment / change order issued by Owner upon signing of formal Contract shall take precedence over respective clauses of the formal Contract and its annexures

2.1.6 Should there be any doubt or ambiguity in the interpretation of the CONTRACT documents or contradiction therein or should there be any discernable error or omission in any CONTRACT document, the CONTRACTOR shall, prior to commencing the relative work or supply, as the case may be, apply in writing to the Engineer-In-Charge for his decision for resolution of the doubt, ambiguity or contradiction or correction of the error or making good the omission, as the case may be. Should the CONTRACTOR fail to apply to the ENGINEER-IN-CHARGE for his decision as aforesaid prior to commencing the relative work or supply, the CONTRACTOR shall perform the said work or make the said supply, as the case may be, at his own risk, and the provisions of NIT shall apply to any such work performed or supply made by the CONTRACTOR.

2.1.7 Notwithstanding anything provided in Clause 2.1.6 hereof above, either the CONTRACTOR or any representative of the OWNER or CONSULTANT may, at any time prior to or during the execution of the work or supply of any material or any part thereof (if the CONTRACTOR has failed to make an application as provided for in Clause 2.1.6), apply to the ENGINEER-IN-CHARGE in writing for his decision in resolution of any doubt, ambiguity or contradiction or for the correction of any error or for making good the omission as the case may be.

2.1.8 The decision of the ENGINEER-IN-CHARGE on any application under Clause 2.1.6 or Clause 2.1.7 hereof shall be in writing and shall be final and binding upon the CONTRACTOR and shall form part of the CONTRACT documents, with the intent that the CONTRACT documents shall be read as though the said decision is and was at all times incorporated therein. It is clarified that in case the Contractor disagrees with the decision of the ENGINEER-IN-CHARGE, the dispute shall be settled as per the provisions of Clause 39.0 of GCC.

2.2 Any work or supply shown, indicated or included in any description of the work, plans, drawings, Specifications and/or Price Schedule or other Contract or Bid documents shall be deemed to form part of the WORK and/or supply contracted for, as the case may be, notwithstanding failure to show, indicate or include such work or supply in any other or others among the documents aforesaid with the intent that the indication or inclusion of the work or supply within any one of the said documents shall be deemed to be a sufficient indication or inclusion of the work or supply, as the case may be, within the work and supply covered by the CONTRACT.

2.3 No verbal agreement, assurance, representation or understanding given by any employee or officer of the OWNER or so understood by the CONTRACTOR, whether given or understood before or after the execution of the contract, shall any-wise bind the OWNER or alter the CONTRACT documents unless specifically given in writing and signed by the OWNER or by the ENGINEER-IN-CHARGE on behalf of the OWNER and issue the amendment of the relative term(s).

2.4 Clause headings given in this or any other contract documents are intended only as a general guide for convenience in reading and segregating the general subject of the various Clauses, but do not form part of the contract documents, with the intent that the Clause headings shall not govern the meaning or import of the Clauses there under appearing or confine or otherwise affect the interpretation thereof.

3.0 MODIFICATIONS IN CONTRACT

3.1 All modifications leading to changes in the CONTRACT with respect to technical or commercial aspects including terms of completion period shall be considered valid only when accepted in writing by OWNER and CONTRACTOR by issuing amendment to the CONTRACT. Issuance of acceptance or otherwise in such cases shall not be any ground for extension of agreed completion date (except in cases where completion period itself is revised by OWNER) and also shall not affect the performance of CONTRACT in any manner except to the extent mutually agreed to, through a modification to CONTRACT. The PARTIES shall have the right to modify or amend the CONTRACT subject to an adjustment in the CONTRACT PRICE and/ or COMPLETION DATE in accordance with the applicable provision of the CONTRACT, if any, and subject to mutual agreement.

3.2 OWNER shall not be bound by any printed conditions or provisions in the CONTRACT-OR's bid forms or acknowledgement of CONTRACT, packing list and other documents which support to impose any condition at variance with or supplemental to CONTRACT

4.0 USE OF CONTRACT DOCUMENTS AND INFORMATION

4.1 The CONTRACTOR shall not, without the OWNER's prior written consent, disclose the CONTRACT or any provision thereof, or any specification, plan, drawing, pattern, sample or information furnished by or on behalf of the OWNER in connection therewith, to any person other than a person employed by the CONTRACTOR in the performance of the CONTRACT. Disclosure to any such employed person shall be made in confidence and shall extend only so far as may be necessary for purpose of such performance.

4.2 The CONTRACTOR shall not without the OWNER's prior written consent, make use of any document or information enumerated in Clause 6.1 except for purpose of performing the CONTRACT.

4.3 Any document other than CONTRACT, itself, enumerated in Clause 6.1 shall remain the property of the OWNER and shall be returned (all copies) to the OWNER on completion of the CONTRACTOR's performance under the CONTRACT if so required by the OWNER.

5.0 **PRICES, TAXES AND DUTIES AND OTHER LEVIES**

The following provisions are in addition to Clause 13 of “Instruction to Bidders” (Section-III)

The prices shall include all duties, taxes and levies etc. including but not limited to customs duty, GST on imports, any tax / duty/ levy as per applicable GST laws, personnel and corporate tax as applicable.

The Bidders are to quote firm prices. In respect of both direct transaction between OWNER and the Bidder and Bought Out Items to be dispatched directly from the sub-vendor's works to Owner's site, the payment towards all applicable Indian Taxes and duties like Custom Duty, GST and other tax/duty/levy, will be made by OWNER in Indian rupees at actuals limited to the amount indicated in the Bid.

In case of Bought out items to be dispatched directly from sub-vendor's works to Owner's site, the CONTRACTOR shall ensure that his sub-vendors raise tax invoice under the provisions of GST Law, billed to the CONTRACTOR and shipped to Owner's site. The CONTRACTOR shall further ensure that he raises his corresponding tax invoices under the provision of GST Law in the name of OWNER during transit of the Material before the delivery of Material is taken by OWNER.

5.1 Except as specifically provided to the contrary in the SPECIAL CONDITIONS OF CONTRACT:

(i) The CONTRACTOR shall, within the price of materials and scope of supply, be liable to pay and bear any and all duties, taxes, levies and cesses lawfully payable on any goods, equipment or materials imported into India or within any local limits for permanent incorporation in the work(s), and on materials sold and supplied to the OWNER pursuant to the CONTRACT.

(ii) The CONTRACTOR shall within the price of services and scope of services be responsible to pay on behalf of the OWNER any and all duties, taxes, levies and cesses including education cess etc. lawfully payable on any goods or equipment imported into India or within any local limits for use in the performance of the work(s), and on services performed pursuant to the CONTRACT.

(iii) The CONTRACTOR shall be liable for and shall pay any and all Indian fees, taxes, duties, levies and cesses including education cess etc., assessable against CONTRACTOR in respect of or pursuance to the CONTRACT. However, GST payment by the CONTRACTOR to the Tax Authority shall be made by the Owner to the CONTRACTOR at actual limited to the Amount indicated in the Bid.

(iii) In addition, the CONTRACTOR shall be responsible for payment of all Indian duties, levies, and taxes etc., assessable against the CONTRACTOR or CONTRACTOR's employees or SUB-CONTRACTOR'S whether corporate or personal or applicable in respect of property.

(iv) CONTRACTOR should comply with the provisions of e-way bill notified by appropriate authorities from time to time. The existing provisions of road permit will continue till such time if applicable.

(v) There will be no materials under the scope of Contract which will be consigned to Owner, unless otherwise specifically mentioned elsewhere in the tender. The Owner will not issue / provide Road permits/e-way bill to the Contactor except in respect of material directly purchased by the Owner.

5.2 **TAX INDEMNITY**

It will be the duty of the CONTRACTOR to duly observe and perform all laws, rules, regulations, orders and formalities applicable under GST and Customs Duty on the manufacture, sale, import and/or supply of any material to OWNER and/or applicable on the services performed by the CONTRACTOR pursuant hereto. The CONTRACTOR shall keep the OWNER indemnified for and against any and all claims, demands, prosecutions, penalties, damages, demurrages and/or other levies whatsoever made or levied by the Court or Customs Authorities with respect to any alleged breach, evasion or infraction of such duties, taxes, charges or levies or any breach or infraction of such laws, rules, regulations, orders or formalities concerning the same and from the consequence thereof.

5.3 The CONTRACTOR confirms that, it has included all taxes, duties, levies etc., as applicable at prevailing rates, in its TOTAL CONTRACT PRICE as quoted in Schedule of Rate. In case, CONTRACTOR has not included any such taxes, duties, levies etc., at all and/or at prevailing rates and CONTRACTOR has to pay such taxes, duties, levies etc., OWNER shall not be liable for payment of such liabilities and/or OWNER shall not reimburse such taxes, duties, levies etc. to CONTRACTOR.

5.4 **The award of work shall be on 'Work Contract Service' basis**.

The contractor shall be responsible for payment of any tax levied on the transfer of property and goods involved with relevant GST act and rules made there under including amendments, if any. The contractor shall be liable to ensure to have registered with the respective tax authorities and to submit self-attested copy of such registration certificate(s) and any taxes/ duties/ levies being charged by the Contractor would be claimed by issuing proper tax invoice/challan indicating details/ elements of all taxes charged and necessary requirements as prescribed under the respective tax laws and also to mention correct and valid registration number(s) on all tax invoices raised to TFL.

5.5 Any other taxes / duties in relation to this CONTRACT, which in terms of relevant legislation is the liability of CONTRACTOR, is discharged by OWNER, would be recovered from the CONTRACTOR from any subsequent payment due to the CONTRACTOR.

5.6 Applicable BOCW shall be included in the quoted TOTAL CONTRACT PRICE. The contractor shall pay the cess under BOCW Act for subject works and submit proof of submission of cess to owner before submitting the next R.A. bill. In case, contractor does not submit the said proof, applicable BOCW shall be deducted at source by the OWNER from the contractor's invoice and deposit the deducted amount to the concerned authority. OWNER does not undertake any further responsibility in this regard.

6.0 **INCOME TAX**

6.1 CONTRACT PRICE shall be inclusive of any and all Indian Income Tax payable in India. OWNER shall deduct Indian Income Tax as per rates prescribed for such contracts from time to time, from the payments due to CONTRACTOR and issue Tax Deducted at Source (TDS) certificate to CONTRACTOR. It will the responsibility of the CONTRACTOR to file proper income tax return and pay taxes thereon if any, or claim refund thereof if any. The CONTRACTOR shall give OWNER all necessary documents relating to its income tax assessments and to keep the OWNER informed about their assessments.

6.2 Personal income tax payable, if any, in respect of salary and perquisites of CONTRACTOR's personnel / SUB-CONTRACTOR's personnel in India shall be payable by the individual so deputed by CONTRACTOR or SUB-CONTRACTOR. It is the responsibility of the individual or CONTRACTOR to file proper income tax return and pay taxes thereon if any, or claim refund thereof if any. The CONTRACTOR shall give OWNER all necessary documents relating to income tax assessments of its personnel and to keep the OWNER informed about their assessments.

7.0 PATENT INFRINGEMENT AND INDEMNIFICATION (WHEREVER APPLICABLE)

7.1 PATENT INFRINGEMENT

7.1.1 CONTRACTOR shall at all times, indemnify and keep indemnified OWNER against all claims or suits and defend, at its own cost, any suit or action brought against OWNER and hold OWNER free and harmless against all costs of such claims or suits which may be made against OWNER in respect of any infringement of any rights protected by patent, copyright, trademarks, and trade secrets to the extent that such claim, suit, or action is a result of the use of CONTRACTOR's Technical Information for the construction, maintenance, and operation of PLANT and the use of CONTRACTOR's and/or any other process licenser's processes used in PLANT. OWNER shall pass on all claims made against it to CONTRACTOR for settlement.

7.1.2 CONTRACTOR declares that to the best of its knowledge and belief the use of CONTRACTOR's Technical Information for the construction, maintenance, and operation of PLANT and the use of CONTRACTOR's processes used in PLANT will not infringe any valid patent rights of a third party. However, if at any time such infringement arises, CONTRACTOR agrees to keep OWNER indemnified and harmless against such claims and costs thereof and make arrangements that will allow OWNER to continue the operation of PLANT.

7.1.3 OWNER shall promptly advise CONTRACTOR in writing of any claim of infringement or any action for infringement of patents brought against it by a third party and based upon the use of CONTRACTOR's Technical Information. If such use is in accordance with instructions given in writing by CONTRACTOR, CONTRACTOR shall undertake the defence, or assist OWNER in the defence, of the claim or suit up to final judgment or settlement.

7.1.4 CONTRACTOR shall undertake the defence on behalf of OWNER and shall have sole charge and direction of the defence, and shall bear all costs related thereto. CONTRACTOR shall further hold OWNER harmless from any damages or other sums that may become payable by OWNER under a final judgment or settlement. However, OWNER shall render to CONTRACTOR all reasonable assistance that may be required by CONTRACTOR in the defence, and shall have the right to be represented therein by advisory counsel of its own selection and at its own expense.

7.1.5 In addition to the measures specified in Clause7.1.4, CONTRACTOR may further, at its option, however, in reasonable consultation with OWNER, seek to abate the alleged infringement by modification of PLANT or its operation without adversely affecting the performance and/or secure for OWNER immunity from suit for infringement. In such case,

CONTRACTOR shall bear/ reimburse OWNER for all costs related to said modification and to said immunity.

7.1.6 In the event that OWNER is legally restrained from operating PLANT on account of any infringement action or suit, CONTRACTOR shall take all possible actions to allow OWNER to operate and use PLANT.

7.1.7 Neither CONTRACTOR nor OWNER shall settle or compromise any suit or action without the written consent of the other if settlement or compromise obliges the other to make any payment or part with any property or assume any obligations or surrender any rights or to be subjected to any injunction by reason of such settlement or compromise.

7.2 INDEMNITIES

7.2.1 INDEMNIFICATION FOR LIABILITIES

7.2.1. CONTRACTOR Indemnification for Liabilities

To the fullest extent permitted by Law, CONTRACTOR assumes liability for and agrees to indemnify, protect, save and hold harmless OWNER from and against any and all Liabilities (including, any strict liability), arising out of acts or omissions of CONTRACTOR or its personnel or its agents in the performance of its obligations under the CONTRACT causing bodily injury, sickness, disease or death, damage to or loss of any property, and whether or not involving damage to WORKS or SITE that may be imposed on, suffered or incurred by or asserted against OWNER and in any way relating to or arising out of (i) WORK, any EQUIPMENT (ii) the presence, discharge, treatment, storage, transportation, disposal, escape or release of any Hazardous Substance, or the threat thereof, at, to or from SITE after commencement of work (any hazardous substance already existing at SITE before commencement of WORK excluded)(iii) The performance of WORK, or as a result of personal injuries (including wrongful death); (iv) the violation by CONTRACTOR or any SUB-CONTRACTOR/VENDOR of any Government Approval or applicable Law relating to WORK (v) any breach of CONTRACT with any SUB-CONTRACTOR/VENDOR, provided, however, that CONTRACTOR shall not be required under this Clause to indemnify OWNER for any liability arising out of or resulting from events or circumstances occurring or existing after PRELIMINARY ACCEPTANCE OF PLANT except where the liability arises from an act or omission of CONTRACTOR or any SUB-CONTRACTOR/VENDOR or any other Person directly or indirectly employed by either of them or anyone for whose acts either of them may be liable that was a contributory cause of such liability.

7.2.2 CONTRACTOR Indemnification for Taxes

It is specifically understood that CONTRACTOR hereby accepts and assumes exclusive liability for and save and hold OWNER harmless from and against of all Taxes arising from the performance of WORK, and all such Taxes shall be deemed to be included in CONTRACT PRICE.

7.2.3 Indemnification by SUB-CONTRACTOR/VENDOR

CONTRACTOR shall obtain from each SUB-CONTRACTOR/VENDOR, which is an affiliate, and shall use all reasonable efforts to obtain from each SUB-CONTRACTOR/VENDOR, an indemnification materially similar in form and substance to Clause-7.1 and Clause-7.2.2 of which the OWNER shall be named as beneficiary.

7.2.4 **Payment of Amounts under this Clause**

Except to the extent covered by insurance, all amounts payable and due by CONTRACTOR to OWNER under this Clause shall be deducted from CONTRACT PRICE or any other amounts owed by OWNER to CONTRACTOR here under. If such amounts payable by OWNER to CONTRACTOR are less than the amounts payable and due by CONTRACTOR under this Clause, CONTRACTOR shall be liable to OWNER for such excess and shall pay such amount to OWNER immediately upon demand.

7.2.5 **Permits and Certificates**

CONTRACTOR shall procure, at its expense, all necessary permits, certificates and licences required by virtue of all applicable laws, regulations, ordinances and other rules in force at the place where any of the works is to be performed, and CONTRACTOR further agrees to hold OWNER harmless from liability or penalty which might be imposed by reason of any asserted or established violation of such laws, regulations, ordinances or other rule. OWNER shall provide the necessary permits for CONTRACTOR's personnel to undertake any work in India in connection with CONTRACT.

7.2.6 **Mechanics Lien**

CONTRACTOR agrees to indemnify and hold harmless OWNER against all labourer's material, man's and/or mechanic's liens arising from its work, and shall keep the premises of OWNER free from all such claims, liens and encumbrances.

8.0 CONTRACT PERFORMANCE SECURITY (CPS)

8.1 The proceeds of **CPS** shall be appropriated by the OWNER as compensation for any loss resulting from the CONTRACTOR's failure to complete their obligations under the CONTRACT without prejudice to any of the rights or remedies the OWNER may be entitled to as per terms and conditions of the CONTRACT.

8.2 The CONTRACTOR shall extend the validity of the **CPS** suitably if it is required due to delay in COMPLETION of the PLANT at it's own cost. The CPS shall be suitably extended in event of repair/replacement of equipment or any part thereof during DEFECT LIABILITY PERIOD to take care of extended warranty period of repair/ replacement. The CPS will be discharged by the OWNER after the CONTRACTOR's performance obligation including any warranty obligation under the CONTRACT. For any component replaced during DEFECT LIABILITY PERIOD, the component should work satisfactorily for a period of 12 months from the date of replacement

The CPS shall be retained by OWNER during the currency of CONTRACT as indicated above or till settlement of all the accounts thereof, whichever is later. In case of any dispute or differences not settled within the validity of CPS, contractor shall arrange to get the CPS extended for the period asked for by OWNER. In case CPS is not extended as asked, OWNER shall have the sole discretion to 'call in' the bank to pay the whole or part of the amount of bank guarantee/CPS. The above deposit shall be deemed to be security for the faithful performance of the CONTRACT and for the

purpose of section 74 of the Indian Contract Act, 1872 and for the extension of that section , the CPS shall deemed to be the bond given by the CONTRACTOR for the performance of essential duty. In the event of breach of any of the terms and conditions of the contract, OWNER shall have the right to draw from the CPS whole or part of the value of CPS. The amount so drawn shall not in any way affect any remedy to which OWNER may otherwise be entitled or any liability incurred by contractor under the contract or any law for the time being in force relating thereto or bearing here upon. This CPS shall be refunded 3 months after expiry of Defect Liability Period. It shall be lawful for OWNER if any differences or dispute is likely to arise to defer payment of the CPS or any portion thereof which may be due for release until such differences and dispute has been finally settled or adjusted. CPS amount shall not bear any interest.

NOTE:

In case CPS is submitted by way of Bank Guarantee, the non-judicial Stamp paper of appropriate value only or equivalent document value shall have to be purchased in the name of the bank executing the bank guarantee and not in the name of the CONTRACTOR.

8.3 **Rights of the OWNER to forfeit CPS:**

i) Whenever any claim against the CONTRACTOR for the payment of a sum of money arises out or under the CONTRACT, the OWNER shall be entitled to recover such sum by appropriating in part or whole the CPS of the CONTRACTOR. In the event of the security being insufficient or if no security has been taken from the CONTRACTOR, then the balance or the total sum recoverable, as the case may be shall be deducted from any sum then due or which at any time thereafter may become due to the CONTRACTOR. The CONTRACTOR shall pay to the OWNER on demand any balance remaining due.

ii) All compensation or other sums of money payable by the CONTRACTOR to the OWNER under terms of this CONTRACT may be deducted from or paid by the encashment or sale of a sufficient part of his CPS or from any sums which may be due or may become due to the CONTRACTOR by the OWNER of any account whatsoever and in the event of his Rights of the OWNER to forfeit CPS.

9.0 DELETED

10.0 SIGNING OF CONTRACT

10.1 All documents as per Clause 2.0 of GCC shall be included in the DLOA.

10.2 Every page of the DLOA &CONTRACT agreement shall be initialled by the authorised representatives of OWNER and CONTRACTOR under the Seal of their respective Companies.

10.3 The CONTRACTOR shall present the above CONTRACT AGREEMENT so prepared in two Sets alongwith proper Power of Attorney and other requisite material on the day of signing the agreement.

10.4 Notwithstanding anything mentioned in any other clause, any conditions imposed from time to time by Government of India shall be followed by the CONTRACTOR.

11.0 Deleted

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12.0 ASSIGNMENT OR SUBLETTING OF CONTRACT AND SUB-CONTRACTING

12.1 No part of the CONTRACT nor any share or interest therein shall in any manner or degree be transferred, assigned or sublet by the CONTRACTOR directly or indirectly to any person, firm or corporation whatsoever without the consent in writing, of the ENGINEER/EMPLOYER except as provided for in the succeeding sub-clause.

i. SUB-CONTRACTS FOR TEMPORARY WORKS ETC.:

The EMPLOYER may give written consent to Sub- contract for the execution of any part of the WORK at the site, being entered in to by CONTRACTOR provided each individual Sub- contract is submitted to the ENGINEER-IN-CHARGE before being entered into and is approved by him.

ii. LIST OF SUB-CONTRACTORS TO BE SUPPLIED

At the commencement of every month the CONTRACTOR shall furnish to the ENGINEER-IN-CHARGE list of all SUB-CONTRACTORS or other persons or firms engaged by the CONTRACTOR and working at the SITE during the previous month with particulars of the general nature of the Sub-contract or works done by them

iii. CONTRACTOR'S LIABILITY NOT LIMITED BY SUB- CONTRACTORS

Notwithstanding any sub-letting with such approval as aforesaid and notwithstanding that the ENGINEER-IN-CHARGE shall have received copies of any Sub-contracts, the contractor shall be and shall remain solely responsible for the quality, proper and expeditious execution of the Contract in all respects as if such sub-letting or Subcontracting had not taken place, and as if such work had been done directly by the CONTRACTOR. The CONTRACTOR shall bear all responsibility for any act or omission on the part of sub-contractors in regard to work to be performed under the CONTRACT.

iv. EMPLOYER MAY TERMINATE SUB-CONTRACTS

If any SUB-CONTRACTOR engaged upon the works at the site executes any works which in the opinion of the ENGINEER-IN-CHARGE is not in accordance with the CONTRACT documents, the EMPLOYER may by written notice to the CONTRACTOR request him to terminate such subcontract and the CONTRACTOR upon the receipt of such notice shall terminate such Subcontract and dismiss the SUB-CONTRACTOR(S) and the later shall forthwith leave the works, failing which the EMPLOYER shall have the right to remove such SUB- CONTRACTOR(S) from the site.

v. NO REMEDY FOR ACTION TAKEN UNDER THIS CLAUSE

No action taken by the EMPLOYER under the clause shall relieve the CONTRACTOR of any of his liabilities under the CONTRACT or give rise to any right or compensation, extension of time or otherwise failing which the EMPLOYER shall have the right to remove such SUB-CONTRACTOR(S) from the site

12.2 DELETED

12.3 **Sub-Contracting for WORKS (to be read in conjunction with clause regarding sub-contractors/Sub-vendors sharing land border with India as per Annexure-VII of tender document).**

12.3.1 **General**

All vendors, suppliers, consultants and SUB-CONTRACTORS/SUB-VENDORS providing equipment, materials, construction equipment, or services to CONTRACTOR under a SUBCONTRACT, purchase order or similar purchase form or arrangement with CONTRACTOR for the performance of the WORK under this CONTRACT are herein referred as "SUB-CONTRACTORS"/ “SUB-VENDORS”, and any such SUB-CONTRACTS, purchase orders or similar purchase forms or arrangement entered into by or on behalf of CONTRACTOR with SUB CONTRACTORS/SUB-VENDORS are herein referred to as "SUB-CONTRACTS" provided that none of OWNER's CONTRACTOR’S or SUB-CONTRACTOR’S/ SUB-VENDOR’S shall be deemed to be a SUB-CONTRACTOR/ SUB-VENDOR under the CONTRACTOR. The CONTRACTOR shall be obligated to select SUB-CONTRACTORS/ SUB-VENDORS it retains in connection with the performance by CONTRACTOR of the WORK from the SUB-CONTRACTOR’S/ SUB-VENDOR’S list which would be finalised and approved by the OWNER. OWNER and CONTRACTOR may by mutual agreement add to or delete from such list from time to time and approve any successor or replacement of any person listed on such list or any other vendor, supplier, material-man, consultant or SUB-CONTRACTOR/SUB-VENDOR.

12.3.2 **Approval of SUB-CONTRACTOR/SUB-VENDOR**

12.3.2.1 The vendor list for procurement of EQUIPMENT and the list of SUB-CONTRACTOR/SUB-VENDOR shall be as attached in the Section VI of NIT. Any changes to such list of SUB-CONTRACTOR/SUB-VENDOR shall require the prior approval of OWNER. CONTRACTOR shall provide name, address, fax number and name of contact person of major SUB-CONTRACTORS/SUB-VENDORS for use in future, to OWNER.SUB-CONTRACTOR/SUB-VENDOR as per agreed Vendor list are not subject to approval.

12.3.2.1.1 Under normal circumstance a CONTRACTOR shall not be allowed to source any equipment/machinery from the vendors other than the Owner’s approved vendor list. However, in exceptional circumstance the CONTRACTOR may suggest additional vendors meeting the following requirement for the approval of Owner.

a. The CONTRACTOR should specify, while pre-qualifying the Vendors, that during the past 7 years the Vendor should have supplied at least two similar plant equipments or machinery. The CONTRACTOR should satisfy themselves that

sufficient documentary proof is submitted by the Vendors in support of this criterion. However, in case of critical equipment, in addition to above criterion, the Vendor should also be prequalified by Process Licensor.

b. The CONTRACTOR would be ultimately responsible for verifying the credentials, the quality of the equipment, machinery and timely supply.

12.3.2.2 The review, approval and consent by OWNER as to the agreed SUB-CONTRACTOR's/VENDOR List or as to CONTRACTOR's entering into any SUB-CONTRACT / PURCHASE ORDER shall not relieve CONTRACTOR of any of its duties, liabilities or obligations under this CONTRACT and CONTRACTOR shall be liable hereunder to the same extent as if any such Subcontract had not been entered into.

12.3.2.3 (a) CONTRACTOR shall provide to OWNER such information concerning the SUB-CONTRACTORS as OWNER may from time to time reasonably request and shall ensure that each SUB-CONTRACT contains provisions in all material respects not less stringent than the provisions of the CONTRACT and shall include terms and provisions required to be included pursuant to the CONTRACT. In the event of termination of the CONTRACT under Clause 34.0 herein, CONTRACTOR shall forthwith deliver to OWNER a copy of each SUBCONTRACT.

(b) CONTRACTOR shall supervise and direct the work of all SUB-CONTRACTORS/SUB-VENDORS and shall be responsible for all design, engineering, procurement, manufacturing, transportation, delivery, fabrication, construction, commissioning, start-up and testing means, erection, operation, maintenance, repair, methods, techniques, sequences and procedures of, and for co-coordinating the work of SUB-CONTRACTORS/ SUB-VENDORS.

(c) If CONTRACTOR fails to correct, or commence to correct and execute the correction with due diligence of deficient or defective work performed by any SUB-CONTRACTOR/SUB-VENDORS within reasonable time (provided it doesn't materially impact safe operation of plant), after receipt by CONTRACTOR of a notice from OWNER with respect thereto, OWNER may (but shall not be obligated to), after seven days following receipt by CONTRACTOR of an additional notice, and without prejudice to any other right or remedy take all reasonable steps to remedy such defective or deficient work at risk and cost of CONTRACTOR.

(d) CONTRACTOR shall require all SUB-CONTRACTORS/SUB-VENDORS to perform the SUB-CONTRACTS in accordance with the relevant requirements of the CONTRACT, all APPLICABLE LAWS and APPLICABLE PERMITS, Prudent Utility Practice, Good Engineering Practices, the requirements of the NIT, and all Warranties of SUB-CONTRACTORS/SUB-VENDORS and Manufacturers and all insurance policies relating to the PLANT or the WORK.

(e) CONTRACTOR shall be solely responsible for paying each SUB-CONTRACTOR/SUB-VENDOR and any other person to whom any amount is due from CONTRACTOR for services, equipment, construction equipment, materials or supplies otherwise related to the PLANT or the WORK.

CONTRACTOR shall take all reasonable steps and actions to ensure that such services, equipment, construction equipment materials and supplies and the like have been or will be received, inspected and approved and that such services have been or will be properly performed.

(f) In performing the duties incidental to its responsibilities hereunder, CONTRACTOR shall issue to the SUB-CONTRACTORS/SUB-VENDORS such directives and impose such restrictions as may be required to obtain such compliance herewith and with the terms of the SUB-CONTRACTS.

12.3.2.4 **SUB-CONTRACTOR/VENDOR AND MANUFACTURER WARRANTIES**

(a) CONTRACTOR shall ensure that all equipment and other items used in connection with the performance of the WORK or incorporated in the PLANT (other than minor items) will be purchased in compliance with CONTRACT Technical Specifications and requirements in order to allow the Plant to achieve the Guarantee and Warrantee as provided for in the CONTRACT, unless otherwise agreed with OWNER.Any residual warranty from sub-contractor/vendor shall be passed to the OWNER after expiry of DEFECT LIABILITY PERIOD.

(b) Neither CONTRACTOR nor its SUB-CONTRACTORS/SUB-VENDORS nor any person under the control of either thereof, shall take any action which could release, void, impair or waive any Guarantee or Warranty on EQUIPMENT or services relating to the PROJECT or the WORK. Any residual warranty from sub-contractor/sub-vendor shall be passed to the OWNER after expiry of DEFECT LIABILITY PERIOD.

(c) Nothing in this clause shall derogate from the obligations of CONTRACTOR to provide the Guarantees and Warranties described in and to comply with the provisions hereinabove.

(d) CONTRACTOR shall, based on its past professional judgement enforce all guarantees and warranties provided hereunder to the fullest extent thereof till such time they are transferred to the OWNER pursuant to sub-clause (g) below.

(e) Upon the expiration or termination of any of the guarantees or warranties provided by CONTRACTOR pursuant to the CONTRACT, the CONTRACTOR shall assign, and hereby assigns, effective as of such date, or otherwise make available, to OWNER all of CONTRACTOR's rights under all such SUBCONTRACTOR's residual Guarantees and warrantee as per 12.3.2.4(a) & (b)(except to the extent CONTRACTOR has thereof provided warranty services to OWNER and is enforcing CONTRACTOR's rights with respect to such services under the applicable guarantee or warranty) and shall deliver to OWNER copies of all contracts providing for such guarantees and warranties.

(f) CONTRACTOR, in accordance with the CONTRACT, shall require all SUB-CONTRACTORS/SUB-VENDORS to be covered by the insurance covers specified in the CONTRACT, during the time in which they are engaged in performing WORK.

(g) CONTRACTOR shall require all SUB-CONTRACTORS/SUB-VENDORS to release and waive any and all rights of recovery against OWNER including its affiliates, subsidiaries, employees, successors, permitted assigns, insurers and underwriters) and against CONTRACTOR and all other SUB-CONTRACTORS/VENDORS which the releasing SUB-

CONTRACTOR/VENDOR may otherwise have or acquire, in or from or in any way connected with any loss covered by policies of insurance maintained or required to be maintained pursuant to this the CONTRACT (other than third party liability insurance policies) or because of deductible clauses in or inadequacy of limits of any such policies of insurance. CONTRACTOR shall further require all SUB-CONTRACTORS/VENDORS to include in all policies of insurance maintained by the SUB-CONTRACTORS/VENDORS clauses providing that each underwriter shall release and waive all of its rights of recovery, under subrogation or otherwise, against OWNER, its promoters, affiliates, subsidiaries, employees, successors, permitted assigns, insurers and underwriters, and against CONTRACTOR and all other SUB-CONTRACTORS/VENDORS.

(h) OWNER shall not be deemed by virtue of the CONTRACT to have any contractual obligation to or relationship with any SUB-CONTRACTOR/VENDOR.

12.3.2.5 **CONTRACTOR's LIABILITY FOR APPROVED SUB CONTRACTOR :**

The review by and approval and consent of OWNER as to the approved SUB-CONTRACTORS list or as to CONTRACTOR entering into any SUB-CONTRACT with any approved SUB-CONTRACTOR or as to any WORK done or supply made or services provided by any such approved SUB-CONTRACTOR/SUB-VENDOR shall not relieve CONTRACTOR of any of his duties, liabilities or obligations under this CONTRACT, and CONTRACTOR shall be liable hereunder to the same extent as if any such SUB-CONTRACT had not been entered into. Any inspection review or approval by OWNER permitted under this CONTRACT of any portion of the work or of any work in progress by CONTRACTOR or SUB-CONTRACTORS/SUB-VENDORS shall not relieve CONTRACTOR of any duties, liabilities or obligations under this CONTRACT.

12.3.3 All WORK performed or EQUIPMENT supplied by SUB-CONTRACTOR/ SUB-VENDOR shall be pursuant to an appropriate SUB-CONTRACT, PURCHASE ORDER or similar agreement which shall, as appropriate, contain provisions that:

12.3.3.1 Preserve and protect all the rights of OWNER here under for WORK to be performed or EQUIPMENT to be supplied under PURCHASE ORDER or SUB-CONTRACT.

12.3.3.2 Require that such WORK be performed or EQUIPMENT be fabricated, supplied and installed in strict accordance with the applicable requirements of this CONTRACT.

12.3.3.3 Obligate such SUB-CONTRACTOR/SUB-VENDOR to consent to and be bound by those obligations under this CONTRACT which by their terms are intended to also obligate such SUB-CONTRACTOR/VENDOR, including the provisions of this Clause.

12.3.3.4 Require such SUB-CONTRACTOR/SUB-VENDOR to provide and maintain adequate insurance consistent with requirements for companies of similar size and performing similar services. Permit the assignment of such SUB-CONTRACT/PURCHASE ORDER by CONTRACTOR to OWNER.

12.3.3 **CONTRACTOR RESPONSIBLE FOR WORK**

12.3.4.1 CONTRACTOR is responsible for WORK, and that the performance thereof conforms in all respects to the requirements of this CONTRACT, regardless of any failure of any SUB-

CONTRACTOR/VENDOR to perform or any disagreement between any SUB-CONTRACTOR/VENDOR or between any SUB-CONTRACTOR/VENDOR and CONTRACTOR. CONTRACTOR shall furnish such information relative to its SUB-CONTRACTOR/VENDOR (including copies of unpaid SUB-CONTRACT or PURCHASE ORDER) as OWNER may request.

12.3.5 **DAMAGES**

It is within the discretion of Contractor, that CONTRACTOR shall agree to hold all SUB-CONTRACTOR/VENDOR, including all persons directly or indirectly employed by them, responsible for any damages due to breach of CONTRACT caused by them or any negligent act and to diligently endeavour to effect recoveries in such damages..

13.0 STANDARDS

The goods and services supplied under this CONTRACT shall conform to the standards mentioned in the technical specifications and when no applicable standard is mentioned, CONTRACTOR to follow best engineering practices.

14.0 INSTRUCTIONS, DIRECTIONS

14.1 The materials described in CONTRACT are to be supplied according to the standards, data sheets, tables, specifications and drawings attached hereto and/or enclosed with the CONTRACT itself and according to all conditions both general and specific enclosed with the CONTRACT, unless any or all of them shall have been modified or cancelled in writing as a whole or in part.

A) All instructions and orders to CONTRACTOR shall, except what is herein provided, be given by OWNER/ CONSULTANT.

B) All the work shall be carried out under the direction of OWNER and according to the CONTRACT requirements.

C) All communications including technical/ commercial clarifications and/ or comments shall bear reference to the CONTRACT.

D) Invoice for payment against CONTRACT shall be addressed to OWNER.

E) The CONTRACT/DLOA number shall be shown on all invoices, communications, packing lists, containers and bills of lading etc.

15.0 DELETED

16.0 TIME SCHEDULE AND PROGRESS REPORTING

16.1 **Time Schedule Network/Bar Chart**

16.1.1 Together with the CONTRACT confirmation, CONTRACTOR shall submit to OWNER, his time schedule regarding the documentation, supply and manufacture of equipment and materials as well as information of his SUBCONTRACTS to be placed with third parties, including the dates on which CONTRACTOR intends to issue such SUB CONTRACTS. A complete activity-wise time schedule shall be furnished by the CONTRACTOR within 30 days from the date of issuance of FOA.

16.1.2 The time schedule will be in the form of a network or a bar chart clearly indicating all main or key events regarding documentation, supply of raw materials, manufacturing, testing, delivery, erection & commissioning.

16.1.3 The original issue and subsequent revisions of CONTRACTOR's time schedule and/or SUB-CONTRACTORS' time schedules shall be sent in two copies to OWNER.

16.1.4 The time schedule network/bar chart shall be updated at least every month using the latest 'Project Management software', i.e. Primavera (latest version), acceptable to the OWNER.

16.2 PROGRESS TREND CHART/MONTHLY REPORT

16.2.1 CONTRACTOR shall report monthly to OWNER of the execution of CONTRACT and achievement of targets set out in time bar chart, in a monthly progress report on 7th working *day* of every Month.

16.2.2 The progress will be expressed in percentages shown in the progress trend chart.

16.2.3 The first issue of the progress trend chart will be forwarded together with the time bar chart along with CONTRACT confirmation.

16.2.4 The monthly reporting will bear the updating of the progress trend chart.

16.2.5 OWNER or his representatives shall have the right to inspect CONTRACTOR's premises to evaluate the actual progress of work on the basis of CONTRACTOR's time schedule documentation.

16.2.6 Irrespective of such inspection, CONTRACTOR shall advise OWNER at the earliest possible date of any anticipated delay in the programme indicating the reasons thereof and corrective measures proposed thereto.

16.2.7 The time for completion and phased time schedule shall be subject to and in accordance with the provision of Sub-Clauses 16.2.8 and 16.2.9 below.

16.2.8 Neither OWNER nor CONTRACTOR shall be considered in default in performance of their obligations if such performance is prevented or delayed by FORCE MAJEURE conditions as stated in Clause 35.0.

16.2.9 Should the CONTRACTOR's preparation for the commencement of the work or any portion of it or its subsequent rate of progress be from any cause whatsoever, so slow and reasons for delay solely attributed to the contractor, the CONTRACTOR will not be able to complete the work or any portion thereof within the stipulated time for completion, the provisions of Clause 34 of GCC shall apply.

16.2.10 In the event that the delay is caused by a delay in the delivery of a sub-contracted EQUIPMENT, CONTRACTOR shall be responsible for such delay and submit details together with copies of the appropriate orders and agreements with SUB-CONTRACTOR/vendor.

17.0 CONTRACTOR TO INFORM HIMSELF FULLY

The CONTRACTOR in fixing his rate shall for all purpose whatsoever reason may be, deemed to have himself independently obtained all necessary information for the purpose of preparing his offer and his offer as accepted shall be deemed to have taken into account all contingencies as may arise due to such information or lack of same. The correctness of the details, given in the Tender Document to help the CONTRACTOR to make up the tender is not guaranteed.

The CONTRACTOR shall be deemed to have examined the CONTRACT DOCUMENTS, to have generally obtained his own information in all matters whatsoever that might affect the carrying out of the works at the schedules rates and to have satisfied himself to the sufficiency of his offer. Any error in description of quantity or omission there from shall not vitiate the CONTRACT or release the CONTRACTOR from executing the work comprised in the CONTRACT according to DRAWINGS and SPECIFICATIONS at the scheduled rates. CONTRACTOR is deemed to have known the scope, nature and magnitude of the WORKS and the requirements of materials and labour involved etc., and as to what all works he has to complete in accordance with the CONTRACT documents whatever be the defects, omissions or errors that may be found in the DOCUMENTS. The CONTRACTOR shall be deemed to have visited surroundings, to have satisfied himself to the nature of all existing structures, if any, and also as to the nature and the conditions of the Railways, Roads, Bridges and Culverts, means of transport and communication, whether by land, water or air, and as to possible interruptions thereto and the access and egress from the site, to have made enquiries, examined and satisfied himself as to the sites for obtaining sand, stones, bricks and other materials, the sites for disposal of surplus materials, the available accommodation as to whatever required, depots and such other buildings as may be necessary for executing and completing the works, to have made local independent enquiries as to the sub-soil, subsoil water and variations thereof, storms, prevailing winds, climatic conditions and all other similar matters effecting these works. He is deemed to have acquainted himself as to his liability of payment of Government Taxes, Customs duty and other charges, levies etc.

Any neglect or omission or failure on the part of the CONTRACTOR in obtaining necessary and reliable information upon the foregoing or any other matters affecting the CONTRACT shall not relieve him from any risks or liabilities or the entire responsibility from completion of the works at the scheduled rates and times in strict accordance with the CONTRACT.

It is, therefore, expected that should the CONTRACTOR have any doubt as to the meaning of any portion of the CONTRACT DOCUMENT he shall set forth the particulars thereof in writing to OWNER in duplicate, before submission of tender. The OWNER may provide such clarification as may be necessary in writing to CONTRACT, such clarifications as provided by OWNER shall form part of CONTRACT DOCUMENTS.

No verbal agreement or inference from conversation with any effect or employee of the OWNER before, during or after the execution of the CONTRACT agreement shall in any way affect or modify and of the terms or obligations herein contained.

Any change in layout due to site conditions or technological requirement shall be binding on the CONTRACTOR and no extra claim on this account shall be entertained

18.0 SUITABILITY OF PLANT FOR INTENDED PURPOSE

18.1 The CONTRACTOR warrants that the PLANT will be suitable in all respects for the purpose mentioned or inherent in the specification and as defined in the CONTRACT.

18.2 Without limiting the generality of the foregoing clause, the CONTRACTOR shall ensure before complying with any direction, that compliance by the CONTRACTOR with that direction will not render the plant unsuitable in any respect for the aforesaid purposes or otherwise prevent the CONTRACTOR from carrying out the CONTRACT in accordance with the terms thereof.

18.3 The CONTRACTOR shall give notice to the OWNER within Twenty one (21) days after receipt of any requirement or direction which he considers will render the plant unsuitable in any respect or is not in accordance with the meaning and intent of the CONTRACT OR otherwise prevent the CONTRACTOR from carrying out the CONTRACT or as aforesaid and submit to the OWNER a proposal or proposals for modifying the requirement or direction. Failure to file an objection within the allotted time will be considered as acceptance of the OWNER's decision and the decision shall become final and binding.

19.0 FEES FOR ROYALITIES AND PATENT RIGHTS (WHEREVER APPLICABLE)

19.1 Payment Due to be Included in CONTRACT PRICE

19.1.1 All payments for royalties, patent rights and fees due to or payable for or in connection with any matter or thing used or required to be used in performance of the CONTRACT or to be supplied under the CONTRACT, whether payable in one sum or by instalments or otherwise, shall be included by the CONTRACTOR in the prices named in the CONTRACT and shall be paid by CONTRACTOR to whom such payments may be due or payable.

19.1.2 The CONTRACTOR, if licensed under any patent covering equipment, machinery, materials or compositions of matter to be used or supplied or methods and process to be practiced or employed in the performance of this CONTRACT, agrees to pay all royalties and license fees which may be due with respect thereto. If any equipment, machinery, materials, composition of matters, be used or supplied or methods and processes to be practiced or employed in the performance of this CONTRACT, is covered by a patent under which the CONTRACTOR is not licensed then the CONTRACTOR before supplying or using the equipment, machinery materials, composition method or processes shall obtain such licenses and pay such royalties and license fees as may be necessary for performance of this CONTRACT. In the event the CONTRACTOR fails to pay any such royalty or obtain any such license, any suit for infringement of such patents which is brought against the CONTRACTOR or the OWNER as a result such failure will be defended by the CONTRACTOR at his own expense and the CONTRACTOR will pay any damages and costs awarded in such suit. The CONTRACTOR shall promptly notify the OWNER if the CONTRACTOR has acquired the knowledge of any plant under which a suit for infringement could be reasonably brought because of the use by the OWNER of any equipment, machinery, materials, process, methods to be supplied hereunder. The CONTRACTOR agrees to and does hereby grant to OWNER, together with the right to extend the same to any of the subsidiaries of the OWNER as irrevocable, royalty free license to use in any country, any invention made by the CONTRACTOR or his employee in or as result of the performance of the WORK under the CONTRACT.

19.2 Payment to the CONTRACTOR by OWNER

19.2.1 Final payment to the CONTRACTOR by the OWNER will not be made while any such suit or claim remains unsettled. In the event any apparatus or equipment or any part thereof furnished by the CONTRACTOR is in such suit or proceedings, held to constitute infringement, and its use is enjoined, the CONTRACTOR shall, at his option, and at his own expense, either procure for the OWNER the right to continue use of the said apparatus, equipment or part thereof, replace it with non-infringing apparatus or equipment or modify it, so that it becomes non-infringing.

20.0 ACTS OF PARLIAMENT, LOCAL AND OTHER AUTHORITIES REGULATIONS AND BYE-LAWS

20.1 Complying With Regulations

20.1.1 Throughout the execution of the WORK, the CONTRACTOR shall comply with the requirements of all applicable laws and regulations, bye-laws or orders made there under and to the requirements of public, municipal and other authorities in any way affecting or applicable to the work. The OWNER shall, when requested by the CONTRACTOR, give all reasonable assistance to the CONTRACTOR in obtaining information concerning local conditions.

20.1.2 Before making any departure from the specification or drawings which may be necessary to conform to such requirements, the CONTRACTOR shall give the OWNER written notice specifying the departure proposed to be made and the reason for making it and applying for instructions thereon. If the CONTRACTOR does not receive such instructions within thirty (30) days, he shall conform to those requirements and inform the OWNER accordingly.

20.2 Notices and Fees

The CONTRACTOR shall give all notices required to be given by the Acts, regulations, bye-laws, orders and requirements referred to in sub-clause 20.1 of this clause and shall pay all fees payable in connection herewith.

Any additional fee becoming applicable due to any change of Acts, regulations, by-laws, orders and requirements after date of submission of FINAL PROPOSAL shall be borne by OWNER in accordance with SCC clause 3.0.

21.0 TIME- PROJECT SCHEDULE

21.1 Without prejudice to anything contained in the CONTRACT, the time and the date of completion of the works as stipulated in the CONTRACT shall be deemed to be of the utmost importance. The CONTRACTOR shall so organise his resources and perform his work so as to complete it within the completion period.

21.2 The contractor shall submit the Primavera Level 4 schedule within thirty (30) days from date of issuance of FOA.

The Primavera Level 4 schedule shall be for OWNER´s review and be based on a level 2 schedule as attachment to the CONTRACT. Such level 2 schedule shall show the

execution periods for (i) engineering, (ii) procurement & delivery of equipment and materials, (iii) & erection (iv) Mechanical Completion and (v) commissioning, testing.

CONTRACTOR shall be contractually obliged to issue a Primavera Level 4 schedule provided that such schedule shall not (i) accelerate the OWNER obligations (to be agreed upon prior to Contract award) (ii) change the GUARANTEED COMPLETION DATE.

21.3 The above Primavera Level 4 schedule shall be periodically reviewed and reports shall be submitted by the CONTRACTOR as directed by the OWNER.

22.0 CONTRACT PRICE

22.1 CONTRACT PRICE is inclusive of the cost/fees of CONTRACTOR's obligations as given below briefly but not limited to the following:

a. Detailed Engineering
b. Basic Engineering
c. Supply of all, Equipment, Bulk Materials, Chemicals & Lubricants and consumables
d. 2 months vendor supervision assistance.
e. Supply of spares
f. All applicable taxes and duties including GST, Indian Income Tax, etc.
g. Forwarding charges, if applicable
h. Freight up to SITE including taxes
i. Unloading, storage at Site, Site Assembly, Erection, Pre-Commissioning and Commissioning until Preliminary Acceptance of Plant.
j. Insurance
k. Inspection and expediting charges
l. Project management and overheads,
m. Guarantee test runs and handing over of PLANT to OWNER.
n. All other costs, expenses and outgoings of the CONTRACTOR not otherwise expressly set forth herein necessary, required or incidental to the full, complete and proper performance and discharge of the CONTRACTOR's obligations under and in accordance with the CONTRACT including completion of the PLANT in all respects and overheads of the CONTRACTOR.

22.2 OWNER shall pay to CONTRACTOR a lump-sum fixed CONTRACT PRICE for the due and faithful performance of CONTRACTOR's obligations under the CONTRACT. CONTRACT PRICE provided for in this Clause covers entire consideration payable to CONTRACTOR for all obligations of CONTRACTOR.

22.3 CONTRACT PRICE is inclusive of cost of all travel, accommodation, living costs and all other expenses of management and personnel of CONTRACTOR, SUB-CONTRACTOR, VENDOR for travelling to and from plant SITE and other places/countries as may be necessary for the proper performance of CONTRACTOR's responsibilities under CONTRACT and shall also include all costs and expenses incurred in attending such meetings in connection with CONTRACT as OWNER may reasonably require.

22.4 CONTRACT PRICE is inclusive of cost of all CONTRACTOR's EQUIPMENT, materials, services, etc. required to complete WORK under CONTRACT.

22.5 All taxes, duties, licence fees and other such levies as may be applied to the CONTRACT, including Custom Duty, all applicable taxes & duties under GST, Corporate income tax in respect of the performance of the CONTRACT as well as income tax on the personnel deputed by the CONTRACTOR to India in connection with the CONTRACT shall be to the account of the CONTRACTOR.

23.0 DEDUCTIONS FROM CONTRACT PRICE

All costs, damages or expenses which the OWNER may have paid for which, under the CONTRACT, the CONTRACTOR is liable, will be claimed by the OWNER. All such claims shall be billed by the OWNER to the CONTRACTOR regularly as and when they fall due. Such claims shall be paid by the CONTRACTOR within fifteen days of the receipt of the corresponding bills and if not paid by the CONTRACTOR within the said period, the OWNER may then deduct the amount from any bill due or becoming due by him to the CONTRACTOR under the CONTRACT or may be recovered by action of law or otherwise, if the CONTRACTOR fails to satisfy the OWNER of such claims.

24.0 Deleted

25.0 Deleted

26.0 TAXES APPLICABLE TO CONTRACTOR'S MANPOWER, TURNOVER, EQUIPMENT, ETC.

26.1 The CONTRACTOR shall be liable and pay all taxes, duties, levies, lawfully assessed against the OWNER or the CONTRACTOR in pursuance of the CONTRACT. The CONTRACTOR shall be solely responsible for all taxes that may be levied on the CONTRACTOR's turnover & profit or on the earnings of any of his employees or personnel engaged by him and shall hold the OWNER indemnified and harmless against any claims that may be made against the OWNER in this behalf. The OWNER does not undertake any responsibility whatsoever regarding any taxes levied on CONTRACTOR and/or his personnel by Centre/State/Local Authorities. The Taxes shall be deducted where the said provisions shall be applicable and/or obligatory on the part of the OWNER.

26.2 For CONTRACTORS who have to bring equipment and material from outside Odisha, will have to obtain necessary registrations and take appropriate steps as required under Odisha State Laws. Further, form 38 / E-Waybill / Road Permit shall be issued by the CONTRACTOR in such cases, wherever applicable. Necessary statutory registrations as required shall be done by CONTRACTOR in this regard.

26.3 CONTRACTOR is responsible for obtaining Customs clearance permit for temporary importation on re-export basis of CONTRACTOR'S EQUIPMENT, tools and tackles etc. If any duties, taxes and expenses are payable on this, the same will be to CONTRACTOR'S account.

27.0 PACKING, FORWARDING AND SHIPMENT

27.1 The CONTRACTOR shall give complete despatch information concerning the weight, size, content of each package including any other information the OWNER may require.

27.2 The CONTRACTOR, wherever applicable shall after proper painting, pack and crate all equipment in such a manner as to protect it from deterioration and damage during rail and road transportation to the site and storage at the site till the time of erection. The CONTRACTOR shall be held responsible for all damages due to improper packing.

27.3 The CONTRACTOR shall notify the OWNER of the date of each shipment from his works, and the expected date for arrival at the site for the information of the OWNER. The CONTRACTOR will be responsible for arranging any requirement of over-dimensional, special rail/road wagon/trailer for transporting.

27.4 The CONTRACTOR shall also give all shipping information concerning the weight, size and content of each package including any other information the OWNER may require. The size of the largest packages being considered as over dimensional consignments shall be as per the latest guidelines.

27.5 The CONTRACTOR shall prepare detailed packing lists of all packages and containers, bundles and loose materials forming each and every consignment despatched to the site. The CONTRACTOR shall further be responsible for making all necessary arrangements for loading, unloading and other handling, right from works till the SITE and also till the EQUIPMENT is erected, tested and commissioned. The CONTRACTOR shall be solely responsible for proper storage and preservation of all equipments& machineries etc.

28.0 INSURANCE

28.1 CONTRACTOR shall take in the joint name of CONTRACTOR and OWNER comprehensive transit insurance for imported and indigenous goods. Transit-cum-Storage-Erection insurance or its equivalents and third party liability insurance policies shall be taken with reputed underwriters to cover ALL RISK whatsoever during the whole period starting with dispatch of GOODS from CONTRACTOR's warehouses/ Exworks in foreign country to CIF port of shipment for imported GOODS and EXW at Contractor's works for indigenous GOODS and shall further cover for performing services in India for transportation, loading, unloading, assembly, erection, testing COMMISSIONING of PLANT till care and custody is transferred to OWNER.

28.1.1 Contractor shall take Public Liability (Third Party) Insurance cover of 10% of TOTAL CONTRACT PRICE.

28.1.2 Contractor shall ensure that in addition to "Erection All risk policy", the coverage in respect of workmen compensation, ESI/Health Insurance, Professional Indemnity (with the amount of minimum excess) has been appropriately taken.

28.2 CONTRACTOR shall be fully responsible for pursuing and settling all claims under the underwriters. In the event of accident, injury, damage or loss likely to form a claim under the above insurance policies, CONTRACTOR shall, as quickly as possible submit the insurance claims by underwriters under intimation to OWNER. CONTRACTOR shall also keep OWNER fully informed about progress of each such case. CONTRACTOR shall undertake immediate repair and replacement of the equipment lost in transit, storage, assembly, erection and COMMISSIONING of PLANT pending settlement of claim thereafter by the underwriters.

28.3 The CONTRACTOR at his cost shall arrange, secure and maintain all insurance as may be pertinent to the works and obligatory in terms of law to protect his interest and interest of OWNER in the project, against all perils detailed herein. The Form and the limit of such insurance as defined herein together with the under-writer in each case shall be acceptable to the OWNER andOWNER´s acceptance shall not be unreasonably withheld. However, irrespective of such acceptance, the responsibility to maintain adequate insurance coverage at all times including third party liability during the period of contract shall be as of CONTRACTOR alone. The contractor's failure in this regard shall not relieve him of any of his contractual responsibilities and obligations. The insurance covers to be taken by the CONTRACTOR shall be in the joint names of OWNER and the CONTRACTOR. The CONTRACTOR shall, however, be authorised to deal directly with insurance company or companies and shall be responsible in regard to maintenance of all insurance covers.

28.4 All insurance other than marine insurance for transportation outside India is to be covered from IRDA approved insurance company registered in India. There should be a single cover for marine cum inland transit, storage and erection upto PRELIMINARY ACCEPTANCE OF PLANT.

However adequacy, credibility and maintenance of Insurance policies is sole responsibility of CONTRACTOR and CONTRACTOR shall keep the OWNER indemnified against any such failure.

All insurance covers shall be taken by CONTRACTOR in joint name of CONTRACTOR and OWNER.

Alternatively, the CONTRACTOR has the option to take separate Insurances as

1. Marine Cargo Insurance for transit of all imported and indigenous goods from Ex -Works at CONTRACTOR'S/SUB-CONTRACTOR's works to Site.
2. Erection and All Risk (EAR) Insurance
3. Third Party Liability Insurance

Marine Cargo Insurance and Third Party Liability Insurance can be a part of Global Policy of the CONTRACTOR. However certificate of endorsement in favour of OWNER shall be provided by the CONTRACTOR from the insurance company. These two global policies of Marine Cargo Insurance and Third Party Liability Insurance shall be counter guaranteed by Indian Insurance Company. However, Erection and All Risk (EAR) is to be covered from Insurance Company registered in India and shall be separate dedicated policies for OWNER.

28.5 Any loss or damage to the equipment during handling, transportation, storage, erection, putting the equipment into satisfactory operation and all activities to be performed till the successful completion of trial operation of the plant shall be to the account of the CONTRACTOR. The CONTRACTOR shall be responsible for reference of all claims and make good the damages or loss by way of repairs and/or replacement of the equipment, damaged or lost. The CONTRACTOR shall provide the OWNER with copies of all insurance policies and documents taken out by him in pursuance of the CONTRACT. Such copies of documents shall be submitted to the OWNER immediately after such insurance coverage. However, if Marine cargo insurance or Third party liability Insurance is a part of their global policies; insurer certificate (including the main terms of policy) shall be submitted by CONTRACTOR. The CONTRACTOR shall also inform the OWNER in the writing at least thirty (30) days in advance regarding the expiry/

cancellation and/or change in any of such documents and ensure revalidation, renewal etc. as may be necessary well in time. However adequacy, credibility and maintenance of Insurance policies is the sole responsibility of CONTRACTOR and CONTRACTOR shall keep the OWNER indemnified against any such failure.

28.6 The perils required to be covered under the insurance shall include, but not be limited to fire and allied risks, miscellaneous accidents (erection risks) workman compensation risks, loss or damage in transit, theft, pilferage, riot and strikes and malicious damages, civil commotion, weather conditions, accidents of all kinds, war risks (during ocean transportation only) etc. The scope of such insurance shall be adequate to cover the replacement/reinstatement cost of the equipment for all risks till the equipment is taken over by the OWNER. The insurance policies to be taken should be on replacement value basis and/or incorporating escalation clause. Notwithstanding the extent of insurance cover and the amount of claim available from the underwriters, the CONTRACTOR shall be liable to make good the full replacement/rectification of all equipment/materials and to ensure their availability as per project requirements without additional financial liability to the OWNER.

The workman compensation policy taken by the SUB-CONTRACTOR of the CONTRACTOR shall be passed on to the OWNER.

28.7 CONTRACTOR shall at its own cost and initiative at all times upto the successful completion of PRELIMINARY ACCEPTANCE, take out and maintain all insurable liability, including but not limited to third Party insurance and liabilities under the Motor Vehicles Act, Worker's Compensation Act, Fatal Accidents Act, Personal Injuries Insurance Act, Emergency Risk Insurance Act and/or other Industrial Legislation from time to time in force in India with Insurance Company(ies), such policy(ies) shall not be of lesser limits hereunder specified with reference to the matters hereunder specified, namely:

- Workmen's Compensation Insurance to the limit to which compensation may be payable under Indian laws.

28.8 All cost on account of insurance liabilities covered under the CONTRACT will be to the CONTRACTOR'S account and will be included in the CONTRACT PRICE. The CONTRACTOR, while arranging the insurance, shall ensure to obtain all discounts on premium, which may be available for higher volume or for reason of financing arrangement of the project.

28.9 Irrespective of single or separate insurances, the CONTRACTOR shall take the same in the joint name of OWNER and CONTRACTOR, with OWNER as Primary Beneficiary and CONTRACTOR as Joint Beneficiary, to cover all risk including marine cum erection insurance (MCE), workmen compensation / Employees State Insurance (ESI) under ESI Act 1948 for Contractor's personnel, fire risk policy etc. till handing over of PLANT to OWNER duly commissioned and tested. However, for CONTRACTOR"s EQUIPMENT, CONTRACTOR can be the sole beneficiary.

Further, OWNER shall have the first right over the claim amount for all insurance claims, where owner has made part or full payment to the contractor.

However, OWNER should have first right over the claim amount in case payment for the "equipment damaged" has already been paid to the CONTRACTOR

28.10 The CONTRACTOR shall be fully responsible for pursuing and settling all claims with the underwriters within stipulated timelines. In the event of accident, injury, damage or loss likely to form a claim under the above insurance policies, the CONTRACTOR shall as quickly as possible but not later than the claim period submit such details as are necessary for settling such claims by underwriters and shall also provide information and assistance necessary to settle the claim. The CONTRACTOR shall also keep OWNER fully informed about progress of each such case.

28.11 All charges on account of insurance shall be included in TOTAL LSTK PRICE/TOTAL CONTRACT PRICE.

29.0 Deleted

30.0 LIABILITY FOR ACCIDENTS AND DAMAGES

30.1 Under the CONTRACT, the CONTRACTOR shall be responsible for loss or damage to the PLANT and provide new equipment and machineries in lieu of equipment/machineries lost/damaged beyond repairs, free of cost until the PLANT is handed over after successful completion of performance guarantee test run.

Notwithstanding the provisions in the CONTRACT, the CONTRACTOR shall not be responsible for any loss or damage to the PLANT or any part thereof if and to the extent that such loss or damage is not covered by insurance coverage such as War risk, provided the same is general exclusion of the policy of the EAR insurance. War Risks shall mean any of the following events occurring within India:
War , hostilities, warlike operations (whether a state of war be declared or not), invasion, act of foreign enemy, civil war, rebellion, terrorism, revolution, insurrection, mutiny, usurpation of civil or military government, conspiracy, riot, civil commotion, mine, bomb, shell, grenade or other projectile, missile, munitions or explosive of war.

30.2 The CONTRACTOR shall indemnify the OWNER in respect of all damage or injury to any person or to any property (other than property forming part of the Work) and against all actions, suits, claims, demands, costs, charges and expenses arising in connection therewith which shall have been occasioned by the negligence of the CONTRACTOR or any SUB-CONTRACTOR, or by defective design (other than a design made, furnished or specified by the OWNER and which the CONTRACTOR has disclaimed responsibility in writing within a reasonable time after receipt of the OWNER's instructions) material or workmanship, any breach of the CONTRACTOR's obligations.

31.0 Deleted

32.0 Deleted

33.0 TIME EXTENSION OF CONTRACT

33.1 The CONTRACTOR shall promptly notify the ENGINEER-IN-CHARGE any event or conditions which might delay the completion of erection work in accordance with the approved schedule and the steps being taken to remedy such situation.

33.2 If the Work is delayed at any time in the commencement or during the progress of the WORK by any act, delay or neglect solely attributable to OWNER or his employees, or by any other contractor utilised by the OWNER or by FORCE MAJEURE conditions, the time of completion shall be extended by OWNER (without levy of Mutually Agreed Damages) in writing for a reasonable period as may be mutually agreed upon, at the time of closure of contract. The CONTRACTOR shall, immediately on occurrence of such special circumstances but not later than 14 working days, bring to the knowledge of OWNER through written application for any such delay as mentioned above.

33.3 OWNER shall have the right to suspend the WORK in whole or in part for such time as may be necessary in order that WORKS shall be well and properly executed. In such events, suitable extension of time shall be granted to CONTRACTOR. However, should the cumulative period of suspension exceed 45 days during the scheduled duration of CONTRACT, the CONTRACTOR shall be compensated as mutually agreed in addition to extension of time, provided the suspension is caused due to reasons not attributable to CONTRACTOR.

34.0 TERMINATION OF CONTRACT

34.1 **Termination due to Legal Incapacity**

If the CONTRACTOR goes into liquidation or has an administrator order made against him or carries on his business or any part of it under an administrator or receiver or manager for the benefit of the creditors or any of them, without prejudice to any other rights or remedies, the OWNER may forthwith by notice in writing terminate the CONTRACT.

34.2 **Termination due to Default by CONTRACTOR**

34.2.1 If the CONTRACTOR is in default in that he:

(a) Neglects to execute the work or part of the work; or

(b) without reasonable cause, suspends or abandons the carrying out the works, either partly or wholly, before their completion; or

(c) Fails to proceed regularly and diligently with the works; or

(d) Defaults in the performance or observance of any conditions or terms of the CONTRACT or neglects to carry out any order, instruction, direction or determination which the OWNER is empowered to give or make under the CONTRACT and which is given or made in writing to the CONTRACTOR,

then, without prejudice to any other rights or remedies which the OWNER may possess, the OWNER may, by notice in writing (which shall specify with reasonable particularity the neglect, default or refusal on the part of the CONTRACTOR) require the CONTRACTOR:

i) to put forward his proposals for

a) Rectifying such neglect, default or refusal as the case may be and

b) Commence and diligently pursue the rectification of the default.

34.2.2 If within 30 days after the posting of the notice addressed to the CONTRACTOR, the CONTRACTOR fails to comply with the notice or if in the opinion of the OWNER, the CONTRACTOR's reasons or proposals are not satisfactory, then the OWNER, without

prejudice to any other rights that he may have under the CONTRACT against the CONTRACTOR, may either:

a) DETERMINE THE CONTRACT in which event the CONTRACT shall stand terminated and shall cease to be in force and effect on and from the date appointed by the OWNER on that behalf, whereupon the CONTRACTOR shall stop forthwith any of the CONTRACTOR's work then in progress, except such WORK as the OWNER may, in writing, require to be done to safeguard any property or WORK, or installations from damage, and the OWNER, for its part, may take over the work remaining unfinished by the CONTRACTOR and complete the same through a fresh contractor or by other means, at the risk and cost of the CONTRACTOR, and any of his sureties if any, shall be liable to the OWNER for any excess cost occasioned by such work having to be so taken over and completed by the OWNER over and above the cost at the rates specified in the schedule of quantities and rate/prices.

b) WITHOUT DETERMINING THE CONTRACT, take over the work of the CONTRACTOR or any part thereof and complete the same through a fresh contractor or by other means at the risk and cost of the CONTRACTOR. The CONTRACTOR and any of his sureties are liable to the OWNER for any excess cost over and above the cost at the rates specified in the Schedule of Quantities/ rates, occasioned by such works having been taken over and completed by the OWNER.

In such events of Clause 34.2.2 (a) or (b) above.

(i) The whole or part of the Contract Performance Security furnished by the CONTRACTOR is liable to be forfeited without prejudice to the right of the OWNER to recover from the CONTRACTOR the excess cost referred to in the sub-clause aforesaid, the OWNER shall also have the right of taking possession and utilising in completing the works or any part thereof, such as materials equipment and plants available at work site belonging to the CONTRACTOR as may be necessary and the CONTRACTOR shall not be entitled for any compensation for use or damage to such materials, equipment and plant.

(ii) The amount that may have become due to the CONTRACTOR on account of work already executed by him shall not be payable to him until after the expiry of Six (6) calendar months reckoned from the date of termination of CONTRACT or from the taking over of the WORK or part thereof by the OWNER as the case may be, during which period the responsibility for faulty materials or workmanship in respect of such work shall, under the CONTRACT, rest exclusively with the CONTRACTOR. This amount shall be subject to deduction of any amounts due from the CONTRACT to the OWNER under the terms of the CONTRACT authorised or required to be reserved or retained by the OWNER.

(iii) Before determining the CONTRACT as per Clause 34.2.2 (a) or (b) provided in the judgement of the OWNER, the default or defaults committed by the CONTRACTOR is/are curable and can be cured by the CONTRACTOR if an opportunity given to him, then the OWNER may issue Notice in writing calling the CONTRACTOR to cure the default within such time specified in the Notice.

(iv) The OWNER shall also have the right to proceed or take action as per 34.2.2 (a) or (b) above, in the event that the CONTRACTOR becomes bankrupt, insolvent, compounds with his creditors, assigns the CONTRACT in favour of his creditors or any other person or persons, or being a company or a corporation goes into voluntary liquidation, provided that in the said events it shall not be necessary for the OWNER to give any prior notice to the CONTRACTOR.

(v) Termination of the CONTRACT as provided for in sub- clause 34.2.2(a) above shall not prejudice or affect their rights of the OWNER which may have accrued upto the date of such termination.

34.2.3 In case of termination of CONTRACT herein set forth (under clause 34.2) except under conditions of Force Majeure and termination after expiry of contract, the CONTRACTOR shall be put under holiday [i.e. neither any enquiry will be issued to the party by Talcher Fertilizers Limited (TFL) or any of it's JV partners against any type of tender nor their offer will be considered by TFL or any of it's JV partners against any ongoing tender (s) where contract between TFL/it's JV partners and that particular CONTRACTOR (as a bidder) has not been finalized],for a period of three years from the date of termination by TFL to such CONTRACTOR.

34.3 **Duration of suspension of payment due to CONTRACTOR:**

34.3.1 Owner shall have right to suspend making any payments to the contractor for the portion of WORK having a bearing with CONTRACTOR's default during the period of rectification of the defaults.

34.4 **Work taken out of the hands of the CONTRACTOR**

34.4.1 Employment of other contractors:

If the OWNER takes action under sub-clause 34.2.2, he may complete the work or any part of it by contracting with or employing any other contractor to execute further and complete work or any part of it and to provide all equipment, materials and labour as may be necessary for such further execution and completion. If practicable the further execution and completion shall be carried out in accordance with the specification and at prices obtained under competitive conditions.

The OWNER may also take possession of and permit such person or persons to use for the purposes of the CONTRACT only such materials, tools and equipment and all other things on or about the SITE which are the property of the CONTRACTOR as are requisite and necessary for such further execution and completion, and the CONTRACTOR shall have no right to any compensation or allowance in respect thereof.

On the completion of such work, all tools and equipment and the surplus of the materials so taken possession of shall be handed over to the CONTRACTOR but without payment or allowance for the fair wear and tear they may have sustained in the meantime, provided that if there by a deficiency as referred to in sub clause 34.4.2 of this clause, and if the CONTRACTOR fails to make good such deficiency such of the tools, equipment and materials as are necessary to make good the deficiency may be sold and a sufficient part of the monies received retained by the OWNER and applied in payment of such deficiency.

In addition the OWNER shall be entitled:

a) To take possession of and remove from the CONTRACTOR's premises within a reasonable period anything (including but without limiting the generality thereof any design, drawings, specification, material or other goods) the property which is vested in the OWNER pursuant to the CONTRACT;

b) To full particulars of any sub-contract made by the CONTRACTOR with any person for the execution of any portion of the WORKS and to peruse and copy any instrument (including but without limiting the generality thereof any agreement, letter or other paper) relating to any such SUB-CONTRACT made by the CONTRACTOR with any person for the execution of any portion of the WORKS.

c) To pursue and copy any standard working drawing or other drawing or data necessary in the opinion of the OWNER for completion of the WORKS and the property which is not vested to the OWNER pursuant to the CONTRACT provided that the OWNER shall in no case make use of any copy made pursuant to sub paragraphs (b) or (c) hereof other than for the purpose of completing the WORKS and that on the fulfilment of the whole of the obligations of the CONTRACTOR under the CONTRACT the OWNER shall return to the CONTRACTOR any such copy.

The CONTRACTOR shall offer to the OWNER all rights of access and all reasonable facilities to enable the OWNER to remove any such thing or pursue or copy any such instrument, drawing or data and shall supply such particulars on request by the OWNER in that behalf.

For the purposes of sub-clause 34.4.2the cost incurred by the OWNER in and about for such removal, perusal or copying or obtaining such particulars shall be deemed to be part of the cost of carrying out that portion of the work taken out of the CONTRACTOR's hands.

34.4.2 **Extra cost to the OWNER of completing work for deduction**:

On completing the terminated portion of WORK as provided under Article 34.4.1 the OWNER shall ascertain the reasonable and direct costs based on the documentary evidence of the cost incurred but such amount shall not include any extra cost due to departures from the specification unless such departures were necessitated by the CONTRACTOR's default. Should the amount so ascertained be greater than the CONTRACT PRICE which would have been paid to the CONTRACTOR, if the whole of the Work had been carried out by him, the difference between the two amounts shall be deducted from any monies which may then be or thereafter become due to the CONTRACTOR or which may have been deposited by him as security under the CONTRACT, and if such monies be less than the amounts to be deducted the deficiency shall be paid by the CONTRACTOR to the OWNER and which may be recovered as provided in sub clause 34.4.1 of this clause or by way of arbitration, jurisdiction or both, such payment of excess amount shall be independent of penalty for delay if the completion of work is delayed.

34.5 **Preservation of rights of the OWNER**

No action taken by the OWNER under sub clause 34.3 and 34.4 of this clause shall vitiate the CONTRACT or shall operate to the prejudice of the right of the OWNER to recover from the CONTRACTOR or to deduct from any monies which may be or may become due to the CONTRACTOR all sums of money which may be or may become due to the OWNER under the CONTRACT as damages, penalties or otherwise.

34.6 Should the OWNER decide to terminate the CONTRACT under sub clause 34.2.2(b) of this clause, he may do so under notice in writing as from the date of such notice, and

the termination shall be without prejudice to any right that may have occurred to the OWNER or to the CONTRACTOR under the CONTRACT.

34.7 **Termination of Contract on Account of OWNER's Convenience**

34.7.1 The OWNER, may, by 30 days written notice send to the CONTRACTOR, terminate the CONTRACT, in whole or in part, at any time for his convenience. The notice of termination shall specify that termination is for the OWNER's convenience, the extent to which performance of work under the CONTRACT is terminated and the date upon which such termination becomes effective.

34.7.2. Upon receipt of the notice of termination under GCC Clause 34.7.1, the CONTRACTOR shall either immediately or upon the date specified in the notice of termination.

(a) cease all further work, except for such work as the OWNER may specify in the notice of termination for the sole purpose of protecting that part of the Facilities already executed, or any work required to leave the Site in a clean and safe condition.

(b) terminate all subcontracts, except those to be assigned to the OWNER pursuant to paragraph (d)(ii) below.

(c) remove all CONTRACTOR’s Equipment from the Site, repatriate the CONTRACTOR’s and its SUB-CONTRACTORs’ personnel from the Site, remove from the Site any wreckage, rubbish and debris of any kind, and leave the whole of the Site in a clean and safe condition.

(d) In addition, the CONTRACTOR, subject to the payment specified in GCC Clause 34.7.2.1, shall

(i) deliver to the OWNER the parts of the PLANT executed by the CONTRACTOR up to the date of Termination.

(ii) to the extent legally possible, assign to the OWNER all right, title and benefit of the CONTRACTOR to the PLANT and Equipment as at the date of termination, and, as may be required by the OWNER, in any subcontracts concluded between the CONTRACTOR and its SUB-CONTRACTORs.

(iii) deliver to the OWNER all non-proprietary drawings, specifications and other documents prepared by the CONTRACTOR or its Sub-CONTRACTORs as at the date of termination in connection with the PLANT.

34.7.2.1 In the event of termination of the Contract under GCC Clause 34.7.1, the OWNER shall pay to the CONTRACTOR the following amounts:

(a) the Contract Price, properly attributable to the parts of the PLANT executed by the CONTRACTOR as of the date of termination

(b) the costs reasonably incurred by the CONTRACTOR in the removal of the CONTRACTOR’s Equipment from the Site and in the repatriation of the CONTRACTOR’s and its SUB-CONTRACTOR’s personnel

(c) any amounts to be paid by the CONTRACTOR to its SUB-CONTRACTORs or Vendors in connection with the termination of any subcontracts or supply agreement, including any cancellation charges

(d) costs incurred by the CONTRACTOR in protecting the PLANT and leaving the Site in a clean and safe condition pursuant to paragraph (a) of GCC Clause 34.7.2

34.7.3 **Termination for Insolvency**

OWNER may at any time terminate CONTRACT giving written notice to CONTRACTOR, if CONTRACTOR becomes bankrupt or otherwise insolvent, provided that such termination will not prejudice or affect any right of action or remedy which has occurred or will accrue thereafter to OWNER.

If the Contract is terminated under GCC Sub-Clauses 34.7.3, the OWNER shall pay to the CONTRACTOR all payments specified in GCC Sub-Clause 34.7.2 as reasonable compensation for all loss or damage sustained by the CONTRACTOR arising out of, in connection with or in consequence of such termination.

34.7.4 **Termination by CONTRACTOR due to default of OWNER**

If the OWNER has failed to pay the CONTRACTOR any sum due under the Contract within the specified period or commits a substantial breach of the CONTRACT, the CONTRACTOR may give a notice to the OWNER that requires payment of such sum or specifies the breach and requires the OWNER to remedy the same, as the case may be. If the OWNER fails to pay such sum or fails to remedy the breach or take steps to remedy the breach within thirty (30) days after receipt of the CONTRACTOR's notice then the CONTRACTOR may give a notice to the OWNER thereof, and if the OWNER has failed to pay the outstanding sum or to remedy the breach within thirty (30) days of such notice, the CONTRACTOR may by a further notice to the OWNER, terminate the CONTRACT.

If the CONTRACT is terminated under GCC Clause 34.7.4, the OWNER shall pay to the CONTRACTOR all payments specified in GCC Clause 34.7.2 as reasonable compensation for all loss or damage sustained by the CONTRACTOR arising out of, in connection with or in consequence of such termination.

34.8 **Surviving Obligations**

Termination of this CONTRACT (a) shall not relieve CONTRACTOR of its obligations with respect to the confidentiality as set forth in this CONTRACT, (b) shall not relieve CONTRACTOR of any obligation hereunder which expressly or by implication survives termination hereof, and (c) except as otherwise provided in any provision of this CONTRACT expressly limiting the liability of CONTRACTOR, shall not relieve CONTRACTOR of any obligations or liabilities for loss or damage to the other Party arising out of or caused by acts or omissions of CONTRACTOR prior to the effectiveness of such termination or arising out of such termination, and shall not relieve CONTRACTOR of its obligations as to portions of SERVICES already performed or of obligations assumed by CONTRACTOR prior to the date of termination, except as otherwise agreed by OWNER in writing.

34.8.1 Termination of this CONTRACT (a) shall not relieve OWNER of its obligations with respect to the confidentiality as set forth in this CONTRACT, (b) shall not relieve OWNER of any obligation hereunder which expressly or by implication survives termination hereof, and (c) shall not relieve OWNER of any obligations or liabilities for loss or damage to the

other Party arising out of or caused by acts or omissions of OWNER prior to the effectiveness of such termination or arising out of such termination.

35.0 **FORCE MAJEURE**

35.1 CONDITIONS FOR FORCE MAJEURE: In the event of either party being rendered unable by Force Majeure to perform any obligations required to be performed by them under the CONTRACT the relative obligation of the party affected by such Force Majeure shall upon notification to the other party be suspended for the period during which Force Majeure conditions lasts. The cost and loss sustained by the either party shall be borne by the respective parties. The term "Force Majeure" as employed herein shall mean acts of God, earthquake, war (declared or undeclared), revolts, riots, fires, floods, rebellions, explosions, hurricane, sabotage, civil commotions and acts and regulations of respective Government of the two parties, namely the OWNER and the CONTRACTOR. Upon the occurrence of such cause(s) and upon its termination, the party alleging that it has been rendered unable as aforesaid thereby, shall notify the other party in writing immediately but not later than 120 (one hundred and twenty) hours of the alleged beginning and ending thereof giving full particulars and satisfactory evidence in support of its claim. Time for performance of the relative obligation suspended by the Force Majeure shall then stand extended by the period for which such conditions lasts..

OUTBREAK OF WAR

(i) If during the currency of the CONTRACT there shall be an out-break of war whether declared or not, in that part of the World which whether financially or otherwise materially affect the execution of the WORK the CONTRACTOR shall unless and until the CONTRACT is terminated under the provisions in this clause continue to use his best endeavour to complete the execution of the WORK, provided always that the OWNER shall be entitled, at any time after such out-break of war to terminate or re-negotiate the CONTRACT by giving notice in writing to the CONTRACTOR and upon such notice being given the CONTRACT shall, save as to the rights of the parties under this clause and to the operation of the clauses entitled settlement of Disputes and Arbitration hereof, be terminated but without prejudice to the right of either party in respect of any antecedent breach thereof.

(ii) If the CONTRACT shall be terminated under the provisions of the above clause, the CONTRACTOR shall with all reasonable diligence remove from the SITE all the CONTRACTOR's equipment and shall give similar facilities to his SUB-CONTRACTORS to do so

35.2 If the CONTRACTOR suffers delay in the due execution of the contractual obligations due to delays caused by Force Majeure as defined above, the agreed time of completion of job covered by this CONTRACT or the obligation of the CONTRACTOR shall be extended by a period of time on account of force majeure conditions, provided that on the occurrence of any such contingency, the CONTRACTOR within120 hours reports to the OWNER in writing, the cause of delay and likely duration of cause of delay with requisite documentary evidence.

35.3 If the works to be executed by the CONTRACTOR are suspended by Force Majeure conditions lasting for more than 2 (two) months, the OWNER shall have the option to terminate the CONTRACT or re-negotiate the contract provisions.

35.4 CONTRACTOR and OWNER shall endeavour to prevent, overcome or remove the causes of FORCE MAJEURE.

35.5 No ground for exemption can be invoked if CONTRACTOR has failed to give timely notice by registered letter/ Speed-Post/Courier/Email/Hand Delivery and subsequently supported it by documentary evidence.

35.6 Delay or non-performance by a party hereto caused by the occurrence of any event of FORCE MAJEURE shall not:

(a) Constitute a default or breach of the CONTRACT,

Or

(b) Give rise to any claim for damages or additional cost or expense occasioned thereby, if such delay or non-performance is caused by the occurrence of any event of FORCE MAJEURE. FORCE MAJEURE conditions are not payable under any circumstances.

35.7 Force Majeure is no one's fault, therefore each party should bear its own cost and a provision to terminate the CONTRACT in case of Force Majeure extending beyond six (06) months is provided. Should OWNER wish the CONTRACTOR to continue further, both parties may sit together and mutually agree on the future course failing which Parties will have the right to terminate. Such termination shall not be considered as Termination for Owner's Convenience. However, outstanding invoices, payment for supplies made and payment to the work already performed will be paid by OWNER on such termination.

Contractor shall have the right to take action to mitigate the impact of the prolonged Force Majeure event in mutual consent with Owner. For instance, Contractor shall have the right to demobilize Contractor's equipment and personnel from the Plant.

36.0 NO WAIVER OF RIGHTS

Neither the inspection by the OWNER or any of their officials, employees, or agents nor any order by the OWNER for payment of money or any payment for or acceptance of, the whole or any part of the WORKS by the OWNER nor any extension of time, nor any possession taken by the OWNER shall operate as a waiver of any provision of the CONTRACT, or of any power herein reserved to the owner or any right to damages herein provided, nor shall any waiver of any breach in the CONTRACT be held to be a waiver of any other subsequent breach.

37.0 BANKRUPTCY AND LIQUIDATION OF CONTRACTOR OR BUSINESS UNDER RECEIVERSHIP

If the CONTRACTOR becomes insolvent or bankrupt, or has a receiving order made against him, or compound with his creditors, or being a corporation commence to be

wound up not being a member's voluntary winding up for the purpose of reconstruction or carry on his business under a receiver for the benefit of his credit, the CONTRACTOR shall within fourteen (14) days notify the OWNER accordingly. On the occurrence of any of the happenings stated in the first sentence of this clause, the OWNER shall be at liberty to:

a) Determine the CONTRACT forthwith by notice in writing to the CONTRACTOR or to the receiver or liquidator or to any person in whom the CONTRACT may have become vested, and act in the manner provided in clause 34.1 (proceedings or default) or,

b) Give to such receiver liquidator or other person in writing the option for a period of one month of carrying out the WORK subject to his providing a guarantee for the due and faithful performance of the CONTRACT upto the CONTRACT value of the work for the time being remaining unexecuted and subject to his taking all reasonable steps to prevent stoppage of the work. In the event of stoppage of the work, the period of the option under this clause shall be fourteen (14) days only.

38.0 CERTIFICATE NOT TO AFFECT RIGHT OF OWNER AND LIABILITY OF CONTRACTOR

No interim payment certificate of the OWNER nor any sum paid on account by the OWNER nor any extension of time for execution of the WORKS granted by the OWNER shall affect or prejudice the rights of the OWNER against the CONTRACTOR or relieve the CONTRACTOR of his obligations for the due performance of the CONTRACT or be interpreted as approval of the WORK done or of the equipment furnished and no certificate shall create liability on the OWNER to pay for alterations, amendments, variations, or additional works not ordered, in writing, by the OWNER or discharge the liability of the CONTRACTOR for the payment of damages whether due certified or not or any sum against the payment of which he is bound to indemnify the OWNER and the Consultant nor shall any such certificate nor the acceptance by him of any sum paid on account or otherwise affect or prejudice the rights of the CONTRACTOR against the OWNER.

39.0 SETTLEMENT OF DISPUTES

39.1 Except as otherwise specifically provided in the CONTRACT, all disputes concerning questions of fact arising under the CONTRACT shall be considered by the OWNER subject to a written appeal by CONTRACTOR to the OWNER.

39.2 Any disputes or differences including those considered as such by only of the parties arising out of or in connection with the CONTRACT shall be to be extent possible settled amicably between the parties.

39.3 If, after 60DAYs from the commencement of such informal negotiations, OWNER and CONTRACTOR are unable to resolve amicably the dispute, either party may require that the dispute be referred for resolution to the arbitration as described under clause 40 below.

40.0 ARBITRATION

40.1 Refer clause no. 45 of Section-III of NIT.

40.2 Continuation of Work and payments during Arbitration

WORK shall be continued by CONTRACTOR during the arbitration proceedings unless the matter itself is the subject of Arbitration or unless the matter itself is such that WORK cannot practically be continued until the decision of the arbitrator is obtained and CONTRACTOR shall remain liable and bound in all respects under the Contract. Except as otherwise expressly provided in CONTRACT, no payment due and payable by OWNER shall be withheld on account of such arbitration proceedings unless it is the subject matter or one of the subject matters.

41.0 GOVERNING LAWS, LANGUAGE AND MEASURES

41.1 CONTRACT shall be governed and construed according to the Indian Law as in force and shall be subject to the jurisdiction of the Court in Delhi.All disputes arising during the execution of the CONTRACT shall be resolved as per Clause no. 39.0 (Settlement of Dispute) & 40.0 (Arbitration) of GCC and thereafter in accordance with said law.

41.2 The governing language for all communication, notices, Technical Information, etc. pertaining to CONTRACT shall be English. Any literature, correspondence, documents, etc., shall be considered only if its accompanied by English translation. For the purpose of interpretation English translation shall govern and be binding on all parties.

41.3 The metric system of measurement shall be used exclusively in the CONTRACT.

42.0 RELEASE OF INFORMATION

The CONTRACTOR shall not communicate or use in advertising, publicity, sales releases or in any other medium, photographs or other reproduction of the WORKS under this CONTRACT or descriptions of the SITE, dimensions, quantity, quality or other information, concerning the work unless prior written permission has been obtained from the OWNER. Notwithstanding the above, CONTRACTOR is entitled, under intimation to OWNER, to make such public Announcements, as it may be bound to in compliance with the Law, the Rules and any Governmental Agency or Stock Exchange Regulation the CONTRACTOR is subjected to.

43.0 COMPLETION OF CONTRACT

Unless otherwise terminated under the provisions of any other relevant clause, this CONTRACT shall be deemed to have been completed at the expiry of the DEFECT LIABILITY PERIOD.

44.0 ENFORCEMENT OF TERMS

The failure of either party to enforce at any time any of the provisions of this CONTRACT or any rights in respect thereto or to exercise any option herein provided, shall in no way be construed to be a waiver of such provisions, rights or options or in any way affect the validity of the CONTRACT. The exercise by either party of any of its rights herein shall not preclude or prejudice either party from exercising the same or any other right provided in the contract.

45.0 OWNER'S DECISION

45.1 In respect of all matters which are left to the decision of the OWNER/ENGINEER-IN-CHARGE including the granting or withholding of the certificates, the OWNER/ ENGINEER-IN-CHARGE shall, if required to do so, by the CONTRACTOR, give in writing a decision thereon.

45.2 In each case involving a financial commitment, the written APPROVAL of the owner alone shall be binding.

45.3 In matters of difference of opinion on a decision passed by the OWNER/ENGINEER-IN-CHARGE to the CONTRACTOR, stipulations of Clause 39.0 of GCC shall govern.

46.0 CO-OPERATION

46.1 **CO-OPERATION WITH OWNER**

The CONTRACTOR and OWNER shall co-operate with each other in the discharge of their respective obligation under the CONTRACT with the aim of satisfactory completing the PLANT and the WORKS in accordance with the CONTRACT.

46.1.1 The parties shall deal fairly, openly and in good faith with each other. Subject to Clause 53 (Secrecy) of GCC, each party shall disclose information which the other might reasonably need in order to exercise its rights and to perform its obligations under the CONTRACT. In particular, each party shall promptly disclose full information to the other concerning any matter which will or may prevent the Plant and Works being completed in accordance with the CONTRACT. The parties shall work together in a manner consistent with their respective obligations under the CONTRACT to resolve or mitigate any such problem.

46.1.2 OWNER shall be at liberty to object with reasonably valid reasons to employment of any person at SITE and the objection shall be communicated in writing and CONTRACTOR shall make immediate arrangements for removal of such person.

46.2 COOPERATION WITH OTHER CONTRACTORS

The CONTRACTOR shall not object to the execution of the work by other contractors or tradesmen engaged by OWNER and offer them every facility for the execution of their several works simultaneously with CONTRACTOR’s work, provided however that CONTRACTOR’S WORK is not hampered by such co-operation. CONTRACTOR shall at all times provide sufficient fencing, notice boards, lighting and watchmen to protect and warn the public and guard the works and in default thereof, OWNER may provide such facilities at CONTRACTOR's cost, if such failure is attributable to CONTRACTOR.

The CONTRACTOR shall agree to cooperate with the OWNER and OTHERCONTRACTORs and exchange with them such technical information, provided that such CONTRACTOR is bound towards CONTRACTOR on confidentiality and limited use obligations not less stringent than those accepted by OWNER under the CONTRACT and shall not be a competitor of CONTRACTOR as is necessary to obtain the most efficient and economical design and to avoid unnecessary duplication of efforts. The

OWNER shall be provided with three (3) copies of all correspondence addressed by the CONTRACTOR to other SUB-CONTRACTORS in respect of such exchange of technical information.

47.0 SUSPENSION OF WORKS

(i) Subject to the provisions of sub-para (ii) of this clause, the CONTRACTOR shall, if ordered in writing by the ENGINEER-IN-CHARGE, or his representative, temporarily suspend the WORKS or any part thereof for such written order, proceed with the WORK therein ordered to be suspended until, he shall have received a written order to proceed therewith. The CONTRACTOR shall not be entitled to claim compensation for any loss or damage sustained by him by reason of temporary suspension of the WORKS aforesaid. An extension of time for completion, corresponding with the delay caused by any such suspension of the WORKS as aforesaid will be granted to the ONTRACTOR should he apply for the same provided that the suspension was not consequent to any default or failure on the part of the CONTRACTOR.

(ii) In case of suspensions of entire WORK, ordered in writing by ENGINEER-IN-CHARGE, for a period of more than two months, the CONTRACTOR shall have the option to terminate the CONTRACT.

48.0 REPLACEMENT OF PARTS AND MATERIALS (DEFECTIVE/DAMAGED/LOST DURING TRANSIT/ERECTION AND COMMISSIONING)

48.1 If during the progress of the WORK, the OWNER shall decide and inform in writing to the CONTRACTOR that the CONTRACTOR has manufactured any plant or part of the plant in an unsound or imperfect manner or has furnished any plant inferior to the quality specified, the CONTRACTOR on receiving details of such defects or deficiencies shall at his own expense, within seven (7) days of his receiving the notice or otherwise within such time as may be reasonably necessary for making it good, proceed to alter, reconstruct or remove such work and furnish fresh equipment upto the standards of the specifications. In case the CONTRACTOR fails to do so, the OWNER may, on giving the CONTRACTOR seven (7) days notice in writing of his intentions to do so, proceed to remove the portion of the works so complained of and at the risk &cost of the CONTRACTOR, perform all such work or furnish all such equipment provided that nothing in this clause shall be deemed to deprive the OWNER of or affect any rights under the CONTRACT which the OWNER may otherwise have in respect of such defects and deficiencies.

48.2 The CONTRACTOR's full and extreme liability under this clause shall be satisfied by the payments to the OWNER of the extra cost, of such replacement procured including erection as provided for in the CONTRACT, such extra cost being the ascertained difference between the price paid by the OWNER for such replacements and the CONTRACT price portion for such defective plants and repayments of any sum/ paid by the OWNER to the CONTRACTOR in respect of such defective plant.

48.3 If the material/ equipment or any portion thereof is damaged or lost during transit and handling, storage, erection, commissioning at site, the replacements of such material / equipment shall be effected by the CONTRACTOR within a reasonable time to avoid unnecessary delays and without waiting for realisation of cost of damages from the

insurance company, appointed by him for this purpose. This will not alter the time schedule in any way.

49.0 DEFENCE OF SUITS

49.1 If any action in Court is brought against the OWNER or an officer or agent of the OWNER for the failure omission or neglect on the part of the CONTRACTOR to perform any acts, matters, covenants or things under the CONTRACT, or for damage or injury caused by the alleged omission or negligence on the part of the CONTRACTOR, his agents representatives or his SUB-CONTRACTORS or in connection with any claim based on lawful demands of SUB-CONTRACTORs, workmen, suppliers or employees, the CONTRACTOR shall in all such cases indemnify and keep the owner and/ or his representative harmless from all losses damages, expenses or decrees arising out of such action.

49.2 If any action in court referred to in Clause 49.1 of GCC above is brought against OWNER or an officer or agent of OWNER, OWNER shall promptly give the CONTRACTOR notice thereof and CONTRACTOR may at its own expense and in OWNER's name, conduct such proceedings or claim for the settlement of any such proceedings or claim. If CONTRACTOR fails to notify OWNER within twenty-eight (28) days after receipt of such notice that it intends to conduct any such proceedings or claim, then the OWNER shall have full power and right at his discretion to defend or comprise any suit or pay claim or demand brought or made against him as aforesaid whether pending or threatened as he may consider necessary or desirable and shall be entitled to recover from the CONTRACTOR all sums of money including the amount of damages and compensation and all legal costs, charges and expenses in connection with any compromise or award which shall not be called into question by the CONTRACTOR and shall be final and binding upon him provided however that, unless CONTRACTOR has so failed to notify OWNER within the twenty-eight (28) days period, OWNER shall make no admission which may be prejudicial to the defence of any such proceedings or claim.

50.0 CONTRACTOR'S RESPONSIBILITIES

50.1 In consideration of payment by the OWNER, the CONTRACTOR shall regularly and diligently carry out and complete the WORKS in accordance with the CONTRACT.

50.2 All work carried out by the CONTRACTOR shall be carried out with sound workmanship and materials, safety and in accordance with the Contract requirements.

50.3 The CONTRACTOR shall set out the PLANT by reference to points, lines and levels of reference as defined in the approved SPECIFICATION.

50.4 The PLANT/WORKS as completed by the CONTRACTOR shall in every respect comply with the requirements defined in the Specification or any other provision of the CONTRACT.

50.5 If at any time during the performance of the CONTRACT, the CONTRACTOR is of the opinion that a change to the WORKS or the design or method of operation of the PLANT

a. is necessary to eliminate a potential defect in the PLANT or a specific hazard to any person or party in the performance of the WORKS or in the operation of the PLANT which has occurred or would otherwise occur' or

b. would improve operating or life cycle costs of the PLANT; or

c. would otherwise be beneficial to the OWNER;

the CONTRACTOR shall bring the matter to the attention of the ENGINEER-IN-CHARGE stating the reasons for his opinion and where appropriate, submit his proposals for a Variation in accordance with Clause 3 of SPECIAL CONDITIONSOF CONTRACT.

50.6 The CONTRACTOR shall at all times have and maintain adequate resources available for the proper and timely execution of the WORKS, including financial resources, and competent, appropriately experienced and physically capable staff and labour whether employed by the CONTRACTOR, any SUB-CONTRACTOR or third parties.

50.7 The CONTRACTOR shall provide and maintain records as specified in the CONTRACT.

Unless otherwise agreed, the CONTRACTOR shall, at intervals of not more than one calendar month, report to the ENGINEER-IN-CHARGE on the progress of the WORKS, supporting his reports with appropriate documentation including any revisions to the approved programme.

50.8 The CONTRACTOR shall maintain and cause SUB-CONTRACTORs to maintain, a quality assurance system as specified in the CONTRACT. The existence of such a quality assurance system shall not relieve the CONTRACTOR from any of his other duties, obligations or liabilities under the CONTRACT. The CONTRACTOR shall also prepare and implement a validation plan, if such a requirement is specified in the CONTRACT.

51.0 PROGRESS REPORTS AND PHOTOGRAPHS

51.1 The CONTRACTOR shall furnish soft copy of progress photographs of the work done in his shop/site. Photographs shall be taken when and where indicated by the ENGINEER-IN-CHARGE. Photographs, if required shall be approximately 8 inches by 10 inches in size, including a margin on one 10 inch side for binding. Each photograph shall contain the date, the name of the CONTRACTOR and the title of the view taken. (technical to check, whether to be shifted to SCC)

51.2 Required number of monthly progress reports, in prescribed proforma, shall be submitted by the CONTRACTOR to the ENGINEER-IN-CHARGE for review. These shall detail the status of design, procurement of raw materials and bought outs, approval of the CONTRACTOR's drawings, manufacture of the equipment, statutory approvals taken, inspection of equipment/material, completed despatches, materials received at site, damages, if any, during transit, actions taken or replacement of damaged equipment, progress of erection work and programme of work for succeeding month and statement showing position of payment.

52.0 **DELETED**

53.0 **SECRECY**

53.1 The technical information, drawings, specifications and other related documents forming part of the NIT or the CONTRACT or such of those materials prepared during the execution of the project including photographs, micro-films, design, calculations etc. are the property of the OWNER and shall not be used for any other purpose, except for execution of contract. All rights, including rights in the event of grant of a patent and registration of designs are reserved. The technical information, drawings, specifications, records and other documents shall not be copied, transcribed, traced or reproduced in any other form or otherwise in whole and/or duplicated, modified, divulged and/or disclosed to a third party nor misused in any other form whatsoever, without the OWNER's previous consent in writing except to the extent required for the execution of this CONTRACT. Such technical information, drawings specifications and other related documents furnished shall be returned to the OWNER with all approved copies and duplicates, if any, immediately after they have been used for the agreed purposes.

For avoidance of any doubt it may be clarified that this clause relate to documents prepared by OWNER or is a property of OWNER.

In the event of any breach of this provision, the CONTRACTOR shall indemnify the OWNER from any loss, cost or damage or any other claim whatsoever from any parties claiming from or through them in respect of such breach.

All intellectual property rights in documents and calculations prepared by CONTRACTOR shall at all times exclusively vest with CONTRACTOR and be used by OWNER in accordance with the CONTRACT.

53.2 **Records of Contract Documents**

53.2.1 The CONTRACTOR shall at all times make and keep sufficient copies of the DRAWINGS, Specifications and CONTRACT documents for him to fulfil his duties under the CONTRACT.

53.2.2 The CONTRACTOR shall keep at site atleast three copies of each and every Drawing, Specification and CONTRACT document and these copies shall be available at all times for use by the OWNER and EIC and by any other person authorized by the OWNER who needs to know about the PROJECT.

54.0 CORRESPONDENCE

54.1 All correspondences from the CONTRACTOR to the OWNER shall be as per the correspondence distribution schedule. All communications including clarifications and/or comments shall be addressed to OWNER/PMC and shall always bear reference of DLOA No.

54.2 Any notice to the CONTRACTOR under the terms of the CONTRACT shall be served by registered e-mail, Speed Post or courier.

54.3 Any notice to the OWNER shall be served from the CONTRACTOR's Principal office in the same manner.

54.4 Any written order or instruction of OWNER or his duly authorised representative, communicated to authorised representative of the CONTRACTOR at site office shall be deemed to have been communicated to the CONTRACTOR at his legal address.

54.5 A notice shall be effective when delivered or on date of the notice, whichever is later.

55.0 MATERIALS AND EQUIPMENT

55.1 **Materials**

55.1.1 CONTRACTOR shall supply all materials required for incorporation in the works, within the scope of work, necessary to establish, commission and operate the PLANT.

55.1.2 **INVOICES**

CONTRACTOR's invoices shall be raised as per approved Billing Schedule.

(a) The CONTRACTOR's invoice shall be in the format with all the requisite information as prescribed under GST Laws.

(b) Before raising GST invoices, CONTRACTOR shall coordinate with the OWNER with respect to address and GSTIN number on which such invoices have to be raised

55.1.3 The CONTRACTOR shall be responsible at his own cost and initiative within the scope of WORK, to take delivery of the materials from the port of delivery in India in respect of imported materials and from the factory or ware-house or other place(s) of delivery in respect of indigenous materials and to transport these to the CONTRACTOR's stockpiles, godowns or other places of storage approved by the ENGINEER-IN-CHARGE, and to transport the same from said godowns or place(s) of storage to the work site for installation in the permanent WORKS.

55.1.4 The work of delivery and transportation of materials shall include (but not be limited to) the following:

i) Clearance of the goods through custom and port clearance including filling and/or filing of all custom manifests, bills of entry, and custom declarations and other documents as may be required for the clearance of the goods from customs or port authorities.

ii) Stevedoring, clearing, forwarding and handling services as required for clearing, forwarding and handling imported and indigenous materials and consignments including payment at CONTRACTOR's cost of any demurrage, wharfage, port charges, siding charges, retention charges, detention charges or other charges whatsoever and howsoever designated or levied by any railway, air-port, ship and/or other authorities for or in connection with the loading, unloading or detention of any materials or vessels or other means of transport beyond the free period or unloading, clearance, retention or detention or loading, as the case may be, provided by the relevant authority(ies) or carrier(s) in this behalf.

iii) All works and operations necessary to lift and to remove the material from port, ware-house, railway or other siding, factory or other places of delivery, loading, handling, transporting and unloading and safely stacking, placing or storing the same at approved godowns, yards or other place(s) of storage including lashing

or other-wise securing or protecting the same in transit and during and in storage.

iv) Supply, procurement, mobilization, and deployment of all labour thereof, equipment & machinery necessary for lifting, loading, handling, removing, transporting, unloading, stacking or securing the materials.

v) Transit and storage insurance of all materials for the full replacement value thereof delivered at site.

vi) All acts, deeds, matters or things required to fulfil all local, municipal and other statutory authorities with respect to the transportation of any materials through or into any State, municipal, local or other barriers or limits or for the import of the materials or any of them within the limits of such barrier, including payment of octroi or other local toll, terminal and/or entry or other taxes payable on the passage or entry of the materials through or within any local limits, for which purpose the OWNER shall give the CONTRACTOR and/or CONTRACTOR's designate(s) any and all authority(ies) as may be reasonably required in this behalf.

vii) All other acts, deeds, matters and things whatsoever ancillary, auxiliary or incidental to the above including but not limited to the grading of the site and/or creation of temporary approaches and ramps etc. as may be required.

55.2 GENERAL PROVISION WITH REGARD TO MATERIALS

55.2.1 The CONTRACTOR shall, within the scope of work, undertake the following activities and responsibilities with respect to and in addition and without prejudice to the activities and responsibilities under Clause 55.1 and associated clauses thereunder in respect of materials:

i) The CONTRACTOR shall be taking delivery, ensure compliance of any condition applicable for delivery from the concerned authority or carrier, and shall be exclusively responsible to pay and bear any detention, demurrage or penalty or other charges payable by virtue of any delay or failure by the CONTRACTOR in lifting the materials or in observing any of the conditions aforesaid, and shall keep the OWNER indemnified from and against all consequences thereof

ii) The CONTRACTOR shall maintain a day-to-day account of all materials indicating the daily receipt(s), consumption(s) and balance of each material and category thereof. Such account shall be in the format, if any, prescribed by the ENGINEER-IN-CHARGE and shall be supported by all documents necessary to verify the correctness of the entries in the account. Such account shall be maintained at the CONTRACTOR office and site(s) and shall be open for inspection and verification (by verification of documents in support of the entry as also by feasible verification of the stock) at all times by the ENGINEER-IN-CHARGE with authority at all times without obstruction to enter into or upon any godown or other place(s) or premise(s) where the materials or any part of them are lying or stored and to inspect the same himself and or through his representative(s).

iii) All materials shall be taken delivery of, held, stored and utilised by the CONTRACTOR as Trustee of the OWNER, and delivery of the material to the CONTRACTOR shall constitute an entrustment thereof to the CONTRACTOR, with the intent that any utilization, application or disposal thereof by the CONTRACTOR otherwise than for permanent incorporation in the contractual works in terms of the contract shall constitute a breach of trust by the CONTRACTOR.

iv) The CONTRACTOR shall at all times be exclusively responsible for any and all losses, damages, deterioration, misuse, wastage, theft, or other application or misapplication or disposal of the materials or any of them contrary to the provisions hereof and shall keep the OWNER indemnified from and against the same and shall forthwith at its own cost and expenses replace any such material, lost, damaged, deteriorated, misused, wasted, stolen, applied, mis-applied and/or disposed as aforesaid with other material of equivalent quality and quantity delivered to site at the CONTRACTOR's risks and costs in all respects.

v) The CONTRACTOR shall take out, at his own cost and keep in force at all times, during transit, handling, storage and erection, till the period as defined in the SPECIAL CONDITIONS OF CONTRACT (SCC),all the Insurance policy(ies) with Insurance Company(ies) for the full replacement value of the materials at site against the risks specified in the CONTRACT. Such policies shall be in the joint names of the OWNER and the CONTRACTOR, with exclusive right in the OWNER to receive all monies due in respect of such policy(ies) and with right in the OWNER (but without obligation to do so) to take out and pay the premia for any such policy(ies) and deduct the premia and any other costs and expense in this behalf from the monies for the time being due or in future becoming due to the CONTRACTOR. In case of any Insurance claim, the GST leviable on the transfer of the claim money from OWNER to CONTRACTOR shall be over and above the GST cap indicated in the CONTRACT and shall be borne by OWNER.

vi) If the CONTRACTOR shall default in replacing any material lost, damaged, deteriorated, misused, wasted, short, stolen, misapplied or disposed of within the provisions hereof above, the CONTRACTOR shall be liable to pay to the OWNER the cost of such materials.

a) Notwithstanding anything herein provided, the CONTRACTOR shall be and remain solely and exclusively liable to repair, restore or replace, as the case may be, the materials damaged or destroyed as a result of any act or omission, notwithstanding the existence or otherwise of any policy(ies) of insurance aforesaid, with the intent that any policy(ies) of insurance aforesaid taken out by the CONTRACTOR or by the OWNER, on default by the CONTRACTOR, shall not anywise absolve the CONTRACTOR from his full liability up to and until expiry of Defect Liability Period defined in the contract. Further, as provided in respect of the works, the work(s) and all materials incorporated therein shall be and remain at the risk of the CONTRACTOR in all respects, including (but not limited to) accident, lightning, earth-quake, fire, storm, flood, tempest, riot, civil commotion and/or war or otherwise with respect to the materials. The insurance policies for above risks shall constitute merely an additional security and not a substitution of liability.

b) It shall be the exclusive responsibility of the CONTRACTOR to lodge and pursue any or all claims in respect of the insurance covers as above.

c) The CONTRACTOR shall, as a condition to the certification of any Running Account Bill, satisfy the OWNER/ Engineer-In-Charge of the existence of one or more policy(ies) of insurance, covering the materials as specified herein. The policy(ies) of insurance aforesaid shall cover all insurable risks, including but not limited to, any loss or damage commencing from the supplier's ware house in handling, transit, storage and during erection, theft, pilferage, riot, civil commotion, force majeure (including earth quake, flood, storm, cyclone, tidal wave, lightening and other adverse weather conditions), accidents of kinds, fire, war risks and explosion.

55.3.0 **BILL OF MATERIALS**

55.3.1 The CONTRACTOR shall furnish to the OWNER a detailed "Bill of Materials (BOM)" specifying the materials, which on preliminary determination made by the CONTRACTOR, will be required to be incorporated in the permanent works in order to establish the WORK/ Unit and to operate the PLANT/Unit, including construction materials.

55.3.2 Each item entered in the Bill of Materials shall be priced. The Bill of Materials and said price break–up therein are intended only to form a basis for the purpose of calculating on account payments and for calculating payments due to the CONTRACTOR under Clause 34.0 of GCC upon cancellation of contract, and for no other purpose.

55.3.3 The OWNER shall review or cause to be reviewed the prima facie adequacy, sufficiency, validity and/or suitability of the materials listed in the Bill of Materials for the works for which they are intended and of the prices indicated in the Bill of Materials in respect thereof. Such review shall be performed in conjunction with the design, engineering, specification and other technical reviews to be done by the OWNER and all provisions applicable thereto with reference to critical drawings shall be applicable to the review of the Bill of Materials.

55.3.4 The priced Bill of Materials shall constitute the Bill of Materials envisaged in the contract documents. However, the CONTRACTOR shall have full responsibility under the CONTRACT to sell and supply to the OWNER all materials required for the permanent incorporation in the works and which are required to establish, commission and operate the PLANT/ Unit in accordance with the CONTRACT and the specifications, complete in all respects including spares, tools, tackles and testing equipment, so far as included within the scope of supply, whether or not any particular material is actually included within or omitted in the Bill of Materials and whether or not the price thereof is included in the price indicated in the Bill of Materials and whether or not the price thereof is in conformity with the price thereof indicated in the Bill of Materials. The review and approval of the Bill of Materials and the prices therein are intended only for the satisfaction of the OWNER that the priced Bill of Materials, prima-facie covers the materials required to be supplied by the CONTRACTOR within the scope of supply.

55.4 **SUPPLY OF MATERIALS**

55.4.1 The CONTRACTOR shall supply the materials required to be supplied within the Contractor's scope of supply for incorporation in the permanent works in accordance with and to meet the requirements in quality, quantity and other particulars of the descriptions, specifications, plans, drawings, designs and other documents applicable thereto, and the CONTRACTOR shall be deemed to have undertaken that all materials selected, procured and supplied by the CONTRACTOR within the scope of supply shall be of the best quality

and workmanship and shall be capable of producing the designed desired results and to perform the designed and desired functions to meet the contractual requirements in all respects for the project.

55.4.2 The CONTRACTOR shall undertake and complete the supply of materials within the scope of supply to meet the scheduled progress and requirements of the WORK within the scope of work.

55.4.3 All materials shall be deemed to have been accepted only when the material is received at the project SITE and accepted by the ENGINEER-IN-CHARGE. Such acceptance shall however be subject to the terms and conditions of CONTRACT, including the right of rejection and/or replacement as elsewhere herein specified.

55.4.4 Without prejudice to any other terms of the contract, it is clarified that the mere agreement, acceptance or prescription of a Delivery or other Schedule containing an extended time of commencement or completion in respect of the entire delivery(ies) or any of them shall not anywise constitute an extension of time in a terms of the CONTRACT so as to bind the OWNER or relieve the CONTRACTOR of all or any of his liabilities under CONTRACT, nor shall constitute a promise on behalf of the OWNER or a waiver by the OWNER of any of its rights in terms of the contract relative to the performance of the CONTRACT within the time specified or otherwise, but shall be deemed only (at the most) to be a guidance to the CONTRACTOR for better organising his work on a recognition that the CONTRACTOR has failed to organise his supplies and/or make the same within the time specified in the Delivery Schedule.

55.4.5 If the CONTRACTOR fails to supply the materials in accordance with the dates in this behalf specified in the Delivery Schedule which has an impact on the critical path of the schedule, the CONTRACTOR shall provide the OWNER with a suitable plan to recover the delay, but without prejudice to any other rights, discount or remedy available to the OWNER in respect of such delay or failure.

55.4.6 **MAKE OF MATERIALS**

i) All equipment and materials to be supplied under this CONTRACT shall be from approved vendors as indicated in the Bidding Document or as otherwise approved by the ENGINEER-IN-CHARGE / OWNER.

ii) Where the makes of materials are not indicated in the Bidding document, the CONTRACTOR shall furnish details of proposed makes and supplies and supply the same after obtaining the OWNER's/ ENGINEER-IN-CHARGE's approval.

55.5.0 **CERTIFICATE OF VERIFICATION AND GOOD CONDITION**

55.5.1 The CONTRACTOR shall, before supply of material covered within the scope of supply, at his own risks, costs and initiative, undertake or cause to be undertaken all tests, analysis and inspections as shall be required to be undertaken with regard to the materials under the specifications and any codes, practices, orders and instructions with respect thereto and shall cause the results thereof to be recorded, reported or certified, as the case may be, and shall not offer for delivery or deliver any material(s) which has/have not passed such tests/analysis or inspection and which are not accompanied by the tests results, reports and/or certificates in this behalf provided in the applicable specifications, code(s) and/or practices.

55.5.2 On arrival of the material at site the CONTRACTOR shall give written notice thereof to the ENGINEER-IN-CHARGE or Inspection Agency notified by the OWNER in this behalf, to

inspect the materials, and shall keep in readiness for inspection, the materials and the relevant tests results, reports and certificates hereto.

55.5.3 Notwithstanding any other provisions in the contract documents for analysis or tests of materials and in addition thereto, the CONTRACTOR shall, if so required by the ENGINEER-IN-CHARGE or Inspection Agency in writing at his own risks and costs, analyse, test, prove and weigh all materials (including materials incorporated in the works) required to be analysed, tested, proved and/or weighed by the ENGINEER-IN-CHARGE or Inspection Agency in this behalf and shall have such analysis or tests conducted by the agency(ies), or authority(ies) if any specified by the ENGINEER-IN-CHARGE or Inspection Agency. The CONTRACTOR shall provide all equipment, labour, materials and other things whatsoever required for testing, preparation of the samples, measurement of work and/or proof of weighment of the materials as directed by the ENGINEER-IN-CHARGE or Inspection Agency.

55.5.4 If on Inspection or proof, analysis or tests as aforesaid the ENGINEER-IN-CHARGE or Inspection Agency nominated by the OWNER in this behalf is prima facie satisfied that the material received is in conformity with the material requirements of the Bill of Materials and description given in the shipping documents and in the CONTRACTOR's invoices in this behalf and that the test reports/results/certificates given in respect thereof are prima facie in conformity with the relevant result/reports/certificates required in respect thereof in terms of the specifications and/or relevant codes and practices, and that the material appears to be prima facie in good order and condition, the ENGINEER-IN-CHARGE shall issue to CONTRACTOR, a Certificate of Verification and Good Condition in respect of such material, and this shall constitute the Certificate of Verification and Good Condition elsewhere envisaged in the CONTRACT documents. Should the ENGINEER-IN-CHARGE not issue said Certificate within 5 working days following the conformity of the aforementioned requirements, the Certificate of Verification and Good Condition shall be deemed issued.

55.5.5 Such certificate is only intended to satisfy the OWNER that prima facie the material supplied by the CONTRACTOR is in order and shall not anywise absolve the CONTRACTOR of his/its full responsibility under the CONTRACT in relation thereto, including in relation to,–fulfilment and/or performance of works or other guarantees envisaged in the CONTRACT.

55.5.6 Notwithstanding that any area(s) or source(s) has/have been suggested by the OWNER to the CONTRACTOR from which any material for incorporation in the WORKS can be obtained, the CONTRACTOR shall independently satisfy himself of the suitability, accessibility and sufficiency of the source(s) of supply suggested by the OWNER and suitability of the material available from such source(s) with the intent that any suggestion as aforesaid shall not anywise relieve the CONTRACTOR of his full liability in respect of the suitability and quality of the material(s) obtained from said source(s) and the CONTRACTOR shall obtain material(s) there from and incorporate the same within the permanent works entirely at his own risks and costs in all respects, with the intent that any such suggestion by the OWNER shall only be by way of assistance to the CONTRACTOR and shall not entail any legal responsibility or liability upon the OWNER.

55.6.0 MATERIALS WITHIN THE CONTRACTOR'S SCOPE OF SUPPLY

The OWNER does not warrant or undertake the provisions of any materials and the CONTRACTOR shall not imply, by conduct, expression or assurance or by any other means, any promise or obligation on the part of the OWNER in his respect understood by the CONTRACTOR.

55.7.0 **Deleted**

55.8 **PACKING AND FORWARDING**

- The CONTRACTOR shall, wherever applicable, after proper painting, pack and crate all items in such a manner so as to protect them from deterioration and damage during rail and road transportation to the site and during storage at the site till the time of erection. Without prejudice to any other liabilities or obligations of the CONTRACTOR, the CONTRACTOR shall be responsible for all damage(s) due to improper packing.
- The CONTRACTOR shall notify OWNER/ ENGINEER-IN-CHARGE the expected date of arrival materials at the site for the information of OWNER/ ENGINEER-IN-CHARGE.
- The CONTRACTOR's notification shall also give all shipping information concerning the weight, size and content of each packing and such other information as the OWNER/ ENGINEER-IN-CHARGE EIC may require.
- The following documents shall be sent to the OWNER/ EIC in three copies:

a) Signed Invoice(s)
b) Delivery Challan
c) Packing list.
d) Manufacturer's certificate of inspection for shipment duly approved by the CONTRACTOR in one original and one photocopy
e) Third Party Inspection Release Note clearly indicating that material has been inspected and accepted as per QAP approved by OWNER or TPI waiver certificate issued by OWNER.
f) Railway Receipt/LR
g) Intimation to Insurance Company for arranging Transit Insurance
h) Guarantee certificate (wherever applicable)
i) Operation & Maintenance manual (wherever applicable)

55.9 Assembly Marks and Name Plates

55.9.1 All component/parts of EQUIPMENT shall be indelibly hard marked with identification marks, comprising EQUIPMENT, part numbers, and CONTRACT number/PO number which shall also be shown on drawing to facilitate speedy identification, assembling or dismantling.

55.9.2 On each EQUIPMENT, a nameplate indicating basic details, pressure rating, wherever applicable, code number of EQUIPMENT, electrical characteristics in case of electrical EQUIPMENT, name of instrument with tag no., manufacturer's name shall be fixed at proper place.

55.9.3 For packages where marking is not possible at least two metallic nameplates must be affixed. Marking on the plates will be by means of engraving or indelible paint and will include the information listed above.

55.10 **Despatch/Shipping notice**

CONTRACTOR shall notify OWNER by E-mail for its information the expected date of delivery of a consignment, date of readiness of EQUIPMENT for shipment, total gross weight and total volume with dimensions.

55.11 **Heavy Lift Consignment (HLC) or Over Dimensional Consignments (ODC).**

55.11.1 CONTRACTOR shall follow the guidelines of Ministry of Road transport and Highways (MORTH) India, for the shipping/transportation of all packages/consignments. The CONTRACTOR shall be responsible to comply with rules relating to E-way Bills and other related provisions under the GST laws for movement of packages/consignments.

55.11.2 CONTRACTOR shall make his own arrangements for movement of all consignments including ODC/HLC.

55.11.3 CONTRACTOR confirms that it has surveyed the route for transportation of ODC/HLC items of EQUIPMENT and CONTRACTOR further confirms that it has included all cost of repairs of road, civil works, strengthening of bridges, culverts, widening of roads, etc. as required for transportation of ODC/HLC items of EQUIPMENT in its CONTRACT PRICE. OWNER shall not be responsible for repairs of road, civil works, strengthening of bridges, culverts, widening of roads, etc. as required for the transportation of ODC/HLC items of EQUIPMENT and shall not be liable to reimburse the cost of such repairs of road, civil works, strengthening of bridges, culverts, widening of roads, etc. to CONTRACTOR.

55.12 **Marking**

55.12.1 CONTRACTOR shall mark the following on packing three sides i.e. two sides faced and cover (Top) EQUIPMENT with indelible paint in conspicuous printed letters not less than 5 cm. in size in English:

A. For Imported EQUIPMENT

Government of India
A/c TALCHER PROJECT, ODISHA, INDIA.

a) CONTRACT /PO NO. : _____
b) Equipment Description and Item Nos.: _____
c) Package : _____ of _____
d) Gross / Net Weight (Kgs.) : _____
e) Dimension L x W x H cms. : _____
f) WARNING MARKS (FRAGILE, ATTENTION, TOP, KEEP DRY ETC.)
g) Forwarding No. : _____
h) Part shipment/full shipment/final shipment : _____
i) Each package shall bear a symbol contained in the package as follows:

'A' Storage in a closed storehouse.

'B' Storage under a shed.

'C' Storage in the open.

55.12.2 Depending on the characteristics of the contents in the packages, the packages have to be marked with appropriate international marking ("HANDLE WITH CARE"; "THIS SIDE UP"; "SLING MARK"; ETC.) and other indications necessary for correct handling such as Centre of Gravity and points of slinging (in case of heavy loads).

55.12.3 For packages where marking is not possible, at least two metallic nameplates must be affixed. Marking on the plates will be by means of engraving or indelible paint and will include the information listed above.

55.12.4 All corners of the packages shall be painted with indelible 'Blue' paint at least 125 mm in depth for easy identification/location of the packages for clearance and handling at the port.

55.13 **Packing List**

55.13.1 CONTRACTOR will include in each package an item-wise packing List, Invoice No. and associated drawings.

55.13.2 The packing list and any other documents shall be put in a closed polyethylene envelope and included in each package.

55.13.3 A second copy of the packing list shall be placed in a polyethylene envelope on the outside of the each package by means of metallic plate marked "Documents". As regards columns, exchangers and similar equipment, the envelope shall be placed in a nozzle being identified by an arrow, in indelible paint, followed by the word "Document".

55.13.4 Shipping documents must always be presented in the number of copies indicated in this CONTRACT.

55.14 **Shipping Arrangements and Forwarding of Documents**

CONTRACTOR shall avoid the use of over aged vessels for the shipment of the imported EQUIPMENT under this CONTRACT and if so used, the cost of additional insurance, if any, shall be borne by CONTRACTOR.

55.15 **Despatch/Shipment Notice for Insurance.**

55.15.1 CONTRACTOR shall send intimations of despatches indicating items despatched, quantity, value, weight and carrier particulars directly through fax to the insurance company fixed by CONTRACTOR.

55.15.2 Insurance for transit risks and other risks shall be covered by CONTRACTOR.

55.16 UTILITIES AND CONSUMABLES ETC.

Subject to any other provision to the contrary in the CONTRACT, the CONTRACTOR shall be and remain at all times exclusively responsible within the scope of work to provide all utilities, consumables, permits, licenses, easementsand facilities and other items and things whatsoever required for or in connection with the WORK, including but not limited to those indicated by expression or implication in the bid documents and/or other CONTRACT documents or howsoever otherwise as shall be or may from time to time be necessary for or in connection with the WORK.

56.0 MEASUREMENTS, CERTIFYING INSPECTIONS AND PAYMENTS

56.1 Final Measurements:

56.1.1 Within 15 (fifteen) days from the date of certification of works completed /milestone achieved in respect of the WORKS or of any portion of the WORKS, section, group or job site, as the case may be, measurements for the works covered by such certification shall be jointly taken by the ENGINEER-IN-CHARGE and the CONTRACTOR as herein provided.

56.1.2 If the CONTRACTOR fails to apply to the ENGINEER-IN-CHARGE for measurements within15 (fifteen) days from the date of certification of works completed/ milestone achieved as specified in Clause 56.1.1, the ENGINEER-IN-CHARGE shall notify the CONTRACTOR in writing of the date(s) for measurements, and require the CONTRACTOR to be present on date(s) so notified.

56.2 Mode of Measurement

56.2.1 All measurements shall be recorded in the metric system, and shall be taken in accordance with the procedures set forth or provided for in the Schedule of Rates, Specifications and other CONTRACT Documents.

56.2.2 Where the mode of measurement is not provided for in the Contract Documents in respect of any item of work, it shall be measured in accordance with the Indian Standard Specification No. 1200 (latest edition) and in the event of such item not being covered by Indian Standard Specifications, it shall be measured in accordance with the method of measurement in this behalf specified by the ENGINEER-IN-CHARGE, whose decision in this regard shall be final and binding upon the CONTRACTOR. If the Contractor disagrees with the decision of the ENGINEER-IN-CHARGE, the dispute shall be settled as per the provisions of Clause 39.0 of GCC.

56.2.3 All measurements shall be taken jointly by the ENGINEER-IN-CHARGE and the CONTRACTOR or their respective representatives. The CONTRACTOR or his authorized representative shall be entitled to remain present at all times when joint measurements are being taken.

56.2.4 Despite due intimation, if the CONTRACTOR omits or fails to be present to witness joint measurements, the measurements shall be taken in the presence of the ENGINEER-IN-CHARGE and the measurements so recorded and signed by the ENGINEER-IN-CHARGE as correct, shall be final and binding upon the Parties.

56.2.5 Except in cases covered by Clause 56.2.4, in all other cases measurements shall be signed and dated on each page by the CONTRACTOR / CONTRACT MANAGER and ENGINEER-IN-CHARGE or his representative. If the CONTRACTOR objects to any of the measurements recorded, including the mode of measurement, such objection shall be noted in the measurement book against the item objected to and such note shall be dated

and authenticated by the CONTRACTOR / CONTRACT MANAGER and ENGINEER-IN-CHARGE or his representative. In the absence of any objection noted as aforesaid, the CONTRACTOR shall be deemed to have accepted the relative measurements as entered in the Measurement Book / Sheets and shall be barred from raising any objection at a later date in respect of any measurements recorded in the Measurement Book.

56.2.6 All objections noted in the Measurement Book in terms of Clause 56.2.5 shall be considered and decided within 15 days by the ENGINEER-IN-CHARGE. The decision of the ENGINEER-IN-CHARGE relative thereto (whether on the correct measurement to be adopted or on the mode of measurement to be adopted)shall be final and binding upon the Parties. If the Contractor disagrees with the decision of the ENGINEER-IN-CHARGE, the dispute shall be settled as per the provisions of Clause 39.0 of GCC.

56.2.7 The measurement as finally recorded in terms of Clause 56.2.4 or Clause 56.2.5 or 56.2.6, as applicable, shall be the Final Measurement.

56.3 CERTIFYING INSPECTIONS

All provisions referred to in Clauses 56.1 to 56.2, in respect of Mode of Measurement, shall apply to all inspections required to be made in order to qualify the CONTRACTOR for any payment(s) under the CONTRACT and any reference in the said clauses to measurements shall, for the purpose of this clause, be deemed to be a reference to certifying inspections and any reference therein to the measurement book shall, for the purpose of this clause, be deemed to be a reference to the certifying inspection book.

56.4.0 Deleted

56.5.0 PRICE SCHEDULE

56.5.1 The remuneration determined due to the CONTRACTOR as provided for in Clause 56.4.1 hereof shall constitute the entirety of the remuneration and entitlement of the CONTRACTOR in respect of the WORK under the CONTRACT, and no further or other payment whatsoever shall be or become due or payable to the CONTRACTOR under the CONTRACT.

56.5.2 Without prejudice to the generality of the provisions of Clause 56.5.1 hereof, the TOTAL LSTK CONTRACT PRICE shall be deemed to include and cover (unless otherwise expressly specified to the contrary in any CONTRACT document(s)):

(i) All costs, expenses, outgoings and liabilities of every nature and description whatsoever and all risks whatsoever (foreseen or unforeseen, including force majeure) to be taken or which may occur in or relative to execution, completion, testing, commissioning and/or handling over the WORKS to the OWNER and/or in or relative to acquisition, loading, unloading, transportation, storing, working upon, using, converting fabricating, or erecting any item, equipment, system, material or component in or relative to the WORKS, and the CONTRACTOR shall be deemed to have known the nature, scope, magnitude and the extent of the works and items, MATERIALS, EQUIPMENT, and components required for the proper and complete execution of the Works though the CONTRACT documents may not fully and precisely set out, describe or specify them, and the generality hereof shall not be deemed to be anywise limited, restricted or abridged because in certain cases the CONTRACT documents or any of them shall or may and/or in other cases they shall or may not expressly state that the CONTRACTOR shall do or perform any particular labour or service or because in certain cases the CONTRACT documents state that a particular work, operation,

supply, labour or service shall be performed/made by the CONTRACTOR at his own cost or without additional payment, compensation or charge or without entitlement of claim against the OWNER or words to similar effect, and in other cases they do not, or because in certain cases it is stated that the same are included in or covered by the Price Schedule and in other cases it is not so stated.

(ii) The cost of all construction and related vessels, craft, vehicles, movements, plant, equipment, distribution of water and power, construction of temporary roads and access, temporary works, pumps, wiring, pipes, scaffolding, piling, shuttering and other materials, supervision, labour, insurance, fuel, stores, spares, supplies, appliances and materials, items, articles and things whatsoever (foreseen of unforeseen) by expression or implication to be supplied, provided or arranged in or relative to or in connection with the performance and/or execution of the WORKS and/or related or incidental thereto, complete in every respect in accordance with the CONTRACT document, and the plans, drawing, designs, orders and/or instructions;

(iii) The cost of mobilisation including but not limited to mobilisation of vehicles, movements, machinery, equipment, gear, tools, tackle, consumables and other items and goods and personnel necessary for or to perform the WORKS contemplated under the CONTRACT, preparation and erection of work yards and other work places and facilities necessary for or to perform the WORKS contemplated under the CONTRACT and/or to supply the material included within the scope of supplies including all work, labour, inputs, goods, EQUIPMENT, and other items and things whatsoever necessary for the performance of the WORKS, dismantling and/or removal of the same and restoration of the site, lifting the materials and transporting them to CONTRACTOR's stock piles/work yard, job sites and loading, stacking and/or storing the same.

(iv) The costs and risks of all rents, royalties, licenses, permits, permission and other fees, duties, penalties, levies, and damages whatsoever payable for or in respect of any protected or patented goods, materials, equipment or processes employed in or relative to the works and of all rents, royalties, licenses, permits, permissions and any other fee, duty, penalty, levy, loss or damages payable on the excavation, removal or transportation of any material or acquisition or use of any right of way or other right, licenses, permit, privilege, permission or uses required for or relative to the performance of the WORK.

(v) The cost of all taxes and duties within the scope of work, all customs and import duties, Indian Income Tax, applicable GST, quay, warfare, demurrage, detention and landing charges and all other duties, taxes, fees, charges, levies, and/or cesses whatsoever imposed or to be imposed by the Central Government or State Government or Municipal or Local Bodies or other Authorities whatsoever and payable on any materials supplied and/or on works performed without any entitlement to the CONTRACTOR for any exemption, remission, refund or reduction thereof

(vi) The cost of all indemnities under the CONTRACT, and insurance premia on insurance required in terms of the CONTRACT documents or otherwise under any law, rule or regulation, and the cost of all risks whatsoever (foreseen and unforeseen) including but not limited to risks of delay or extension of time or reduction or increase in the work or scope of work and/or cancellation of CONTRACT, and/or accident, strike, civil commotion, war, strike, labour trouble, third party breach, fire, lighting, inclement weather, storm, tempest, flood,

earthquake and other acts of God, Government regulation or imposition or restriction, dislocation of road, rail, sea, air and other transport, access or facility, flooding of site and/or access roads and approaches thereto, suspension of work, sabotage and other cause whatsoever.

(vii) The cost of all inspections, tests and certificates relative thereto including third party tests and/or inspections where necessary, and of items, instruments, plant and/or tools and appliances required to conduct such inspection and tests.

(viii) The cost of all materials supplied and/or intended for incorporation in the WORKS supplied within the scope of work, delivery thereof to the job site, loading, transportation and unloading thereof, waste on materials, and return of empties and surpluses.

(ix) The cost of all escalations (foreseen and unforeseen) including but not limited to increase in Government taxes and duties (beyond contractual completion period and any extension hereof due to reasons attributable to CONTRACTOR), labor costs and material costs and other inputs whatsoever..

(x) All supervision charges, establishment's overheads, finance charges and other costs and expenses and charges to the CONTRACTOR, and the CONTRACTOR's profit of and relative to the WORK and/or supply.

(xi) The cost of all deductions, reductions, discounts, adjustments and withholdings whatsoever under or in connection with the CONTRACT.

(xii) The cost shall be deemed to include and cover the risk of all possibilities of delay and interference with the CONTRACTOR's conduct of WORK which occur from any causes including orders of the OWNER in the exercise of his power and on account of extension of time granted due to various reasons and for all other possible or probable causes of delay.

56.6.0 Deleted

56.7.0 Deleted

56.8.0 CLAIMS BY THE CONTRACTOR

56.8.1 No claim(s) shall on any account be made by the CONTRACTOR after submission of the Final Bill, with the intent that the Final Bill prepared by the CONTRACTOR shall reflect any and all claims whatsoever of the CONTRACTOR against the OWNER arising out of or in connection with the CONTRACT or any supply made or work performed by the CONTRACTOR there under or in relation thereto, and notwithstanding any enabling provision in any law or CONTRACT and notwithstanding any claim that the CONTRACTOR could have with respect thereto, the CONTRACTOR hereby waives and relinquishes any and all such claims not included in the Final Bill and absolves and discharges the OWNER from and against the same, even if in not including the same as aforesaid, the CONTRACTOR shall have acted under a mistake of law or of fact, or shall claim to have acted under economic compulsion or necessity.

56.8.2 If required by the OWNER, the ENGINEER-IN-CHARGE shall be authorised to require the CONTRACTOR to furnish, and the CONTRACTOR shall, upon the request of the ENGINEER-IN-CHARGE/OWNER, furnish all invoices, vouchers and accounting records as may be deemed necessary by the ENGINEER-IN-CHARGE/OWNER for the purpose of verifying any CONTRACTOR's claim.

56.9 DISCHARGE OF OWNER'S LIABILITY

56.9.1 The acceptance by the CONTRACTOR of any amount paid by the OWNER to CONTRACTOR in respect of the Final Bill of the CONTRACTOR in settlement of all said dues to the CONTRACTOR under the Final Bill shall, without prejudice to the claims of the CONTRACTOR included in the Final Bill in accordance with the provisions of clause 56.4.2 of GCC, be deemed to be in full and final settlement of all such dues to the CONTRACTOR notwithstanding any qualifying remarks, protest or condition imposed or purported to be imposed by the CONTRACTOR related to the acceptance of such payment, with the intent that upon acceptance by the CONTRACTOR of any payment made as aforesaid, the CONTRACT (including the arbitration clause) shall stand discharged and extinguished insofar as relates to and/or concerns the entitlements of the CONTRACTOR under the CONTRACT except for the CONTRACTOR's right, if any, to receive payment in respect of his notified claims included in his Final Bill and the right to receive payment of the unadjusted balance of the Contract Performance Security in accordance with the provisions of Clause 56.10.3 on successful completion of the DEFECT LIABILITY PERIOD. However, nothing herein stated shall affect the CONTRACTOR's undischarged liabilities and obligations under the CONTRACT.

56.9.2 The acceptance by the CONTRACTOR of any amount paid by the OWNER to the CONTRACTOR in respect of the notified claims of the CONTRACTOR included in the Final Bill, in settlement of the claims of the CONTRACTOR, shall be deemed to be in full and final settlement of all claims of the CONTRACTOR and, the CONTRACT shall stand discharged and extinguished insofar as relates to and/or concerns the claims of the CONTRACTOR except for the CONTRACTOR's rights to receive payments of the unadjusted balance, if any, of the Contract Performance Security in accordance with clause 56.10.3.0 hereof on successful completion of the DEFECT LIABILITY PERIOD. However, nothing herein stated shall affect the CONTRACTOR's undischarged liabilities and obligations under the CONTRACT.

56.9.3 Notwithstanding anything provided in Clause 56.9.1 and/or Clause 56.9.2, the CONTRACTOR shall be and remain liable for defects in terms of DEFECT LIABILITY PERIOD and associated clause thereunder and for any indemnity to the OWNER in terms of Clause 56.10.2 and shall be and remain entitled to receive the unadjusted balance of the Contract Performance Security remaining in the hands of the OWNER in terms of Clause 56.10.3 and associated clauses thereunder.

56.10.0 Deleted

56.11 CLAIMS OF OWNER

56.11.1 The release/payment of any unadjusted balance of the Contract Performance Security (furnished in the form of a Bank Guarantee or otherwise) by the OWNER to the CONTRACTOR as aforesaid or otherwise shall not be deemed or treated as a waiver of any right(s) or claim(s) of the OWNER existing before the issuance of the FINAL ACCEPTANCE CERTIFICATE or shall not stop or prevent the OWNER from thereafter making or enforcing any claim or any rights existing before the issuance of the FINAL ACCEPTANCE CERTIFICATE against the CONTRACTOR with the intent that the claims of the OWNER, against the CONTRACTOR shall continue to survive and shall not get extinguished notwithstanding the issue of FINAL ACCEPTANCE CERTIFICATE and/or the release of Contract Performance Security to the CONTRACTOR.

57.0 UNDERGROUND OBSTRUCTIONS

The soil investigation report furnished in the NIT is indicative only and is enclosed purely for information/guidance purpose to the bidders. The contractor shall carry out its own detailed soil investigation for the proposed plant. Design of the foundation system of the plant shall be based, only on the site specific report. Nothing extra shall be paid in case of any variation arising out of the soil report conducted by the bidders and the data given in the tender. In the event, CONTRACTOR encounters any underground obstructions, the same shall be removed by CONTRACTOR without any extra cost implications to the OWNER.

In the event, CONTRACTOR encounters any underground obstruction which entails cost implication to the CONTRACTOR, the OWNER shall consider to compensate the CONTRACTOR reasonable cost compensation and/or time extension, depending on merit of the case after mutual discussion. The decision of the ENGINEER-IN-CHARGE in this regard shall be in writing and shall be final and binding upon the CONTRACTOR. It is clarified that in case the CONTRACTOR disagrees with the decision of ENGINEER-IN-CHARGE, the dispute shall be settled as per the provision of clause 39 of GCC.

57.1 ARTICLES OF VALUE FOUND:

All gold, silver and other minerals of any description and all precious stones, coins, treasure relics, antiquities and other similar things which shall be found in, under or upon the SITE, shall be the property of the OWNER and the CONTRACTOR shall duly preserve the same to the satisfaction of the ENGINEER-IN-CHARGE and shall from time to time deliver the same to such person or persons indicated by the OWNER.

58.0 REGISTRATION OF THE CONTRACTOR WITH STATUTORY AUTHORITIES

Within 30 days of execution of the CONTRACT, the CONTRACTOR shall, insofar as necessary, register itself at their own cost with the applicable statutory authorities as required under the rules and regulations governing in India. The CONTRACT PRICE shall be deemed to include all costs towards the same. A copy of all documents related to all such registration shall be submitted to OWNER for record.

59.0 STATUTORY OBLIGATIONS

59.1 CONTRACTOR shall comply with the requirements of statutory provisions and shall be solely responsible for fulfilment of all legal obligations under Contract Labour (Regulation and Abolition) Act, Inter-state Migrant Workmen (Registration of Employment and Condition of Service) Act, Payment of Wages Act, Workmen Compensation Act, Factories Act, Employees Provident Fund and Misc. Provisions Act, Payment of Bonus Act, Payment of Gratuity Act, Industrial Disputes Act and all other applicable Industrial/Labour enactment and Rules made there under as applicable from time to time. In case OWNER incurs any liability towards payment of any kind whatsoever, due to non-fulfilment of statutory provisions under any industrial/labour law by CONTRACTOR, the same shall be made good by CONTRACTOR.

59.2 SUB-CONTRACTOR engaged by CONTRACTOR for performing civil and erection work/other jobs at SITE shall have PF Code No. in its name issued by Regional Provident Fund Commissioner (RPFC).

59.3 The CONTRACTOR shall ensure that the SUB-CONTRACTOR shall comply with the Statutory Requirements, as applicable, for the execution of this CONTRACT.

60.0 UTILISATION OF LOCAL RESOURCES

60.1 The CONTRACTOR shall ascertain the availability of local SUB-CONTRACTORS and skilled/unskilled manpower and engage them to the extent possible for performance of the WORKS.

60.2 The CONTRACTOR shall not recruit personnel of any category from among those who are already employed by the other agencies working at the site, but shall make maximum use of local labour available.

61.0 FUEL REQUIREMENT OF WORKERS

The CONTRACTOR shall be responsible to arrange for the fuel requirement of his workers and staff without resorting to cutting of trees and shrubs. Cutting of trees and shrubs is strictly prohibited for this purpose. The CONTRACTOR shall abide by the conditions put forth by the Environmental Clearance for the SITE as regards to construction workers.

62.0 SURPLUS MATERIAL

Notwithstanding anything provided elsewhere, all surplus materials shall be dealt as follows:

62.1 Any balance Indigenous/imported surplus MATERIALS including scrap shall belong to the CONTRACTOR upon completion of the WORKS and will be allowed to be taken back by CONTRACTOR after compliance of statutory formalities.

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62.2 For taking out balance indigenous/imported surplus MATERIALS as mentioned above upon the completion of the project, the CONTRACTOR shall have to furnish proof of entry and ownership of such MATERIALS inside the SITE, certification of ENGINEER-IN-CHARGE and OWNER in this regard.

62.3 Following clause will apply only in case of applicability of concessional custom duty (presently, there is no applicability of concessional custom duty):

All imported surplus materials other than CONSTRUCTION EQUIPMENT which is brought to the SITE shall be the OWNER's property and shall be returned by the CONTRACTOR to the OWNER's designated stores. All such materials shall be subject to reconciliation and a proper accounting procedure shall be developed and strictly followed by the CONTRACTOR recorded in the inspection reports, proforma of which will be approved by the ENGINEER-IN-CHARGE. These reports shall form part of the completion DOCUMENTS. Inspection and acceptance of the WORK shall not relieve the CONTRACTOR from any of his responsibilities under this CONTRACT. However, indigenous Surplus Material as certified by the OWNER will be allowed to be taken back by Contractor after compliance of statutory formalities.

63.0 COORDINATION WITH OTHER AGENCIES

63.1 CONTRACTOR shall be responsible for proper coordination with other agencies operating at the site so that WORK may be carried out concurrently, without any hindrance to others. The ENGINEER-IN-CHARGE shall resolve disputes, if any, in this regard, and his decision shall be final and binding on the CONTRACTOR.

63.2 If and when required for the coordination of the WORKS with other agencies involved at SITE, the CONTRACTOR shall within the scope of work, re-route and/or prepare approaches and working areas as may be necessary.

64.0 ERECTION OF EQUIPMENT

All erection shall be carried out by deploying a crane(s) of suitable capacity. Erection by derrick shall not be permissible. The CONTRACTOR shall submit erection schemes for erection of critical equipment to ENGINEER-IN-CHARGE for his APPROVAL. No EQUIPMENT shall be erected in the absence of an approved erection scheme for such EQUIPMENT.

The quoted rates of the CONTRACTOR shall be deemed to include load testing of the crane as required to establish the lifting capacity of the crane.

65.0 ELECTRICAL CONTRACTOR'S LICENCE

65.1 The CONTRACTOR or its nominated SUB-CONTRACTOR(s), as the case may be, shall have a valid electrical contractor's license for working in the State in which the job site is located. The CONTRACTOR shall furnish a copy of the same to ENGINEER-IN-CHARGE before commencement of any electrical work or work pertaining to Electrical System.

65.2 No electrical work or work pertaining to electrical system(s) shall be permitted to be executed without a valid Electrical Contractors License being produced by the CONTRACTOR or SUB-CONTRACTOR, as the case may be, intending to execute the WORK.

66.0 RENTS & ROYALTIES

Unless otherwise specified, the CONTRACTOR shall pay all tonnage and other royalties, rents and other payments or compensation (if any) for getting stone, sand, gravel, clay, bricks or other materials required for the WORKS or any temporary works.

67.0 GOVERNMENT OF INDIA NOT LIABLE

It is expressly understood and agreed by and between the CONTRACTOR and the OWNER that the OWNER is entering into this agreement solely on its own behalf and not on behalf of any other person or entity. In particular, it is expressly understood and agreed that the Government of India is not a party to this agreement and has no liabilities, obligations or rights thereunder. It is expressly understood and agreed that the OWNER is an independent legal entity with power and authority to enter into contracts, solely in its own behalf under the applicable laws of India and general principles of Contract. The CONTRACTOR expressly agrees, acknowledges and understands that the OWNER is not an agent, representative or delegate of the Government of India. It is further understood and agreed that the Government of India is not and shall not be liable for any acts, omissions commissions, breaches or other wrongs arising out of the CONTRACT. Accordingly, CONTRACTOR hereby expressly waives, releases and foregoes any and all

actions or claims, including cross claims or counter claims against the Government of India arising out of this CONTRACT and covenants not to sue the Government of India on any matter, claim, and cause of action or thing whatsoever arising of or under this CONTRACT.

68.0 SITE CLEANING

The CONTRACTOR shall take care to keep clean the job site at all times for easy access to the job site and also from the safety point of view in accordance with the CONTRACT requirements.

69.0 ACCESS TO SITE

69.1 The CONTRACTOR shall at his own cost and initiative arrange for and provide any access to the work area and stringing or other yards for labour, EQUIPMENT and MATERIAL as may be necessary for any cause in addition to the ingress and egress available. Any arrangements in respect thereof as may be entered into by the CONTRACTOR with any person interested in the land through which access is sought, shall be in writing and a copy of the writing (certified by or on behalf of the CONTRACTOR to be true copy thereof) shall forthwith be lodged with the OWNER. Such a writing shall specifically stipulate that the OWNER shall not be responsible for any claims under the CONTRACT or for any damage, loss or injury to the land or any material, item or thing thereon or in, and the CONTRACTOR shall keep the OWNER indemnified from and against any claim, action or proceedings in respect thereof.

69.2 The CONTRACTOR shall at his own cost and initiative arrange for and obtain all necessary permissions, permits, consents and licenses as may be necessary to transport the MATERIALS, tools, EQUIPMENT, machinery and labour along or across any highway, roadway, or other way, or railway, tramway, bridge, dyke, dam or embankment, or lake, pond, canal, river, state terminal toll octroi, or other line, border or barrier. Traffic study if required, shall be carried out by CONTRACTOR independently without any liability on OWNER.

70.0 INDEPENDENT CONTRACTOR

70.1 Neither CONTRACTOR nor any SUB-CONTRACTOR nor the employees, agents or representative of either shall be deemed to be employees, agents or representative of the OWNER in the performance of the CONTRACT.

71.0 PAYEMENT TO THE SUB-CONTRACTOR

CONTRACTOR shall indemnify and hold harmless OWNER for any claim brought by SUBCONTRACTOR against OWNER in relation to CONTRACTOR’s payment obligations for the relevant purchase orders and sub-contracts.

71.1 CONTRACTOR agrees that he shall furnish to OWNER, if requested, satisfactory evidence that all SUB-CONTRACTORS, including vendor to CONTRACTOR have been paid on the time and in full for work done or goods supplied, in connection with the performance of the WORK.

71.2 If evidence is not supplied, then the OWNER shall not be bound to make any further payment to CONTRACTOR for that part of work until it is paid by CONTRACTOR.

71.3 CONTRACTOR shall notify OWNER of any dispute of any kind between CONTRACTOR and any of his SUB-CONTRACTOR or vendors stating the nature of dispute, the amount of any payment which is being withheld by CONTRACTOR, the reasons thereof and the CONTRACTOR's plan to settle the dispute.

72.0 ORDER OF WORKS / PERMISSION / RIGHT OF ENTRY / CARE OF EXISTING SERVICES

CONTRACTOR is required to submit to OWNER the various details with respect to their personnel(s) to be deputed for the execution of WORK such as name(s), nationality and passport details in case of Foreign Nationals (Passport No., Date of Issue, Date of Expiry etc.). These details are required for granting permission to enter and work in the existing fertilizer complex. The OWNER reserves the right to declare any person(s) as non grata. No claim whatsoever shall be entertained by OWNER on this account.

OWNER shall have the right to object to any Representative or personnel deputed to India by CONTRACTOR for execution of WORK or in connection with WORK, due to their misconduct or breach of law and regulation or who are found to be incompetent or negligent. CONTRACTOR shall remove such persons from SITE forthwith and take immediate action for replacement at no cost to OWNER.

73.0 GIFTS, COMMISSIONS, ETC.

Any gift, commission or advantage given, promised or offered by or on behalf of the CONTRACTOR or his partner, agent, officers, directors, employee or servant or anyone on his or their behalf in relation to the obtaining or to the execution of this or any other contract with the OWNER, shall in addition to any criminal liability which it may incur, subject the CONTRACTOR to the cancellation of this and all other contracts and also the payment of any loss or damage to the OWNER resulting from any cancellation. The OWNER shall then be entitled to deduct the amounts so payable from any monies otherwise due to the CONTRACTOR under the CONTRACT.

74.0 LABOUR LAWS- PF, EPF AND ESI

74.1 The CONTRACTOR shall obtain necessary license from the Licensing Authority under the Contract Labour (Regulation & Abolition) Act 1970 and the Central Rules framed there under and produce the same to the ENGINEER-IN-CHARGE before start of WORK.

74.2 The CONTRACTOR shall not undertake or execute or permit any other agency or SUB-CONTRACTOR to undertake or execute any work on the CONTRACTOR'S behalf through contract labour except under and in accordance with the license issued in that behalf by the Licensing Officer or other authority prescribed under the Factories Act or the contract labour (Regulation & Abolition) Act 1970 or their applicable lay, rule or regulation, if applicable.

74.3 The provision of EPF & MP Act, 1952 and Rules scheme there under shall be applicable to the CONTRACTOR and the employees engaged by him for the WORK. The CONTRACTOR shall furnish the code number allotted by the RPFC Authority, to the ENGINEER-IN-CHARGE before commencing the WORK.

74.4 The CONTRACTOR shall be exclusively responsible for any delay in commencing the work on account of delay in obtaining a license under clause 74.1 above or in obtaining the code number under clause 74.3 above and the same shall not constitute a ground for extension of time for any purpose.

74.5 The CONTRACTOR shall enforce the provisions of ESI Act and Scheme framed from time to time there under with regard to all his employees involved in the performance of

the CONTRACT and shall deduct employee's contribution from the wages of each of the employees and shall deposit the same together with employer's contribution of such total wages payable to the employees in the appropriate account.

74.6 All liabilities like salaries, wages and other statutory obligations in respect of the persons engaged by the CONTRACTOR shall be borne by the CONTRACTOR during the period of agreement. In view of the provisions of the ESI Act, PF and EPF Act and other Acts, as may be applicable to OWNER, the CONTRACTOR shall take necessary steps to cover its employees under the said enactments and shall submit proof of such compliance to ENGINEER-IN-CHARGE periodically or at any date upon such request, as may be made by ENGINEER-IN-CHARGE to the CONTRACTOR. In the event of non-compliance with the statute or the provisions thereof, referred to above, it shall be open to OWNER to withhold such amount as in its opinion is due and payable by the CONTRACTOR in respect of its employees from and out of dues, payable by OWNER to the CONTRACTOR and such due shall be held by OWNER with it until proof is submitted by the CONTRACTOR to OWNER indicating compliance with such statutes within reasonable time, failing which OWNER shall deposit such amounts with the authorities concerned on behalf of the CONTRACTOR and inform the CONTRACTOR of such deposit or deposits.

75.0 GENERAL PROVISIONS

75.1 Confidential Information

75.1.1 **Non-disclosure**

Each party agrees to hold in confidence any information imparted to it or in the case of CONTRACTOR, to any of its SUB- CONTRACTOR / VENDOR, by the other Party which pertains to that other party's business activity in any manner, and which is not be subject of general public knowledge, including, without limitation, proprietary processes, technical information and know-how, information concerning other projects, management policies, economic policies, financial and other data and the like. The preceding non-disclosure requirements shall not apply to:

i) Information furnished without restriction by the other Party prior to the date hereof
ii) Information in the public domain; or
iii) Information obtained by a Party from a third Person not under obligation of non-disclosure to the other party.
(iv) Information required to be disclosed in pursuance of an order, judgement, decree of the Court, Tribunal or Statutory Authority.

75.1.2 **Disclosure to Govt. Agency**

Either Party may disclose any such information to the extent that such Party is required by any Government Agency to make such disclosure. In addition, OWNER may disclose such information to the extent that such disclosure is required by any Lender / Lender's Representative, etc. provided that such Lenders signed a confidentiality agreement containing confidentiality and limited use obligations not less stringent than those accepted by OWNER under the CONTRACT and License Agreement, if any and such parties are not competitor of CONTRACTOR or its Licensors.

75.1.3 Upon completion of the Works or in the event of termination pursuant to the provisions of the CONTRACT, CONTRACTOR shall immediately return to the OWNER all drawings, plans, specifications and other documents supplied to the CONTRACTOR by or on behalf of the OWNER or prepared by the CONTRACTOR solely for the purpose of the performance of the WORKS, including all copies made thereof by the CONTRACTOR.

75.1.4 This clause shall survive and remain in full force for a period of ten years following the issue of FINAL ACCEPTANCE CERTIFICATE.

75.2 **Cut-Off Dates**

No claims or correspondence on claims on this CONTRACT shall be entertained by either parties after 6 months after expiry of the Contract Performance Security unless specified otherwise in CONTRACT.

75.3 **Recovery of Sums / Dues**

75.3.1 All costs, damages or expenses which OWNER may have incurred, for which CONTRACTOR is liable under CONTRACT, shall be notified to CONTRACTOR and shall be recovered by OWNER from any payment due to or becoming due to CONTRACTOR under this CONTRACT or other CONTRACT and/or shall be recovered by action at law or otherwise. If the payment due to CONTRACTOR is not sufficient for recovery of the said sums/dues, CONTRACTOR shall pay immediately to OWNER such sums/dues or the balance sums/dues on demand.

75.3.2 All MUTUALLY AGREED DAMAGES applicable and to be recovered from CONTRACTOR under CONTRACT, shall be recovered by OWNER from any payment due to or becoming due to CONTRACTOR under this CONTRACT or other CONTRACT and/or shall be recovered by action at law or otherwise. If the payment due to CONTRACTOR is not sufficient for recovery of the said MUTUALLY AGREED DAMAGES, CONTRACTOR shall pay immediately to OWNER such MUTUALLY AGREED DAMAGES. or the balance MAD on demand.

75.3.3 For avoidance of doubt all the rights and remedies of OWNER/CONTRACTOR and liabilities of the CONTRACTOR/OWNER as set out in the CONTRACT shall be to the exclusion of any other rights, remedies or liabilities available at law.

75.4 **Payments etc. not to affect rights of OWNER**

No sum paid on account by OWNER nor any extension of the date for completion granted by OWNER shall affect or prejudice the rights of OWNER against CONTRACTOR or relieve CONTRACTOR of its obligation for the faithful performance of CONTRACT.

75.5 **Site Working and Safety Conditions**

CONTRACTOR shall follow the SITE working and safety conditions enclosed as Section VI-13.

75.6 **Miscellaneous**

75.6.1 No CONTRACT or understanding in any way modifying the conditions of CONTRACT shall be binding upon either parties hereto unless made in writing and approved by both parties.

75.6.2 Without prejudice to FORCE MAJEURE, CONTRACTOR shall, during inclement weather, carry out WORK in accordance with CONTRACT and CONTRACTOR shall not be entitled to any additional payment over and above the CONTRACT PRICE payable under CONTRACT by reason of its being unable to carry out WORK owing to inclement weather.

76.0 Implementation of Apprentices act 1961

The CONTRACTOR shall comply with the provisions of the Apprentices Act, 1961 and the Rules and Orders issued thereunder from time to time. If he fails to do so, his failure will be a breach of the CONTRACT and the ENGINEER-IN-CHARGE may, at his discretion, cancel the CONTRACT. The CONTRACTOR shall also be liable for any pecuniary liability arising on account of any violation by him of the provisions, of the Act.

77.0 Change in constitution

Where the CONTRACTOR is a partnership firm, the prior approval of the OWNER shall be obtained in writing, before any change is made in the constitution of the firm. Where the CONTRACTOR is an individual or a Hindu undivided family business concern, such approval as aforesaid shall, likewise be obtained before such CONTRACTOR enters into any agreement with other parties, where under, the reconstituted firm would have the right to carry out the work hereby undertaken by the CONTRACTOR. In either case if prior approval as aforesaid is not obtained, the CONTRACT shall be deemed to have been allotted in contravention of clause 12 of GCC and the same action may be taken and the same consequence shall ensure as provided in the said clause.

78.0 Access by Road

CONTRACTOR, if necessary, shall build other temporary access roads to the actual site of construction for his own work at his own cost. The CONTRACTOR shall be required to permit the use of the roads so constructed by him for vehicles of any other parties who may be engaged on the project site. The CONTRACTOR shall also facilitate the construction of the permanent roads should the construction there of start while he is engaged on this work. He shall make allowance in his tender for any inconvenience he anticipates on such account. Non-availability of access roads, railway siding and railway wagons for the use of the CONTRACTOR shall in no case condone any delay in the execution of WORK nor be the cause for any claim for compensation against the OWNER.

79.0 Members of the OWNER not individually liable

No Director, or official or employee of the OWNER/ PMC shall in any way be personally bound or liable for the acts or obligations of the OWNER under the CONTRACT or answerable for any default or omission in the observance or performance of any of the acts, matters or things which are herein contained.

80.0 OWNER not bound by personal representations

The CONTRACTOR shall not be entitled to any increase on the scheduled rates or any other right or claim whatsoever by reason of any representation, explanation statement or

alleged representation, promise or guarantees given or alleged to have been given to him by any person.

81.0 Land for Contractor's Field Office, Godown and Workshop

The OWNER will, at his own discretion and convenience and for the duration of the execution of the work make available near the site, land for construction of CONTRACTOR's Temporary Field Office, godowns workshops and assembly yard required for the execution of the CONTRACT. The CONTRACTOR shall at his own cost construct all these temporary buildings and provide suitable water supply and sanitary arrangement and get the same approved by the ENGINEER-IN-CHARGE. On completion of the works undertaken by the CONTRACTOR, he shall remove all temporary works erected by him and have the SITE cleaned as directed by ENGINEER-IN-CHARGE. If the CONTRACTOR shall fail to comply with these requirements, the ENGINEER-IN-CHARGE may at the expenses of the CONTRACTOR remove such surplus, and rubbish materials and dispose-off the same as he deems fit and get the site cleared as aforesaid; and CONTRACTOR shall forthwith pay the amount of all expenses so incurred and shall have no claim in respect of any such surplus materials disposed off as aforesaid. But the OWNER reserves the right to ask the CONTRACTOR any time during the pendency of the CONTRACT to vacate the land by giving 7 days' notice on security reasons or on national interest or otherwise. Rent may be charged for the land so occupied from contractor by the OWNER. The CONTRACTOR shall put up temporary structures as required by them for their office, fabrication shop and construction stores only in the area allocated to them on the project site by the OWNER or his authorized representative. No tea stalls/canteens should be put up or allowed to be put up by any CONTRACTOR in the allotted land or complex area without written permission of the OWNER. Un-authorized buildings, constructions or structures should not be put up by the CONTRACTOR anywhere on the project site. For uninterrupted fabrication work, the CONTRACTOR shall put up temporary covered structures at his cost within Area in the location allocated to them in the project site by the OWNER or his authorized representative. No person except for authorized watchman shall be allowed to stay in the plant area/CONTRACTOR's area after completion of the day's job without prior written permission from ENGINEER-IN-CHARGE.

82.0 Rounding-Off of Amounts

In calculating the amount of each item due to the CONTRACTOR in every certificate prepared for payment, sum of less than 50 paise shall be omitted and the total amount on each certificate shall be rounded off to the nearest rupees, i.e., sum of less than 50 paise shall be omitted and sums of 50 paise and more upto one rupee shall be reckoned as one rupee.

83.0 Deleted

84.0 Work In Monsoon and Dewatering

(i) Unless otherwise specified elsewhere in the tender, the execution of the WORK may entail working in the monsoon also. The CONTRACTOR must maintain a minimum labour force as may be required for the job and plan and execute the construction and erection according to the prescribed schedule. No extra rate will be considered for such work in monsoon.

(ii) During monsoon and other period, it shall be the responsibility of the CONTRACTOR to keep the construction work site free from water at his own cost.

85.0 General conditions for construction and erection work:

(i) The working time at the site of work is 48 hours per week. Overtime work is permitted in cases of need and the OWNER will not compensate the same. Shift working at 2 or 3 shifts per day will become necessary and the CONTRACTOR should take this aspect into consideration for formulating his rates for quotation. No extra claims will be entertained by the OWNER on this account. No extra claims will be entertained by the OWNER on this account. For carrying out work beyond working hours the CONTRACTOR will approach the ENGINEER-IN-CHARGE or his authorized representative and obtain his prior written permission.

(ii) The CONTRACTOR must arrange for the placement of workers in such a way that the delayed completion of the WORK or any part thereof for any reason whatsoever will not affect their proper employment. The OWNER will not entertain any claim for idle time payment whatsoever.

(iii) The CONTRACTOR shall submit to the OWNER/ENGINEER-IN-CHARGE reports at regular intervals regarding the state and progress of WORK. The details and proforma of the report will mutually be agreed after the award of CONTRACT. The CONTRACTOR shall provide display boards showing progress and labour strengths at worksite, as directed by the ENGINEER-IN-CHARGE.

86.0 Action where no specification is issued

In case of any class of WORK for which there is no SPECIFICATION supplied by the OWNER as mentioned in the Tender Documents such WORK shall be carried out in accordance with Indian Standard Specifications and if the Indian Standard Specifications do not cover the same, the WORK should be carried out as per standard Engineering Practice subject to the approval of the ENGINEER-IN-CHARGE.

87.0 Care of Works:

i) From the commencement to completion of the WORK, the CONTRACTOR shall take full responsibility for the care for all works including all temporary works and in case any damages, loss or injury shall happen to the WORK or to any part thereof or to any temporary works from any cause whatsoever, shall at his own cost repair and make good the same so that at completion the WORK shall be in good order and in conformity in every respects with the requirement of the CONTRACT and the ENGINEER-IN-CHARGE's instructions**.**

ii) **Defects Prior To Taking Over**: If at any time, before the WORK is taken over, the ENGINEER-IN-CHARGE shall: a) Claim that any works done or materials used by the CONTRACTOR or by any SUB-CONTRACTOR is defective or not in accordance with the CONTRACT, or that the works or any portion thereof are defective, or do not fulfill the requirements of CONTRACT (all such matters being hereinafter, called `Defects' in this clause), and b) As soon as reasonably practicable, gives to the CONTRACTOR notice in writing of the said decision, specifying particulars of the defects alleged to exist or to have occurred, then the CONTRACTOR shall at his own expenses and with all speed make good the defects so specified. In case CONTRACTOR shall fail to do so, the OWNER may take, at the cost of the CONTRACTOR, such steps as may in all circumstances, be reasonable to make good such defects. The expenditure so incurred by the OWNER will be recovered from the amount due to the CONTRACTOR. The decision of the ENGINEER-IN-

CHARGE with regard to the amount to be recovered from the CONTRACTOR will be final and binding on the CONTRACTOR. As soon as the WORK has been completed in accordance with the CONTRACT (except in minor respects that do not affect their use for the purpose for which they are intended and except for maintenance thereof provided in clause 3.0 (22) of General Conditions of Contract) and have passed the tests on completion, the ENGINEER-IN-CHARGE shall issue a certificate (hereinafter called Completion Certificate) in which he shall certify the date on which the WORK have been so completed and have passed the said tests and the OWNER shall be deemed to have taken over the WORK on the date so certified. If the WORK has been divided into various groups in the CONTRACT, the OWNER shall be entitled to take over any group or groups before the other or others and there upon the ENGINEER-IN-CHARGE shall issue a Completion Certificate which will, however, be for such group or groups so taken over only. In such an event if the group /section/ part so taken over is related, to the integrated system of the work, notwithstanding date of grant of Completion Certificate for group/ section/ part.

iii) **Defects After Taking Over**: In order that the CONTRACTOR could obtain a COMPLETION CERTIFICATE he shall make good, with all possible speed, any defect arising from the defective materials supplied by the CONTRACTOR or workmanship or any act or omission of the CONTRACT or that may have been noticed or developed, after the works or groups of the works has been taken over, the period allowed for carrying out such WORK will be normally one month. If any defect is not remedied within a reasonable time, the OWNER may proceed to do the WORK at CONTRACTOR's risk and expense and deduct from the final bill such amount as may be decided by the OWNER. If by reason of any default on the part of the CONTRACTOR a COMPLETION CERTIFICATE has not been issued in respect of any portion of the WORK within one month after the date fixed by the CONTRACT for the completion of the WORK, the OWNER shall be at liberty to use the WORK or any portion thereof in respect of which a completion certificate has not been issued, provided that the WORK or the portion thereof so used as aforesaid shall be afforded reasonable opportunity for completing these works for the issue of Completion Certificate.

iv) COMPLETION CERTIFICATE' where ever mentioned shall be read as 'PRELIMINARY ACCEPTANCE CERTIFICATE'

88.0 Field Management & Controlling / Coordinating Authority:

i) The field management will be the responsibility of the ENGINEER-IN-CHARGE, who will be nominated by the OWNER. The ENGINEER-IN-CHARGE may also authorize his representatives to assist in performing his duties and functions.

ii) The ENGINEER-IN-CHARGE shall coordinate the works of various agencies engaged at site to ensure minimum disruption of work carried out by different agencies. It shall be the responsibility of the CONTRACTOR to plan and execute the work strictly in accordance with site instructions to avoid hindrance to the work being executed by other agencies.

89.0 Local Conditions:

i) It will be imperative on each tenderer to inform himself of all local conditions and factors which may have any effect on the execution of WORK covered under the Tender Document. In their own interest, the tenderer are requested to familiarize themselves with the Indian Income Tax Act 1961, Indian Companies Act 1956/2013, Indian Customs Act 1962 and other related Acts and Laws and Regulations of India with their latest amendments, as applicable. TFL shall not entertain any requests for clarifications from the tenderer regarding such local conditions.

ii) It must be understood and agreed that such factors have properly been investigated and considered while submitting the tender. No claim for financial or any other adjustments to VALUE OF CONTRACT, on lack of clarity of such factors shall be entertained.

90.0 Special Conditions of Contract:

i) Special Conditions of Contract (SCC) shall be read in conjunction with the General Conditions of Contract (GCC), specification of Work, Drawings and any other documents forming part of this CONTRACT wherever the context so requires.

ii) Notwithstanding the sub-division of the documents into these separate sections and volumes every part of each shall be deemed to be supplementary to and complementary of every other part and shall be read with and into the CONTRACT so far as it may be practicable to do so.

iii) Where any portion of the General Condition of Contract is repugnant to or at variance with any provisions of the Special Conditions of Contract, unless a different intention appears the provisions of the Special Conditions of Contract shall be deemed to over-ride the provisions of the General Conditions of Contract and shall to the extent of such repugnancy, or variations, prevail.

iv) Wherever it is mentioned in the specifications that the CONTRACTOR shall perform certain WORK or provide certain facilities, it is understood that the CONTRACTOR shall do so at his cost and the VALUE OF CONTRACT shall be deemed to have included cost of such performance and provisions, so mentioned.

v) The materials, design and workmanship shall satisfy the relevant INDIAN STANDARDS, the JOB SPECIFICATIONS contained herein and CODES referred to. Where the job specification stipulate requirements in addition to those contained in the standard codes and specifications, these additional requirements shall also be satisfied.

91.0 POWER OF ENTRY:

1) If the CONTRACTOR shall not commence the WORK in the manner previously described in the CONTRACT documents or if he shall at any time in the opinion of the ENGINEER-IN-CHARGE -

i) fail to carry out the WORK in conformity with the CONTRACT documents, or

ii) fail to carry out the WORK in accordance with the Time Schedule, or

iii) substantially suspend work or the WORK for a period of fourteen days without authority from the ENGINEER-IN-CHARGE, or

iv) fail to carry out and execute the WORK to the satisfaction of the ENGINEER-IN-CHARGE, or

v) fail to supply sufficient or suitable construction plant, temporary works, labour, materials or things, or

vi) Commit, suffer, or permit any other breach of any of the provisions of the CONTRACT on his part to be performed or observed or persist in any of the above mentioned breaches of the CONTRACT for fourteen days, after notice in writing shall have been given to the CONTRACTOR by the ENGINEER-IN-CHARGE requiring such breach to be remedied, or

vii) if the CONTRACTOR shall abandon the WORK , or

viii) If the CONTRACTOR during the continuance of the CONTRACT shall become bankrupt, make any arrangement or composition with his creditors, or permit any execution to be levied or go into liquidation whether compulsory or voluntary not being merely a voluntary liquidation for the purpose of amalgamation or reconstruction

then in any such case, the OWNER shall have the power to enter upon the WORK and take possession thereof and of the materials, temporary WORK, construction plant, and stock thereon, and to revoke the CONTRACTOR's license to use the same, and to complete the WORK by his agents, other CONTRACTORS or workmen or to relate the same upon any terms and to such other person, firm or corporation as the OWNER in his absolute discretion may think proper to employ and for the purpose aforesaid to use or authorize the use of any materials, temporary work, CONSTRUCTION PLANT, and stock as aforesaid, without making payment or allowance to the CONTRACTOR for the said materials other than such as may be certified in writing by the ENGINEER-IN-CHARGE to be reasonable, and without making any payment or allowance to the CONTRACTOR for the use of the temporary said works, construction plant and stock or being liable for any loss or damage thereto, and if the OWNER shall by reason of his taking possession of the WORK or of the WORK being completed by other CONTRACTOR (due account being taken of any such extra work or works which may or be omitted) then the amount of such excess as certified by the ENGINEER-IN-CHARGE shall be deducted from any money which may be due for work done by the CONTRACTOR under the CONTRACT and not paid for. Any deficiency shall forthwith be made good and paid to the OWNER by the CONTRACTOR and the OWNER shall have power to sell in such manner and for such price as he may think fit all or any of the construction plant, materials etc. constructed by or belonging to and to recoup and retain the said deficiency or any part thereof out of proceeds of the sale.

92.0 LIENS:

1) If, at any time there should be evidence or any lien or claim for which the OWNER might have become liable and which is chargeable to the CONTRACTOR, the OWNER shall have the right to retain out of any payment then due or thereafter to become due an amount sufficient to completely indemnify the OWNER against such lien or claim and if such lien or claim be valid, the OWNER may pay and discharge the same and deduct the amount so paid from any money which may be or may become due and payable to the CONTRACTOR. If any lien or claim remain unsettled after all payments are made, the CONTRACTOR shall refund or pay to the OWNER all money that the latter may be compelled to pay in discharging such lien or claim including all costs and reasonable expenses. OWNER reserves the right to do the same.

2) The OWNER shall have lien on all materials, equipments including those brought by the CONTRACTOR for the purpose of erection, testing and commissioning of the WORK.

3) The final payment shall not become due until the CONTRACTOR delivers to the ENGINEER-IN-CHARGE a complete release or waiver of all liens arising or which

may arise out of his agreement or receipt in full or certification by the CONTRACTOR in a form approved by ENGINEER-IN-CHARGE that all invoices for labour, materials, services have been paid in lien thereof and if required by the ENGINEER-IN-CHARGE in any case an affidavit that so far as the CONTRACTOR has knowledge or information the releases and receipts include all the labour and material for which a lien could be filled.

4) CONTRACTOR will indemnify and hold the OWNER harmless, for a period of two years after the issue of FINAL ACCEPTANCE CERTIFICATE, from all liens and other encumbrances against the OWNER on account of debts or claims alleged to be due from the CONTRACTOR or his SUB-CONTRACTOR to any person including SUB-CONTRACTOR and on behalf of OWNER will defend at his own expense, any claim or litigation brought against the OWNER or the CONTRACTOR in connection therewith. CONTRACTOR shall defend or contest at his own expense any fresh claim or litigation by any person including his SUB-CONTRACTOR, till its satisfactory settlement even after the expiry of two years from the date of issue of FINAL CERTIFICATE.

SECTION – V

SPECIAL CONDITIONS OF CONTRACT

CONTENT

GENERAL

The SPECIAL CONDITIONS OF CONTRACT shall be read in conjunction with the GENERAL CONDITIONS OF CONTRACT, specifications of work, DRAWINGS and any other document forming part of this CONTRACT wherever the context so requires.

Where any portion of the GENERAL CONDITIONS OF CONTRACT is repugnant to or at variance with any other provisions of the SPECIAL CONDITIONS OF CONTRACT, then unless a different intension appears, the SPECIAL CONDITIONS OF CONTRACT shall be deemed to over-ride the provisions of GENERAL CONDITIONS OF CONTRACT and shall prevail to the extent of such repugnancy or variations.

1.0 CONTRACTOR'S OBLIGATIONS

1.1.0 General Responsibility

1.1.1 The CONTRACTOR acknowledges that this CONTRACT is a LSTK Contract (Excluding Civil works as per Technical Section) and CONTRACTOR'S obligation hereunder, notwithstanding anything to the contrary contained herein, is to provide OWNER with fully operational PLANT, complete in all respects under and in accordance with the provision of CONTRACT, within the stipulated time and for the purpose designated herein by OWNER, and to do, furnish and provide everything necessary in connection therewith.

Without prejudice to the foregoing and except as otherwise expressly set forth in the CONTRACT as within the scope of OWNER's obligations under the CONTRACT, the CONTRACTOR shall perform or cause to be performed all WORK and services required in connection with the design, engineering, Manufacturing, supply of equipment, procurement(including, without limitation, all transportation services in connection therewith), Third Party Inspection (TPI) as applicable, Expediting, Site Survey and Condition Assessment, Insurance, Construction and Erection of all Mechanical, Electrical and Instrumentation Works including all technological structures of equipment's, Assembly and Installation of Equipment's, Obtaining all necessary Statutory Approvals, Pre-Commissioning, Commissioning including conducting of Performance Tests and other work and services upto the PRELIMINARY ACCEPTANCE OF PLANT by the OWNER including 2 months supervisory assistance after successful commissioning and in connection therewith provide all materials, equipment, machinery, tools, labour, transportation, administration and other services and items required to complete the PLANT in all respects upto the PRELIMINARY ACCEPTANCE OF PLANT and having the performance as guaranteed under the CONTRACT by the CONTRACTOR on a total, fixed price basis in accordance with this CONTRACT.

'PLANT' for this NIT shall mean the "UREA (Neem Oil Coated) HANDLING & BAGGING PACKAGE" as detailed below and in the Technical Section of NIT:

1. Conveyors system including all relevant components/parts
2. Scraper (Salt Scrapper) in silo

3. Vibrating Screen
4. De-lumper / lump breaker
5. Bagging & Stitching m/c
6. Wagon & truck loader
7. Road weigh bridge
8. Air compressor
9. Bucket Elevator
10. Continuous belt weighers
11. Electric Hoists
12. Bag Testing Machine
13. Neem oil separation system/arrangement
14. Dust Extraction system at required place including urea solution tank
15. All bunkers (approx. 60 MT capacity each) with load cells and ultrasonic level indicator, vibrators (electrically operated), motorised gate etc
16. All Chutes with motorised flap gate/ prism gate wherever applicable
17. All diverters (Electric operated)
18. Check weigh m/c
19. All Electrical Motors, MCC and various other related items & system etc.
20. All field & control room instrumentation including PLC/DCS, Control Desk, Monitors etc.
21. All technological structures of equipment.

The WORK shall, without prejudice to the generality of the foregoing or those enumerated in Clause 1.2.0 include but not be limited to the following:

(a) All engineering and design services including necessary investigation required for a completely engineered PLANT including necessary documentation;

(b) Provision of all equipment, systems, materials, processes, CONTRACTOR's EQUIPMENT, temporary works and all other items, whether of a temporary or permanent nature including those required for the design, erection, Pre-commissioning, commissioning, conducting of PERFORMANCE GUARANTEE TEST RUN and remedying of DEFECTS during DEFECT LIABILITY PERIOD.

(c) Transportation from works, port of entry and import clearance and handling services in and into India and inland transportation from the relevant points of delivery of EQUIPMENT required in connection with the completion of the

PLANT, and the performance of the other WORK

(d) Project management.

(e) Receipt of EQUIPMENT at SITE including stores management.

(f) Construction infrastructure services, mechanical, electrical and instruments erection including all technological structures and installation services, inspection, testing and commissioning, and PERFORMANCE GUARANTEE TEST RUN before PRELIMINARY ACCEPTANCE of PLANT including all relevant applicable permits, with CONTRACTOR having responsibility for overall co-ordination of permits required by the OWNER and all training activities;

(g) Provision of all necessary superintendence, labour, construction fuels and construction chemicals, tools, supplies and other consumables and services;

Construction water (at one point within factory premises and CONTRACTOR to arrange the line upto their Battery Limit) and Construction Power (1 No. 11 kV feeder of 2 MVA at Existing Substation Near 132 kV Switchyard and CONTRACTOR to arrange tap off Power from this feeder) shall be provided within 3 months of issuance of FOA on chargeable basis (presently @ of Rs 4.50/$m^3$for Construction Water and Rs 5.915/KWH for Construction Power. In case of any escalation by statutory authorities in the unit rates during execution of Contract, the same shall be borne by Contractor)

Utilities as defined in Technical part of Section VI-2.0 of NIT and shall be made available to the CONTRACTOR at one point of battery limit 2 months before scheduled Completion Period. However, required utilities prior to this will be arranged by LSTK CONTRACTOR

(h) Rectification of defects during DEFECT LIABILITY PERIOD.

1.1.2 CONTRACTOR shall provide services, for PLANT, in accordance with good engineering practice. CONTRACTOR shall provide services of engineers, designers, draftsmen, buyers, inspectors, expediters and other persons required for the performance of WORK pursuant to CONTRACT.

1.1.3 In the event that there is any item of EQUIPMENT or WORK of the type provided for in CONTRACT, which is not specifically mentioned in the specifications or drawings set out in FINAL PROPOSAL, but which is necessary (even though not mentioned in CONTRACT) for normal, safe and continuous operation of PLANT, CONTRACTOR shall include such item of EQUIPMENT in the design and perform such items of WORK, for such EQUIPMENT or WORK free of cost to OWNER as if the same had been originally included in its Scope of Work/FINAL PROPOSAL.

1.1.4 Subject to prior consent of OWNER, CONTRACTOR may make use of the services of SUB-CONTRACTOR/ VENDOR (approved in writing by the OWNER) in accordance

with the provisions in CONTRACT provided, however, the CONTRACTOR shall remain responsible and liable for the work done by such SUB-CONTRACTOR/vendor.

1.1.5 The CONTRACTOR shall be responsible for obtaining necessary approvals which are to be issued in the CONTRACTOR's name from the various statutory authorities.All approvals/permissions other than Environment Clearance and Consent to Establish/Operate shall be obtained by the CONTRACTOR.

1.1.6 The CONTRACTOR shall provide necessaryfull technical assistanceto OWNER including follow-up for obtaining the necessary approvals to be issued in the name of OWNER from the various statutory authorities.

1.1.7 The CONTRACTOR shall furnish CONTRACT PERFORMANCESECURITYas per the enclosed format in line with the provisions of bidding document.

1.1.8 The enumeration in subsequent Clauses of SPECIAL CONDITIONS OF CONTRACT, in GENERAL CONDITIONS OF CONTRACT and other documents of CONTRACT shall not in any manner limit the general scope of obligations and responsibilities of designing, engineering, procurement, supply, construction, commissioning and proving the performance guarantees of PLANT within the scope of CONTRACT.

1.2.0 CONTRACTOR's Scope of Work

1.2.1 Deleted

1.2.2 Deleted

1.2.3 Design & Engineering

1.2.3.1 CONTRACTOR shall provide all design and engineering services necessary for completion of the PLANTS in conformity with the CONTRACT and Good Engineering Practices and the NIT including but not limited to:

(a) Preparation of

- Project design book which shall form the basis of PLANT design;
- The conceptual design; and
- The engineering and design necessary to describe and detail the PLANT and the Project.

(b) Provision of criteria for the detailed design by other suppliers of equipment/system/structures for incorporation into the PLANTS.

(c) Preparation of design, engineering, drawings, plans, bill of material, schedule and estimates for the PLANT and the project and the performance by CONTRACTOR of its obligations hereunder so that the PLANT constructed and commissioned by the CONTRACTOR is capable of meeting the performance

guarantees and will be such as could be legally, safely and reliably placed in commercial operation by the OWNER.

(d) CONTRACTOR shall perform the design and engineering for PLANT so that when constructed and commissioned, PLANT shall be capable of meeting the guarantees with respect toconsumption of utilities, and Pollution Level as guaranteed under CONTRACT and shall be reliable and safe and operable in accordance with the sound engineering practice. CONTRACTOR shall ensure design capacity of all sections of PLANT in accordance with CONTRACTOR's experience vis-a-vis as indicated in this NIT and expertise for obtaining a full throughput under varying conditions within the limits specified in CONTRACT. PLANT shall be designed so as to be capable of producing at full plant capacity when operated as specified in CONTRACT. CONTRACTOR shall review the basic design conditions and other conditions furnished by OWNER in NIT. If CONTRACTOR observes any inconsistency or insufficiency in these data, CONTRACTOR shall bring to the notice of OWNER the same, before its use.

1.2.4 Deleted

1.2.5 Codes and Standards

1.2.5.1 The engineering shall be performed and EQUIPMENT shall be manufactured and supplied according to acceptable international standards, as specified in the Technical Specification/FINAL PROPOSAL, meeting safety and other requirements of various national/international Codes and Regulations being in force as on submission of the FINAL PROPOSAL. The design of PLANT shall be based on the criteria enumerated in CONTRACT. However, it shall be CONTRACTOR's responsibility to follow all Indian Rules and Regulations as applicable.

CONTRACT shall comply with and shall cause the WORK and all components thereof (including, without limitation, the design and engineering of the PLANT) to comply with all APPLICABLE LAWS and APPLICABLE PERMITS as they may be in effect at the time of CONTRACTOR's performance under the CONTRACT.

The CONTRACTOR shall ensure that all actions on its behalf in connection with the WORKS shall be in compliance with applicable laws of India. The CONTRACTOR agrees to take all reasonable steps to ensure that Persons appointed by it in connection with the WORK shall comply with the applicable laws/ regulations/ guidelines and obligations.

1.2.6 **Drawings and Documents**

1.2.6.1 CONTRACTOR shall prepare or secure and furnish to OWNER all data, specifications, drawings, plans and other documents as required/used for WORK as specified in Technical Specifications.

1.2.7 **Owner's/PMC Review**

1.2.7.1 ENGINEER-IN-CHARGE shall review all documents and give its comments to CONTRACTOR within 14 (Fourteen) working days from the date of receipt of the same. Review as aforesaid by OWNER/PMC and furnishing of comments by OWNER/PMC or the failure of OWNER/PMC to review or comment as aforesaid shall not relieve CONTRACTOR in any manner of its obligations including performance guarantees under this CONTRACT.

1.2.8 **Procurement Services**

1.2.8.1.1 As part of the WORK, CONTRACTOR shall procure and pay in CONTRACTOR's name as an independent contractor and not as agent for OWNER, all CONTRACTOR and SUB-CONTRACTOR's labour, materials, equipment, supplies, soil, gravel and similar materials and manufacturing, fabrication and related services (whether on or off the PLANT Site) for construction and incorporation in the PLANT or which are otherwise required for completion of the WORK in accordance with the Specification and the CONTRACT and are not explicitly specified to be furnished by OWNER pursuant to the terms and provisions of the CONTRACT including FINAL PROPOSAL.

1.2.8.1.2 CONTRACTOR shall procure and provide all EQUIPMENT required for PLANT. EQUIPMENT procured shall be according to specifications as set forth in the CONTRACT, proven record of performance and with suitable delivery time to meet the Contractual COMPLETION PERIOD. EQUIPMENT shall be procured from the vendor list agreed between CONTRACTOR and OWNER.

In connection with its procurement work, CONTRACTOR shall be responsible for the shipping, transportation and delivery of all items fabricated, manufactured, constructed or procured as set forth in the FINAL PROPOSAL and the CONTRACT. All such items and equipment, materials and supplies to be provided by the CONTRACTOR pursuant to the CONTRACT shall be new and of required quality, free from improper workmanship or defects and properly warranted or guaranteed in accordance with the CONTRACT. Any apparent omission or error in the equipment specifications will be corrected by the CONTRACTOR to the extent required by the CONTRACT.

1.2.8.2 **Equipment**

1.2.8.2.1 CONTRACTOR agrees that EQUIPMENT procured shall be strictly in accordance with the specifications as provided, however, that any apparent omission or error in the specifications will be corrected by CONTRACTOR if it is necessary for the functioning of EQUIPMENT. CONTRACTOR shall inform OWNER for such omission or error or ambiguity in the specifications and corrections made for the same.

1.2.8.2.2 Completeness of EQUIPMENT shall be the responsibility of CONTRACTOR. Any fittings, accessories, etc. which may not be specifically mentioned in Technical Specifications but which is required for the satisfactory functioning of EQUIPMENT

and realization of PERFORMANCE GUARANTEES shall be provided by CONTRACTOR without any extra cost.

1.2.8.2.3 CONTRACTOR shall ensure that the modern practices in the manufacture of high grade EQUIPMENT are followed notwithstanding any omission in the specifications.

1.2.8.2.4 The supplies including fittings, accessories, etc. shall be in strict compliance to the applicable specifications/codes/standards. Components for which no relevant standards exist, the same shall be designed and manufactured as per good engineering practices.

1.2.8.2.5 The true intent and meaning of this Clause is that CONTRACTOR shall in all respects design, engineer, ensure quality of manufacture and supply EQUIPMENT in a thorough workman like manner, within prescribed time and in accordance with good engineering practice in order to enable proper operation of EQUIPMENT and PLANT.

1.2.8.2.6 CONTRACTOR shall furnish drawings and documents of EQUIPMENT as described in Technical part, Section VI. These documents shall include but not limited to technical documents, final drawings, preservation instructions, operation and maintenance manuals, test certificates, spare parts catalogues, etc. in a bound book for all rotating EQUIPMENT and in a folder for other EQUIPMENT, before despatch of EQUIPMENT under intimation to OWNER.

1.2.8.2.7 The documents, required for statutory approvals once submitted during construction period by CONTRACTOR shall be firm and final and not subject to subsequent changes unless such subsequent changes are approved by statutory agencies. CONTRACTOR shall be responsible for any payment of penalty as imposed by the Statutory Agencies consequent to furnishing of any incorrect data/drawings.

1.2.8.2.8 All dimensions and weights shall be in metric system.

1.2.8.2.9 EQUIPMENT to be supplied and WORK to be carried out under CONTRACT shall conform to and comply with the provision of relevant Regulations/Acts (or both) as may be applicable in the State of ODISHA and in India to the type of EQUIPMENT/ WORK carried out and necessary certificates shall be furnished.

1.2.8.2.10 CONTRACTOR shall provide cross sectional drawings wherever applicable to identify the spare part numbers and their location, e.g. the size of bearings/ seals, their make and number shall be furnished.

1.2.8.3 CONTRACTOR shall furnish unpriced copy of Purchase Orders/Work Order/Contract for equipments and major items as per the list to be mutually agreed(including Priced copy of Purchase Orders/Work Order/Contract as required by the statutory authority) together with spares and special maintenance tools covering accurately all terms and conditions such as specifications requirements for quality, inspection, and test, warranties and guarantees, erection and commissioning assistance by vendor, delivery schedule, packing, transportation and insurance, and documentation.

1.2.8.4 CONTRACTOR shall arrange & furnish/provide to OWNER,

a) Lubrication schedule from VENDOR, if required ,

b) Mechanical specifications and equipment data sheets for review by OWNER for CRITICAL EQUIPMENT before manufacture is started,

c) Shop fabrication drawings as made available by vendor,

d) Characteristic curves for pumps and compressors, etc. as made available by vendor,

e) Certified drawings including civil scope drawing and loading data, pertinent bulletin, installation, operation and maintenance manuals and test certificates as received from vendor,

f) Final revised vendor's drawings including one reproducible, as described in Technical Specifications, before PRELIMINARY ACCEPTANCE.

g) Any other information as may be sought by OWNER.

Any changes necessary during commissioning period can be incorporated in the as- built drawing and will be submitted after PAC as per the mutually agreed schedule.

1.2.8.5 CONTRACTOR shall provide services of vendor's specialist for installation and commissioning of EQUIPMENT whenever necessary.

1.2.8.6 Deleted

1.2.8.7 **Inspection, Expediting & Testing**

1.2.8.7.1 CONTRACTOR shall establish an inspection and expediting system and use its services for obtaining EQUIPMENT which conforms to the required technical and quality specifications and delivery schedule according to Purchase Order. CONTRACTOR shall send copies of expediting and inspection reports regularly to OWNER. CONTRACTOR shall arrange Third Party Inspection and quality certification of EQUIPMENT, as described in CONTRACT. Copies of all test results/report of the tests shall be furnished promptly by the CONTRACTOR to the OWNER.

Third party Inspection shall be carried by LLyods/BV/TUV/DNV.

1.2.8.7.2 OWNER or its INSPECTOR shall have the right to inspect and/or to test EQUIPMENT to check its conformity to the specifications laid down in the CONTRACT and as per approved QAP (Quality Assurance Plan). CONTRACTOR shall specify the inspections and tests to be carried out giving reference of applicable codes/standards and the location of inspection/test to OWNER. OWNER shall notify CONTRACTOR in

writing the name of INSPECTOR retained for this purpose. Expediting by OWNER's representative in no way relieves the CONTRACTOR of his obligation under the terms and conditions of this CONTRACT.

1.2.8.7.3 The inspection and tests may be conducted at the premises of CONTRACTOR or SUB-CONTRACTOR/vendor before delivery and/or at SITE. All reasonable facilities and assistance including access to all drawings and production data shall be furnished to INSPECTOR at no charge to OWNER.

1.2.8.7.4 Should any inspected or tested EQUIPMENT fail to conform to the specifications, OWNER may reject it and CONTRACTOR shall either replace the rejected EQUIPMENT or make all alterations necessary to meet specification requirements free of cost.

1.2.8.7.5 OWNER's right to inspect and wherever necessary, comment about EQUIPMENT after its arrival at SITE or its participation in tests in respect of any EQUIPMENT shall in no way be limited or waived by reason of EQUIPMENT having previously been inspected, tested and passed by OWNER or INSPECTOR/representative prior to its shipment/despatch.

1.2.8.7.6 INSPECTOR shall follow the progress of the manufacture of EQUIPMENT under CONTRACT to ensure that the requirements outlined in CONTRACT are not being deviated from with respect to Schedule and Quality.

1.2.8.7.7 CONTRACTOR shall allow INSPECTOR to visit, during working hours, the workshops relevant to execution of CONTRACT during the contractual period and INSPECTOR will have the right to inspect EQUIPMENT at all stages of manufacture right from identification of material up to its shipment/despatch, to the extent that the delivery schedule shall not be delayed, with prior notice to CONTRACTOR in writing.

1.2.8.7.8 In order to enable INSPECTOR to obtain entry visa in time, CONTRACTOR shall notify OWNER two months before assembly, testing and packing of main EQUIPMENT and if requested assist INSPECTOR in getting visa in the shortest possible time.

1.2.8.7.9 CONTRACTOR shall place at the disposal of INSPECTOR free of charge all tools, instruments and other apparatus necessary for the inspection and/or testing of EQUIPMENT. INSPECTOR is entitled to prohibit the use and despatch of EQUIPMENT that has failed to comply with the characteristics/specifications of EQUIPMENT during test and inspection.

1.2.8.7.10 CONTRACTOR shall ensure that the permission for inspection/test is granted by its SUB-CONTRACTOR/VENDOR.

1.2.8.7.11 In respect of the inspection, CONTRACTOR shall advise in writing of any delay in the programme at the earliest possible date, describing in detail what has caused the delay and the proposed corrective action.

1.2.8.7.12 All tests and trials in general of EQUIPMENT shall be witnessed by INSPECTOR. Therefore, CONTRACTOR shall confirm to OWNER by E-mail about the exact date of inspection at least 15DAYS in advance. CONTRACTOR shall specify the items and quantities ready for testing and indicate whether a Preliminary or Final Test is to be carried out. On receipt of this notice, if OWNER decides to waive the right to witness the test, information shall be given to CONTRACTOR within 15 DAYS of receipt of the notice from CONTRACTOR and CONTRACTOR then shall have right to proceed with the inspection

1.2.8.7.13 CONTRACTOR shall be held responsible for any possible delay in the approval or testing phase as well as for any possible delay in the remittance of necessary certificates. Delay on the part of the Inspection institutions will not be considered a case of 'Force Majeure'.

1.2.8.7.14 Any and all expenses incurred in connection with tests, preparation of reports and analysis made by qualified laboratories, necessary technical documents, testing documents and drawings shall be at CONTRACTOR's cost. Technical documents shall include the references and numbers of the standard used in the fabrication/construction and, wherever deemed practical by INSPECTOR. INSPECTOR shall attach importance to the views given by CONTRACTOR or its SUB-CONTRACTOR/VENDOR. Any and all expenses for boarding, lodging and airfare/rail fare incurred in connection with OWNER's INSPECTOR shall be borne by OWNER.

1.2.8.7.15 Participation or presence of OWNER or their representatives at any tests or their failure to be present at or to witness any tests to be undertaken pursuant hereto shall not in any way or manner relieve or release the CONTRACTOR from any of its warranties, guarantees or other obligations under the CONTRACT.

1.2.8.7.16 Nothing in Clause -1.2.8.7.2 to 1.2.8.7.15 shall in any way relieve CONTRACTOR from any warranty or other obligations under this CONTRACT.

Not performing or failing to perform the inspection by OWNER hereunder shall not be a waiver of any of CONTRACTOR's obligations hereunder nor it be construed as an approval or acceptance of any of the WORK hereunder nor it shall absolve the CONTRACTOR in any way or manner of its liabilities, responsibilities and obligations under the CONTRACT.

1.2.8.7.17 Arrangements for all inspections required by Statutory Authorities and as specified in Technical Specifications shall be made by CONTRACTOR. If certain category of EQUIPMENT/piping fall under the jurisdiction of Indian Boiler Regulations (IBR), irrespective of the fact whether these are proprietary in nature or not, certification from an internationally recognised agency approved by IBR is considered necessary to enable local IBR authorities to allow their installation and operation. In such cases, inspection and certification from such authorities will also have to be arranged by CONTRACTOR. CONTRACTOR shall also submit, as may be required by IBR

authorities, necessary design calculations from respective fabricators and/or manufacturers of such EQUIPMENT.

1.2.8.7.17 **Rejections, Removal of Rejected EQUIPMENT and Replacement**

1.2.8.7.17.1 Preliminary inspection at SUB-CONTRACTOR's / vendor's works by INSPECTOR shall not prejudice OWNER for commenting on EQUIPMENT including its specifications on final inspection at SITE or claim under warranty provisions.

1.2.8.7.17.2 If EQUIPMENT is not of specification or fail to perform specified duties, OWNER shall be entitled to reject EQUIPMENT or part thereof and ask for modification, repair or free replacement within reasonable time subject to the relevant provisions in the CONTRACT.

1.2.8.7.17.3 In the event of such rejection, OWNER shall be entitled to use EQUIPMENT in a reasonable and proper manner for a time reasonably sufficient to enable it to obtain replacement, without any liability to CONTRACTOR. After free replacement of such rejected EQUIPMENT, the rejected equipment shall become the property of CONTRACTOR.

1.2.8.7.17.4 Nothing in this Clause shall be deemed to deprive OWNER and/or affect any of its rights under CONTRACT which it may otherwise have in respect of such defects or deficiencies or in any way relieve CONTRACTOR of its obligation under CONTRACT.

1.2.8.7.17.5 EQUIPMENT rejected by OWNER shall be removed by CONTRACTOR, within reasonable time, at its own cost after replacement of the said EQUIPMENT. OWNER shall in no way be responsible for any deterioration or damage to rejected EQUIPMENT under any circumstances whatsoever.

1.2.8.7.17.6In case, the rejected EQUIPMENT is to be taken out of OWNER's premises for repair,Ownershall have the right to withhold the payment for such cost of equipment to the extent of payment made by Owner towards the equipment until the equipment is returned / replaced.

1.2.8.8 **Packing**

1.2.8.8.1 CONTRACTOR shall ensure that packing of EQUIPMENT is as required to prevent their damage or deterioration during transit to its final destination.

1.2.8.8.2 The packing, markings and documentation within and outside the packages shall comply strictly with the provisions of CONTRACT.

1.2.8.8.3 CONTRACTOR shall be responsible for any eventual consequence occurred to EQUIPMENT due to improper packing of the same.

1.2.8.9 **Delivery/Time Schedule and Documents**

1.2.8.9.1 Time schedule shall include time for submission of documents/drawings for review/approval, incorporation of comments, if any, and final review of drawings by ENGINEER-IN-CHARGE. Within 14(Fourteen) working days after receipt by ENGINEER-IN- CHARGE of any document requiring OWNER's review, ENGINEER-IN-CHARGE shall either return one copy thereof to CONTRACTOR as it is, if ENGINEER-IN-CHARGE has no comments or with its comments and reasons thereof.

1.2.8.9.2 Special care shall be taken by CONTRACTOR to furnish Manufacturer's Test Certificates, material of construction, make, type, pressure ratings wherever applicable and included in the scope of supply of EQUIPMENT.

1.2.8.9.3 In case of delay beyond the stipulated COMPLETION PERIOD, **(**except for reasons not attributable to OWNER, FORCE MAJEURE and suspension of WORK by OWNER), even though provisional extension of COMPLETION PERIOD time is allowed by OWNER, all extra costs on account of changes of statutory regulations/Acts or increase in price on any other account, shall not apply to CONTRACT PRICE and the same shall be borne by CONTRACTOR.

1.2.8.10 **Despatch, Transportation/Shipping**

1.2.8.10.1 CONTRACTOR shall be responsible for despatch of EQUIPMENT by sea/ rail/ road/air after proper packing and protection. The consignment shall be despatched after inspection by OWNER unless otherwise agreed to in writing however such inspection shall not constitute waiver of the CONTRACTOR's obligations, responsibilities for the EQUIPMENT including care, safety and preservation in any way and manner and the CONTRACTOR's responsibility and obligation in this behalf shall continue till PRELIMINARY ACCEPTANCE OF PLANT.

1.2.8.10.2 Generally, on-Deck shipment shall not be made without prior permission of OWNER. However, in case of towers, reactors, vessels and other large-sized EQUIPMENT, CONTRACTOR may, at its own discretion, make on-deck shipment, without OWNER's prior permission. In case of damage to such EQUIPMENT, during delivery or at any stage before PRELIMINARY ACCEPTANCE OF PLANT, CONTRACTOR shall be responsible for repair/replacement of EQUIPMENT.

1.2.8.10.3 Clean onboard bill of lading for all offshore supplies shall be drawn as under:

For CIF/FOB/FAS/FCA shipments

Shipper = CONTRACTOR/Supplier
Consignee = CONTRACTOR

1.2.8.10.4 **Property in EQUIPMENT**

1.2.8.10.4.1 In case of all EQUIPMENTS/MATERIALS, the title of Ownership shall pass on to OWNER on PRELIMINARY ACCEPTANCE ofPlant. However, the OWNER shall have Lien on all EQUIPMENTS/MATERIALS including those brought by the

Contractor for the purpose of Erection, testing and commissioning of the WORK. However, in case of Termination of Contract the Transfer of Title shall pass automatically to OWNER.

1.2.8.10.4.2 CONSTRUCTION EQUIPMENT used by the CONTRACTOR and its SUB-CONTRACTORS in connection with the execution of works shall remain the property of CONTRACTOR or its SUB-CONTRACTORS. All duties, levies, taxes etc payable on account of CONSTRUCTION EQUIPMENT shall be borne by the CONTRACTOR. CONTRACTOR shall indemnify the OWNER on this count.

1.2.9 **Spares, Special Maintenance Tools, Lubricants, Chemicals(if applicable) and Consumable**

1.2.9.1 CONTRACTOR shall procure and supply commissioning spares, special maintenance tools and fixtures for EQUIPMENT, lubricants, chemicalsand consumable in sufficient quantity for COMMISSIONING and maintenance of PLANT, as described in FINAL PROPOSAL. The commissioning spares, special maintenance tools, lubricants, chemicals and consumable procured and supply shall be optimum, so as not to fall short during COMMISSIONING, and GTR. CONTRACTOR shall obtain for these items the appropriate guarantees and warranties. CONTRACTOR shall also ensure that the commissioning spares and special maintenance tools and fixtures are procured alongwith the related items of EQUIPMENT and form part of PURCHASE ORDER for the related items of EQUIPMENT.

1.2.9.2 **Lubricants, Chemicals, Consumable etc.**

CONTRACTOR shall supply Consumables, lubricants and chemicals, as required for 100% full load run for 6 month's operation after successful commissioning (and include the cost in CONTRACT PRICE). Consumables, lubricants and chemicals to be supplied in phased manner and shall be mutually agreed between OWNER and CONTRACTOR considering the consumption and storage capacity.

1.2.9.3 **Special Maintenance Tools**

CONTRACTOR shall supply special devices or tools required for normal maintenance, special handling and lifting of EQUIPMENT with main EQUIPMENT. The cost of such special maintenance tools shall be included in CONTRACT PRICE.

1.2.9.4 **Bidder's Recommended Operational Spares**

CONTRACTOR shall provide Itemised Price List for Bidder's Recommended operational spares 6 months prior to Mechanical Completion with validity of 2 Years. The recommended spares shall be optimum so as not to cause any short fall or excessive inventory. The price of above shall NOT be included in CONTRACT PRICE.

1.2.9.5 **Special Tools & Tackles**

CONTRACTOR shall supply special tools, tackles and fixture, required during normal operation & maintenance of PLANT. The cost of such special tools & tackles shall be included in CONTRACT PRICE.

1.2.9.6 **Chemicals (If applicable)**

CONTRACTOR shall supply all chemicals for first filling and make-up, if required as indicated in Technical Section of NIT. The cost of these chemicals shall be included in the CONTRACT PRICE.

1.2.9.7 **Lubricants**

1.2.9.7.1 CONTRACTOR shall supply lubricants in sufficient quantity for the first filling and make-up required as indicated in Technical Section of NIT. The cost of lubricants shall be included in the CONTRACT PRICE.

1.2.9.7.2 CONTRACTOR shall furnish the name of recommended lubricants indicating their commercial/trade name, quality and grade and equivalent quality lubricants (in case of imported lubricants) available in India to OWNER.

1.2.9.8 **Commissioning spares and Consumables**

CONTRACTOR shall supply spares and consumables required for construction, PRE COMMISSIONING, COMMISSIONING, start-up and testing of PLANT. The cost of such spares and consumables shall be included in TOTAL CONTRACT PRICE.

1.2.9.9 **Mandatory Spares**

CONTRACTOR shall provide Mandatory Spares as per Section VI-6.0, of Technical Document. Notwithstanding anything contained in this CONTRACT, the Prices for Mandatory Spares/Insurance Spares shall be included in TOTAL CONTRACT PRICE. However, details along with breakup for the above shall be submitted by successful bidder during execution.

Bidder to submit MoU(s) with the Salt Scrapper supplier for supply of spares for the system alongwith their Bids. The MoU shall cover provisions for " Supply & Service of Spare Parts for a minimum period of 5 (five) years" from the date of PAC with standard engineering drawings for all major spares/components.

1.2.9.10 **General**

1.2.9.10.1 CONTRACTOR shall furnish to OWNER, the blue prints, drawings and specifications of the spare parts.

1.2.9.10.2 CONTRACTOR shall provide to OWNER all addresses and particulars of its SUB-CONTRACTOR/VENDOR on whom PURCHASE ORDER for EQUIPMENT covered

under CONTRACT has been placed and will further ensure with its SUB-CONTRACTOR/VENDOR that, OWNER if so desires, shall have the right to place order for two years spare parts directly on them on mutually agreed terms based on offers of such SUB-CONTRACTOR/ VENDOR.

1.2.9.10.3 Spare parts shall be new and as per engineering standards/codes, free of any defects (even concealed), deficiency in Design, Materials and Workmanship and also shall be completely interchangeable with the corresponding parts.

1.2.9.10.4 Type and sizes of bearing/seals and bearing number with make shall be clearly indicated.

1.2.9.10.5 Spare parts shall be packed for long storage under tropical climatic conditions in suitable cases, clearly marked as to their intended purpose.

1.2.10 **Warrantees and Guarantees**

1.2.10.1 Materials and Workmanship Warranty

1.2.10.1.1 CONTRACTOR warrants that EQUIPMENT/PLANT supplied under CONTRACT are new, unused, of the recent or current models and incorporate all recent improvements in design and materials unless provided otherwise in CONTRACT. CONTRACTOR further warrants that EQUIPMENT supplied under this CONTRACT shall be according to specifications, have no defect (even concealed) arising from design, materials or workmanship or form any act or omission of CONTRACT that may develop under normal use of the supplied EQUIPMENT in the conditions prevailing in the country of final destination.

1.2.10.1.2 The warranty period for the EQUIPMENT/PLANT supplied by CONTRACTOR shall be valid for minimum 12 months for all EQUIPMENT from the date of PRELIMINARY ACCEPTANCE.

1.2.10.1.3 The warranty shall be valid for the period as described under Clause -1.2.10.1.2 from the date of PRELIMINARY ACCEPTANCE. and shall be governed by Clause 17 of SPECIAL CONDITIONS OF CONTRACT. Should any DEFECTS be noticed in design, material and/or workmanship within the said warranty period, ENGINEER-IN-CHARGE shall inform CONTRACTOR and CONTRACTOR shall immediately on receipt of such intimation depute their personnel within 10 DAYS to investigate the causes of DEFECTS and arrange rectification / replacement / modification of the defective EQUIPMENT at SITE without any cost to OWNER, within a reasonable period. If CONTRACTOR fails to take proper corrective action to replace/ repair defective Equipment satisfactorily within a reasonable period, OWNER shall be free to take such corrective action as may be deemed necessary at CONTRACTOR's risk and cost, after giving notice to CONTRACTOR. OWNER shall promptly notify CONTRACTOR in writing of any claims arising under this warranty.

The cost of any special or general overhaul rendered necessary during the guarantee period due to defects for which CONTRACTOR is liable under CONTRACT in the

PLANT or defective work carried out by the CONTRACTOR shall be borne by the CONTRACTOR.

1.2.10.1.4 After the issue of the PRELIMINARY ACCEPTANCE. CERTIFICATE and upto the defect liability period, in the event of an emergency where, in the judgement of the OWNER, delay would cause serious loss or damage, repairs or adjustments may be made by the OWNER or a third party chosen by the OWNER without advance notice to the CONTRACTOR and the documented and direct cost of such work shall be paid by the CONTRACTOR but only to the extent that the repair or adjustment was due a defect attributable to CONTRACTOR.

1.2.10.1.5 In case defects are of such nature that EQUIPMENT shall have to be taken to CONTRACTOR's/ SUB-CONTRACTOR's/ vendor's works for rectification etc., CONTRACTOR shall take EQUIPMENT at its cost after giving necessary undertaking or security as may be required by OWNER. OWNER shall, if so required by CONTRACTOR, despatch EQUIPMENT by quickest mode on freight to pay basis to CONTRACTOR's / SUB-CONTRACTOR's / vendor's works. After repairs CONTRACTOR shall deliver EQUIPMENT at SITE on freight paid basis. All transit risks to and from site shall be borne by CONTRACTOR.

1.2.10.1.6 EQUIPMENT or part thereof so repaired or replaced shall have further warranty for a period of 12 months from the date of its acceptance after repair/replacement and the Contract Performance Security shall be suitably extended for the same. The value of the Contract Performance Security during the extended warranty period shall be 3 (Three) percent of the cost of such repaired/replaced EQUIPMENT or its parts for which documentary evidence to be submitted.

However, extended DEFECTS LIABILITY PERIOD shall have an upper limit of 24months for extended DEFECTS LIABILITY PERIOD, starting from the PRELIMINARY ACCEPTANCE.

At the end of the DEFECT LIABILITY PERIOD or the extended DEFECT LIABILITY PERIOD, the CONTRACTOR's liability ceases. In respect of goods supplied by the SUB-CONTRACTORS to the CONTRACTOR where a long guarantee (more than 12 months) is provided by such SUBCONTRACTORs/SUB- VENDOR(s), the OWNER shall be entitled to the benefit of such longer guarantees.

1.2.10.1.7 If the repairs, replacements or modifications referred to above are of such nature which may affect the efficiency of EQUIPMENT, OWNER shall have right to give notice in writing to CONTRACTOR within one month of such repair/ replacement/ modification to carry out tests as may be required for acceptance of EQUIPMENT.

1.2.10.1.8 If CONTRACTOR fails to meet its obligation to repair or replace defective EQUIPMENT and make it good within a reasonable period of time and or if CONTRACTOR refuses to carry out WORK under the guarantee clause and implied guarantee conditions and/or in case of severe urgency, OWNER shall be entitled to carry out repair/replacement/WORK or arrange to carry out repair/ replacement/WORK

by a third party. The entire cost of such repair/ replacement/WORK including transit insurance, freight, taxes and duties etc. shall be borne by the CONTRACTOR. In case, the cost of such repair/replacement has been incurred by OWNER, CONTRACTOR shall reimburse the same immediately on demand by OWNER with a document substantiating such costs.

1.2.10.1.9 Damages to EQUIPMENT deriving from incomplete, erroneous instructions issued by CONTRACTOR will be considered CONTRACTOR's fault and will be treated according to the provision of warranty clause. Normal wear and tear shall not come under purview of this clause.

1.2.10.1.10 The acceptance of any equipment by the OWNER shall in no way relieve the CONTRACTOR of his obligation under this clause.

1.2.10.1.11 During the GUARANTEE PERIOD, the CONTRACTOR shall provide if required by the OWNER, the services of operation engineers to advise the OWNER for such period and in such number as may be mutually agreed upon. The CONTRACTOR's operation engineers shall also train the OWNER's personnel, act as a liaison between the OWNER and the CONTRACTOR, assist the OWNER in ordering and obtaining spare parts, generally monitoring operation and maintenance and trouble shooting and supervising repair work under guarantee.

1.2.10.2 **Design and Vendors'/ Sub-Contractors' Guarantees**

1.2.10.2.1 CONTRACTOR shall guarantee the design and engineering work carried out by him against mistakes, errors, defective specifications, inadequacy and other such items which lead to the supply of inadequate PLANTS and Facilities. In case of detection of such mistakes, errors, deficiencies etc. the CONTRACTOR shall redo the design and/or engineering work to overcome all such mistakes, errors, deficiencies etc. at no extra cost to OWNER.

1.2.10.2.2 CONTRACTOR shall be responsible for all the items of the EQUIPMENT procured by him from VENDORS/ SUB-CONTRACTORS. Further, CONTRACTOR shall replace or repair any item of EQUIPMENT which is demonstrated to be defective under normal operating conditions within DEFECT LIABILITY PERIOD.

1.2.11 **Performance Guarantee of PLANT(S)/ EQUIPMENT**

1.2.11.1 CONTRACTOR guarantees that the performance of PLANTS supplied under CONTRACT shall be strictly in conformity with the specifications and shall perform the duties and have consumption, production and other guarantees set forth in CONTRACT.

1.2.11.2 If the performance of PLANTS and/or any of EQUIPMENT fails as guaranteed and set forth in CONTRACT, CONTRACTOR shall investigate the causes and provide free of cost to OWNER, design, engineering, MATERIALS and services and EQUIPMENT

within a reasonable period to prove guarantees. CONTRACTOR's liability in this respect shall be limited as per the provisions of 22.0 of SCC except that the Works Cost Guarantee shall be governed by the provisions of Cl.No.21.2. of SCC.

1.2.12 **STATUTORY APPROVALS**

1.2.12.1 Unless otherwise specified in Bidding Documents, it shall be the CONTRACTOR's sole responsibility to obtain all approvals from any authority (except for environment clearance and Consent to Establish/Operate, however the data and information required for the same shall be made available by the LSTK contractor) required under any statute, rule or regulation of the Central or State Government concerned with the performance of the CONTRACT and/or the contractual Work. The application on behalf of the OWNER for submission to relevant authorities alongwith copies of required certificates complete in all respects shall be prepared and submitted by the CONTRACTOR well ahead of time so that the actual execution of the WORKS is not delayed for want of the APPROVAL/inspection by the concerned authorities. The CONTRACTOR shall arrange for the inspection of the works by the authorities and will undertake necessary coordination and liaison required and shall not be entitled to any extension of time for any delay in obtaining such approval. All statutory fees shall be paid by the CONTRACTOR and the same shall be reimbursed by the OWNER upon production of documentary evidence by the CONTRACTOR.

1.2.12.2 Any deficiency(is) as pointed out by any such authority shall be rectified by the CONTRACTOR within the scope of relative supply and/or WORK at no extra cost to the OWNER. The inspection and acceptance of the WORKS by such authorities shall, however, not absolve the CONTRACTOR from any of its responsibilities under this CONTRACT.

1.2.12.3 No extension of time shall be granted for meeting the requirement and/or obtaining APPROVAL of statutory authorities.

1.2.12.4 **Government Clearances, Permits and Certificates**

CONTRACTOR shall procure at its expenses, all necessary APPLICABLE PERMITS, certificates and licenses required by virtue of all APPLICABLE LAWS, regulations, ordinances and other rules in effect at the place where any of WORK is to be performed, and CONTRACTOR shall further hold OWNER harmless from liability or penalty which might be imposed by reason of any asserted or established violation of such laws, regulations, ordinances or other rules. OWNER will provide the necessary assistance to CONTRACTOR for obtaining PERMITS for CONTRACTOR's personnel to undertake WORK in India in connection with CONTRACT.

1.2.12.5 CONTRACTOR shall furnish necessary technical information, data, drawing, etc. as and when required by OWNER for submission to Government/Statutory Agencies.

1.2.13 **Network Schedule**

1.2.13.1 OWNER would be using a computerized time and cost monitoring system and CONTRACTOR shall provide necessary input data for the same. CONTRACTOR shall prepare within 30 (thirty) days from date of FOA and provide to OWNER a PROJECT MASTER SCHEDULE indicating the important milestones of activities relating to WORK from date of FOA to the date of PRELIMINARY ACCEPTANCE. This PROJECT MASTER SCHEDULE shall be discussed with and approved by OWNER. Based on the approved PROJECT MASTER SCHEDULE, CONTRACTOR shall also prepare network schedules for activities relating to WORK. CONTRACTOR shall obtain the details of progress of various activities of WORK from SUB-CONTRACTOR and vendor wherever required and update the network schedules and PROJECT MASTER SCHEDULE incorporating the progress achieved by CONTRACTOR, SUB-CONTRACTOR and vendor and submit the same to ENGINEER-IN-CHARGE on monthly basis.

1.2.13.2 CONTRACTOR shall clearly indicate any delay in WORK in the above schedules and shall inform ENGINEER-IN-CHARGE the action taken to achieve the COMPLETION PERIOD.

1.2.14 **Transportation and Storing of EQUIPMENT**

1.2.14.1 CONTRACTOR shall be responsible for proper packing, transportation from vendor's workshop to port or railway station (whether by road, rail, ship or aircraft), handling and clearances at port or railway station including loading and unloading, customs clearance, carriage to SITE, unloading at SITE, warehousing, coding and tagging, storage including proper preservation, etc. of EQUIPMENT. Any special clearance, lifting, handling, loading/unloading, and transport arrangements for over dimensional consignments shall also be done by CONTRACTOR. CONTRACTOR shall ensure timely delivery of EQUIPMENT. CONTRACTOR shall endeavor to have the consignments in the upper part of the hold to enable early discharge at the Port of disembarkment. The above arrangement shall be in accordance with the guidelines set forth in the Co-ordination Procedure which shall be finalised mutually after issuance of FOA. CONTRACTOR shall be responsible for inspection of EQUIPMENT on receipt at SITE and for maintenance and management of stores and warehousing of EQUIPMENT at SITE including all activities connected with the issue of EQUIPMENT, accounting and final reconciliation and handing over of stores to OWNER.

1.2.14.2 OWNER shall provide area at SITE for making shed/covered stores etc. for storing EQUIPMENT. CONTRACTOR shall be responsible for making shed/covered stores etc. for safe storage of EQUIPMENT.

1.2.15 **Construction**

1.2.15.1 CONTRACTOR shall be responsible for all erection, site fabrication insulating & painting works, , piping, instrumentation, electrical installation, and other miscellaneous construction jobs of PLANT leading to MECHANICAL COMPLETION and PRELIMINARY ACCEPTANCE of PLANT. CONTRACTOR shall organise these

activities in appropriate sequence and use proper methods giving due regard to the requirements of safety, quality, sound engineering practice, compliance with relevant Codes and Regulations, and for achieving COMMISSIONING of PLANT on or before COMPLETION PERIOD.

The CONTRACTOR shall within the scope of work observe in addition to specifications, all national and local laws, ordinances, rules and regulation and requirements pertaining to the WORK.

Various procedures and methods to be adopted by CONTRACTOR during the construction as required in the respective specifications shall be submitted to OWNER in due time and well in advance of the specific work for approval.

The CONTRACTOR shall carry out required supervision as per Quality Assurance Plan and furnish all assistance required by the OWNER in carrying out inspection work. The OWNER will have authorized representatives present who shall have free access to the work at all times. If an OWNER's representative notifies the CONTRACTOR's representative of any deficiency in any work or in the supervision thereof, the CONTRACTOR shall make every effort to carry out such instructions consistent with best industry practice.

The CONTRACTOR shall so far as reasonably feasible employ skilled workers who are Certified Tradesmen in the field(s) of their relative activities(s).

1.2.15.2 In case of delay in completion beyond the stipulated completion period as specified in Invitation For Bid (IFB) under clause 2 (E) for reasons attributable to Contractor, all extra costs on account of changes of statutory regulations / Acts, shall not apply to Contract price and the same shall be borne by Contractor.

1.2.16 **Safety and Plant Security**

1.2.16.1 CONTRACTOR shall observe and also use its best efforts to ensure that all parts of WORK carried out at SITE is being done in a safe and satisfactory manner conforming to the applicable Safety Rules and Regulations. Further, CONTRACTOR shall observe and make provisions in SUB-CONTRACT that employees working for PLANT observe all the Safety Rules as required under the Factories Act and Regulations and other Local Laws and SUB-CONTRACTOR to provide safety apparel and equipment to its employees. OWNER shall have the right to object to any unsafe practice followed by SUB-CONTRACTOR's employees or any CONTRACTOR's personnel and direct them to carry out the job in a manner considered safe by OWNER. CONTRACTOR shall further abide by all the Security Regulations imposed by OWNER.

1.2.16.2 CONTRACTOR shall observe all safety rules so that no harm is done to OWNER's employees or property. If on account of CONTRACTOR, OWNER's property or

personnel are likely to suffer any damage, in such cases any directions issued by OWNER shall be carried out by CONTRACTOR.

1.2.17 **PRE-COMMISSIONING**

1.2.17.1 CONTRACTOR shall render and be responsible for pre-commissioning activities leading to MECHANICAL COMPLETION. These activities will include relevant checking, adjustment, testing, calibration, running in and trial runs of individual items of EQUIPMENT, and other similar jobs.

1.2.17.2 CONTRACTOR shall provide experienced personnel as required for carrying out the PRE-COMMISSIONING activities with OWNER's personnel.

1.2.17.3 CONTRACTOR shall provide SUB-CONTRACTOR's/VENDOR's specialists wherever required. Suitable provision for such services shall be made by CONTRACTOR in PURCHASE ORDER/CONTRACT with their Sub-Vendor/Sub-Contractor.

1.2.17.4 "PRE-COMMISSIONING" shall mean preparation of PLANT so that it is capable of operating on a continuous basis at or near rated capacity for carrying out COMMISSIONING activities

1.2.18 **MECHANICAL COMPLETION**

1.2.18.1 CONTRACTOR shall be responsible for completing the design, engineering, procurement, inspection and expediting, arranging for transportation of EQUIPMENT, construction and PRE-COMMISSIONING for making PLANT ready for acceptance of feed (Urea) on declaration of MECHANICAL COMPLETION.

MECHANICAL COMPLETION" shall mean completion of erection to such an extent that PLANT is ready for commissioning. This shall happen when:

A. The EQUIPMENT capable of producing to rated capacities are installed, aligned and grouted (wherever applicable) in accordance with drawings, specifications as per finally approved P&I Diagrams in accordance with all applicable codes, and laws.

B. All pressure EQUIPMENT is hydrostatically or pneumatically tested once either in CONTRACTOR'S shop or in the field in accordance with Technical Specifications.

C. Deleted

D. Compressor, Pumps, Machinery etc are cold aligned. Couplings are assembled and guards installed as applicable.

E. Instruments, control system, instrument cable, safety interlock are installed, inspected and such non-operating checks are made as to ensure operability in the manner required for the process application. Instrument air lines are checked for correct hook up. Airlines are leak tested.

F. Relief valves are installed prior to this, and have been checked by the CONTRACTOR in the CONTRACTOR's shop.

G. Piping is hydrostatically or pneumatically tested in accordance with the specifications. Special treatment such as chemical cleaning is done as required by drawing or specifications. Suction screens are installed and test blinds are removed. Spring support anchors and guide are checked for removal of all shipping locks.

H. The electric system is installed and tested in accordance with and to the extent required by electrical specifications. All wiring is checked for correct hook up. Motor rotation is checked. All power system protective devices are set.

I. Insulation and drying out are completed to the extent necessary to permit start of commissioning.

J. Pipe support system installed as per drawings.

K. Painting is completed. EQUIPMENT /MACHINERY, piping duly marked and labelled.

L. Safety equipments, systems are installed and checked for operations. Effluent management and treatment systems are installed and operational.

M. All Emergency & Instrument power system are checked and operating.

N. All chemical & lubricants are charged into the system.

O. PRECOMMISSIONING has been completed.

P. The PLANT is ready to take feed (Urea).

Q. All packing and bed support materials are installed.

R. Liquidation of all punch list applicable for achieving MECHANICAL COMPLETION. Balance items of punch list, if any, shall be liquidated as mutually agreed

S. Temporary constructions facilities are removed to extent necessary to permit start of commissioning of Plant

1.2.19 **COMMISSIONING**

1.2.19.1 CONTRACTOR shall be responsible for COMMISSIONING after Mechanical Completion have been completed giving due regard to safety of EQUIPMENT in accordance with the procedures as per the requirement of Contract document after successful testing, pre-commissioning & trial run and per sound engineering practices. CONTRACTOR shall provide operating and maintenance personnel for the same. The COMMISSIONING activities shall be conducted as detailed in Section VI- 4.0 of NIT)

1.2.19.2 CONTRACTOR shall provide engineers as required to commission the PLANT. CONTRACTOR shall be responsible to provide supervision personnel for operation of PLANT for a period of 2 months from date of successful commissioning and OWNER will operate the PLANT under the supervision and instructions of CONTRACTOR.

1.2.20 **Performance Guarantee Test Run (PGTR)**

'PERFORMANCE & GUARANTEE TESTS RUN (PGTR)' shall mean all operational checks and tests required to determine and demonstrate capacity, efficiency and operating characteristics and proving guarantees for work cost as specified in the CONTRACT documents.

During the guarantee test, the range of operating conditions shall be within the limits of the design conditions and shall meet the requirements of safety and compliance with relevant Codes and Regulations
CONTRACTOR shall successfully complete PERFORMANCE TEST as specified in Technical Section-VI, 8.0 of NIT.

1.2.21 Deleted

1.2.22 **2 Months Supervisory Assistance.**

Owner requires two months supervisory assistance after successful Commissioning with designated selected manpower defined by Owner as per the requirement specified in Technical Section VI-8.0, of NIT. Contractor shall include the cost of above services in TOTAL CONTRACT PRICE.

1.2.23 **Laws and Regulations**

1.2.23.1 CONTRACTOR shall abide, while fulfilling its obligations, by all applicable codes and APPLICABLE LAWS from time to time in force in the State of ODISHA and in India.

FINAL PROPOSAL shall be based on the codes, and regulations applicable on the date of submission of the FINAL PROPOSAL.

In the event of change in any codes, legislation, laws or regulation applicable to PLANT WORK or any part thereof after date of submission of FINAL PROPOSAL, which alters the scope of CONTRACTOR's obligations under CONTRACT, CONTRACTOR shall agree to make the necessary changes in scope of WORK. Such changes shall be governed by CHANGE IN WORK as per the provisions of Clause -3 of SCC.Any additional fee becoming applicable due to any change of Acts, regulations, by-laws, orders and requirements after date of submission of FINAL PROPOSAL shall be borne by OWNER in accordance with SCC clause 3.0.

1.2.24 Deleted

1.2.25 **Progress Monitoring and Reporting**

1.2.25.1 CONTRACTOR shall develop a suitable system for monitoring and reporting progress on the various activities up to PRELIMINARY ACCEPTANCE. CONTRACTOR shall submit PROJECT MASTER SCHEDULE and detailed Network Schedule covering the activities and milestones starting from date of FOA until PRELIMINARY ACCEPTANCE, as described under Clause -1.2.13 above. These schedules shall include the activities of CONTRACTOR, SUB-CONTRACTOR/Sub-Vendor. CONTRACTOR shall monitor progress continuously and submit to EIC monthly progress reports giving the status of the activities, indicating those delayed and action being taken, or required to be taken, to bring back those activities on schedule. These reports will also include progress at vendor's workshops and shall be supplemented with photographs, wherever necessary. The Network Schedule shall be updated once in a month. CONTRACTOR shall also furnish information to ENGINEER-IN-CHARGE as may be required by any other Government Authority or any other agency such as Financing Institution etc.

1.2.26 **Technical Information**

1.2.26.1 CONTRACTOR shall furnish to OWNER, CONTRACTOR's Technical Information and know-how as may be necessary for the operation of PLANT and relating to its process according to the provisions of Article 53 of General Conditions of Contract. CONTRACTOR shall grant or cause to be granted to OWNER an irrevocable right to use all such above technical information for PLANT and shall further advise OWNER for a period of five (5) years from date of COMMISSIONING of any improvements in process, know-how, engineering, operation methods, and other conditions which will result in more efficient operation of PLANT that are developed by CONTRACTOR or process licensor or have come to the knowledge of CONTRACTOR, at no extra cost to OWNER. OWNER shall also grant to CONTRACTOR, at no extra cost to CONTRACTOR, to the benefit of process licensor the same right on OWNER's improvements as per the provisions of this Clause. Notwithstanding the generality of the foregoing, ownership of data, technical information processes, technology or software proprietary to CONTRACTOR and/or SUBCONTRACTORS shall remain with

CONTRACTOR and/or SUBCONTRACTOR. CONTRACTOR and/or SUBCONTRACTOR shall ensure that OWNER is legally entitled to use of such data, processes, technology and software in the form of a perpetual, non-terminable, non-exclusive, royalty-free License for the purpose of the operation and maintenance of the PLANT.

1.2.27 **Work of SUB-CONTRACTOR and vendor**

1.2.27.1 CONTRACTOR shall remain responsible for proper execution of such part of WORK as are carried out by its SUB-CONTRACTOR and vendor and any failure of SUB-CONTRACTOR/vendor shall not relieve CONTRACTOR of its obligations under CONTRACT. Furthermore, in the event of any default by SUB-CONTRACTOR/vendor, CONTRACTOR shall either take over SUB-CONTRACTOR/vendor's part of WORK on mutually agreed terms or take remedial action as may be necessary in order to comply with COMPLETION PERIOD and any other activities leading to PRELIMINARY ACCEPTANCE.

1.2.28 **Co-ordination**

1.2.28.1 CONTRACTOR shall render all necessary assistance to ENGINEER-IN-CHARGE required for overall co-ordination of all activities connected with WORKS. For this purpose, CONTRACTOR and ENGINEER-IN-CHARGE shall agree on a meeting as soon as practicable after issuance of FOA, with SUBCONTRACTOR/vendor's and such other parties as are necessary to settle the following:

a) Review the basic design conditions set forth in FINAL PROPOSAL and where appropriate, review possibilities of standardisation.
b) Assess the priorities and key dates required to be included in CONTRACTOR's PROJECT MASTER SCHEDULE.
c) Make an assessment of all items requiring co-ordination.
d) Fix up a date and agenda of any subsequent meeting as may be required in association with OWNER.
e) Discuss with ENGINEER-IN-CHARGE and furnish all technical information.

In the event, ENGINEER-IN-CHARGE pursuant to its responsibilities of overall co-ordination requests CONTRACTOR to make any alteration to the programme, scope of responsibility under CONTRACT, CONTRACTOR shall do the same, subject to the provisions of Clause 3.0.

1.2.29 Notices and Reports

1.2.29.1. CONTRACTOR shall submit the following copies of notices to ENGINEER-IN-CHARGE as part of the Scope of Work:

a) Immediate notification of safety incidents and accidents, including near misses, of any kind or type followed as soon as possible after such event by a full report.

b) Notices from any Government / Statutory Agency or any other Person for a violation of any Law or Government Approval, immediately upon receipt by CONTRACTOR and no later than twenty-four (24) hours after its receipt.

c) Inspection reports by any inspector whether relating to any accident, accepting any test reports or otherwise immediately upon receipt by CONTRACTOR and no later than two (2) working DAYs after its receipt.

d) Any other matter/issue that involves OWNER's interest.

1.2.30 CONTRACTOR's Representative and Key Personnel

1.2.30.1 CONTRACTOR shall with prior consent of ENGINEER-IN-CHARGE, appoint a CONTRACT MANAGER to manage the execution of WORK and to be nominated as CONTRACTOR's Representative. CONTRACTOR's personnel stationed at SITE for providing services during the execution of WORK shall work under the supervision and guidance of CONTRACT MANAGER. The CONTRACT MANAGER shall have the full authority to make binding and enforceable decisions in the name of CONTRACTOR and shall receive all notices/correspondence that OWNER serves on CONTRACTOR.

1.2.30.2 CONTRACTOR shall be responsible for the work performed by CONTRACT MANAGER and CONTRACTOR's personnel and shall under no circumstances be relieved of its responsibilities and obligations under CONTRACT on account of acts or omissions of CONTRACT MANAGER and personnel.

1.2. 30.3 The Key Personnel shall hold the staff positions as indicated in CONTRACT. CONTRACTOR shall use reasonable efforts to ensure that such Key Personnel will be engaged in the execution of WORK continuously until their role is completed unless prior release is approved by OWNER, such approval not to be unreasonably withheld or delayed. Replacement of or addition to Key Personnel shall only be made with persons having qualifications and experience equal to or better than those replaced or added to, and shall be similarly subject to OWNER's prior approval. In the event, any person identified in CONTRACT decides to leave the employment of CONTRACTOR, CONTRACTOR shall use reasonable efforts to retain the services of such person until his portion of WORK is complete. CONTRACTOR further agrees not to remove from WORK Key Personnel, which OWNER considers to be necessary for the proper performance of WORK without the prior written approval of OWNER.

1.2.31 General Warranties

a) CONTRACTOR shall perform WORK in full compliance with its FINAL PROPOSAL and all other terms and conditions set forth herein.

b) WORK shall be performed, in a good and workmanlike manner and in accordance with the FINAL PROPOSAL, all other terms and conditions of this CONTRACT, all DOCUMENTS, all Government Approvals, all APPLICABLE LAWS, and Good Industry Practices.

c) All EQUIPMENT, installed as part of PLANT, (i) shall be free from any encumbrance or lien and shall conform to the specifications and descriptions set forth in CONTRACT and (ii) shall be new and unused, free from DEFECTS and Deficiencies of any kind and shall meet the requirements of the Scope of Work.

d) The completed PLANT shall be free of DEFECTS and Deficiencies and shall be designed, constructed and engineered, in compliance with the Scope of Work.

e) PLANT shall be designed, engineered, constructed, tested, completed and delivered based on Good Industry Practices, CONTRACTOR's specifications and guidelines for operation and maintenance in accordance with the Scope of Work, for CONTRACT PRICE and no later than the COMPLETION PERIOD.

f) All SUB-CONTRACTOR/vendor shall perform their portion of the Scope of Work or supply or install EQUIPMENT in accordance with the applicable terms set forth herein.

g) Adherence to the Operations Manual shall allow safe start-up, operation, maintenance and shut-downs of the completed PLANT, in accordance with CONTRACTOR's guidelines and will not impair any warranty or guarantee of EQUIPMENT incorporated or to be incorporated into PLANT.

1.2.32 General

1.2.32.1 CONTRACTOR shall incorporate during design stage maximum utilization of goods manufactured and/or available in India and also avail shipping, insurance, banking, catering and any other services available from India-owned companies for installation of plant, if quality, delivery and overall cost characteristics are equivalent.

1.2.32.2 CONTRACTOR shall arrange insurance pursuant to Clause 28.0 of GCC, at its own cost.

1.2.32.3 CONTRACTOR shall provide necessary information, documentation, and assistance for obtaining any approvals from Financial Institutions or any other agencies or authorities.

2.0 OWNER'S OBLIGATIONS

OWNER shall be responsible for fulfilling all obligations as specified under the following heads:

2.1 Deleted

2.2 Overall Co-Ordination

The objective of overall co-ordination is to organise orderly execution of WORK, bring about requisite integration amongst the various project activities of executing agencies, to avoid interference between the various activities of the parties in order to achieve the earliest possible completion of WORK. The aim will be to integrate, have compatibility between plants and uniform standardisation of design, engineering, layout, etc.

2.3.0 Review and Approval of Work

2.3.1 CONTRACTOR shall associate OWNER's representatives with WORK as carried out by CONTRACTOR's personnel. For this purpose, OWNER shall associate with WORK at all stages. Specifically, OWNER shall undertake the following tasks:

a) Review/APPROVAL of drawings as per Technical Section and other documents connected with basic and detailed engineering.

b) Review of specifications for EQUIPMENT, lists of spare parts and special maintenance tools, and lists of special construction aids, tools, tackles, and fixtures.

c) Participation in inspection, expediting and testing of EQUIPMENT at SUB-CONTRACTOR's / vendor's works and at SITE, wherever considered necessary by OWNER.

2.3.2 For the smooth functioning, OWNER will nominate an individual who will act as EIC under the CONTRACT. The EIC will have full authority to act on behalf of the OWNER in connection with the CONTRACT. Except as otherwise provided in the CONTRACT, all communications between the OWNER and the CONTRACTOR relating to the WORKS shall be between the ENGINEER-IN-CHARGE and the CONTRACT MANAGER.

2.4 Deleted

2.5 Facilities for CONTRACTOR's Personnel

OWNER shall assist CONTRACTOR in obtaining Visas and other PERMITS from the appropriate authorities for CONTRACTOR's and SUB-CONTRACTOR's / vendor's expatriates to enter and stay in India as necessary for performance of WORK. OWNER shall also provide facilities to CONTRACTOR's expatriates in accordance with the provisions described in Clause-2.8.

2.6 Operating and Maintenance Personnel

OWNER may associate its personnel with the construction and erection of PLANT to familiarise the personnel with WORK, and generally to prepare for proper operation and maintenance of PLANT.

2.7 Utilities

OWNER shall make available the utilities as specified in Section VI-2.0 of bid document for commissioning and PGTR.

2.8 Site Facilities

OWNER shall provide the following SITE facilities:

a) Land for Construction Activities
b) General safety and security without prejudice to Contractor's obligations.
c) Construction Power & Construction Water shall be provided as per clause 1.1.1 (g) above
d) Free and unrestricted access to SITE for CONTRACTOR's Authorized Personnel
e) OWNER shall NOT provide any accommodation and facilities for travelling to and from SITE to the place of residence to the personnel of CONTRACTOR/ SUB-CONTRACTOR, deputed at SITE for performing WORK under CONTRACT.
f) Area for making shed/covered storage for storing EQUIPMENT.

3.0 CHANGES IN WORK/CHANGE ORDER

3.1 OWNER may at any time order change in work scope. OWNER shall have the right to request in writing changes in WORK within the scope of CONTRACT. When the request for a change in WORK by OWNER has been agreed and complied by CONTRACTOR, CONTRACTOR's obligations under CONTRACT shall remain unaffected unless otherwise agreed.

Changes may consist of additions, deletions or revisions of the Scope of Work, and may cause the CONTRACT PRICE, the work schedule or the COMPLETION PERIOD or any other CONTRACTOR's WARRANTEES to be adjusted.

CONTRACTOR shall be entitled to an extension of time to COMPLETION PERIOD suffered and/or payment of additional costs incurred as a result of any change in law or legislation, by way of a CHANGE ORDER, in case it is necessitated or if it becomes applicable.

3.2 The ENGINEER IN CHARGE shall have the right to make any alterations in, omission from, additions to or substitutions for in the scope of work, the original specifications, drawings, designs and instructions that may appear to him to be necessary or advisable during the progress of the WORK and the CONTRACTOR shall be bound to carry out the such altered/ extra/ new items of WORK in accordance with any

instructions which may be given to him in writing signed by the ENGINEER IN CHARGE, and such alterations, omissions, additions or substitutions shall not invalidate the CONTRACT and any altered, additional or substituted work which the CONTRACTOR may be directed to do in the manner above specified as part of the WORK shall be carried out by the CONTRACTOR on the same conditions in all respects on which he agreed to do the main WORK. The time of completion of WORK may be extended for the part of the particular job at the discretion of the ENGINEER IN CHARGE, for only such alterations, additions or substitutions of the WORK, as he may consider as just and reasonable. The rates for such additional, altered or substituted WORK under this clause shall be worked out in accordance with the following:-

CONTRACTOR shall, within 7 days of the date of receipt of order to carry out the WORK, inform the ENGINEER IN CHARGE of the rates which it is his intention to charge for such class of WORK, supported by analysis of the rate or rates claimed, and the ENGINEER IN CHARGE shall determine the rate or rates on the basis of the prevailing market rates, labour cost at schedule of labour rates plus 10% to cover contractor's supervision, overheads and profit and pay the CONTRACTOR accordingly. The opinion of the ENGINEER IN CHARGE as to current market rates of materials and the quantum of labour involved per unit of measurement will be final and binding on the CONTRACTOR.

3.3. If it is established that a request for Change in Work asked by Owner does not fall under original Scope of Contract, then CONTRACTOR shall promptly submit cost estimate, and / or time extension and / or terms of payment (as applicable) for making the requested change in WORK together with the details of any variation required to be made to any of CONTRACTOR’s or OWNER’s obligations and/or guarantees as per clause 3.2 above.

3.4 If in CONTRACTOR's opinion fulfillment of any of its obligations under CONTRACT would be jeopardized by a CHANGE IN WORK requested by OWNER, then CONTRACTOR shall explain in writing to OWNER the reasons for not accepting these changes within fifteen (15) days of receipt of OWNER's written request.

3.5 OWNER and CONTRACTOR shall agree upon the basis and terms of the CHANGE IN WORK in writing.

3.6 It is understood that no change shall become effective and no change will alter the scope of WORK until all of the matters referred to in this Clause 3 have been mutually agreed upon in writing by OWNER and CONTRACTOR.

3.7 It is agreed by both parties that the following changes shall not be considered a CHANGE IN WORK in the meaning in this Clause:

a) Minor changes requested by OWNER and accepted by CONTRACTOR which do not involve any substantial additional cost or man-hour effort, and have no effect on contractual completion period, and/or

b) Any change necessitated due to requirements of prevalent laws in Indiauptothe time of submission of FINAL PROPOSAL.

3.8 This clause is to be read in conjunction with Clause No. 5.0 of GCC.

4.0 ACCEPTANCE OF PLANTS AND FACILITIES

CONTRACTOR's liabilities for the Performance Guarantees given for the PLANTS and Facilities in respect of capacity, consumption, and pollution level shall be discharged only when the PERFORMANCE AND GUARANTEE TESTS as stipulated in Technical, Section VI-8 of NIT have been successfully carried out as per Plant Acceptance criteria specified at Clause 5.0 below and OWNER has issued PRELIMINARY ACCEPTANCE CERTIFICATE.

5.0 PLANT ACCEPTANCE CRITERIA

Subject to fulfilling PERFORMANCE AND GUARANTEE TESTS as per Section VI-8.0 of NIT and Clause 18.0 of SCC, OWNER shall be in readiness to accept the PLANT. CONTRACTOR shall take all steps to fulfil the provisions of the CONTRACT for OWNER to issue PRELIMINARY ACCEPTANCE CERTIFICATE**.** The care and custody of the PLANT shall be passed on to OWNER on PRELIMINARY ACCEPTANCE of the PLANT.

6.0 PRELIMINARY ACCEPTANCE

PRELIMINARY ACCEPTANCE shall mean that following milestones have been achieved for each PLANT (i) MECHANICAL COMPLETION has occurred, (ii) PRE-COMMISSIONING and COMMISSIONING of the PLANT have been accomplished, (iii) the Sustained Load Test has been passed successfully, (iv) PGTR has been conducted by Contractor and accepted by OWNER (v) All statutory approvals in the scope of Contractor, required to operate and maintain the PLANT have been obtained (vi) OWNER has received all DOCUMENTS required hereunder to start up, operate and maintain the PLANT(vii) OWNER has received all operations, maintenance, and spare parts manuals and instruction book necessary to operate and maintain the PLANT in a safe, efficient and effective manner (viii) all special tools and spare parts purchased by CONTRACTOR as provided herein have been delivered to OWNER; and (ix) CONTRACTOR has completed the training program of OWNERS personnel as required under this CONTRACT(x) All demonstration runs have successfully completed

6.1 ISSUANCE OF PRELIMINARY ACCEPTANCE CERTIFICATE

Within 30 (thirty) DAYs from completing successfully all activities as defined at clause 6.0 above by the CONTRACTOR and CONTRACTOR fulfilling all the obligations

under the provision of the CONTRACT, OWNER shall issue PRELIMINARY ACCEPTANCE CERTIFICATE to CONTRACTOR . On issue of this Certificate by OWNER, CONTRACTOR shall become entitled to receive all associated payment as per provisions of the CONTRACT due to CONTRACTOR subject to CONTRACTOR's fulfilling the obligations stipulated under CONTRACT.

7.0 LABOUR AND STAFF

7.1 The CONTRACTOR shall make his own arrangement for labour, erection and COMMISSIONING engineers and all other staff required for carrying out the WORK. The necessary permissions from Government of India regarding work permit and visa requirement shall be obtained by the CONTRACTOR.

7.2 The CONTRACTOR shall make his own arrangements for providing canteen service to his labour and staff. Open space for this purpose may be provided by OWNER.

7.3 The CONTRACTOR shall at his own cost provide office and other accommodation for his staff and workmen. The CONTRACTOR shall also provide communication, transport and medical facilities to his staff and workmen.

7.4 The CONTRACTOR shall be responsible for all statutory obligations and any other laws in this regard in force from time to time regarding the employment or conditions of service of CONTRACTOR's labour, workman or employees.

7.5 The CONTRACTOR shall observe all safety rules as required under various rules, regulations and laws in India and shall also strictly adhere to safety regulations of OWNER.

8.0 TRAINING OF OWNER'S PERSONNEL

8.1 The CONTRACTOR shall provide facilities for Training of OWNER's personnel in the operation and maintenance of plant at CONTRACTOR's other similar installations. The timing of training shall be mutually discussed and agreed between the parties. The costs towards travel, transportation and living expenses of the OWNER's personnel shall be borne by OWNER.

CONTRACTOR shall make arrangements, for training of OWNER's personnel in similar PLANT of CONTRACTOR's design having comparable capacity and design features and in VENDOR's workshops (for scope & duration of training refer relevant Section VI of Technical part of NIT).CONTRACTOR shall provide assistance to OWNER's personnel for proper co-ordination and management of the practical experience. Detailed programme and modalities for practical experience shall be mutually agreed between OWNER and CONTRACTOR.

9.0 MODE OF CONTRACTING

9.1 Notwithstanding anything stated elsewhere in the CONTRACT documents, the CONTRACT is awarded on single point responsibility basis.

9.2 The CONTRACT shall be in all respect being construed and governed in accordance with the Indian laws.

9.3 The Contract shall be treated as a "WORK CONTRACT SERVICE".

10.0 FINAL BILL

10.1 On the basis of the LUMPSUM PRICE provided in the CONTRACT and subsequent Change Order(s)/Amendment(s), if any and the approved billing schedule, the CONTRACTOR shall prepare a Final Bill in the prescribed form. Additions claimed to the LUMPSUM PRICE or reductions thereof on account of CHANGE ORDER(s) shall be separately indicated in the Final Bill with reference to the relative CHANGE ORDERS(s).

10.2 The Final Bill shall, in addition to the payment entitlements arrived at according to the provisions of Clause 10.1 hereof shall separately state and include therein all claims of the CONTRACTOR, if any, with full particulars of the nature of such claim and grounds on which it is based and the amount claimed.

10.3 The Final Bill drawn in accordance with Clause 10.1 shall be submitted together with the PRELIMINARY ACCEPTANCE CERTIFICATE to the ENGINEER-IN-CHARGE for certification, who shall certify the Final Bill, if drawn in accordance with Clause 10.1 After certification of the ENGINEER-IN-CHARGE, the Final Bill shall be submitted in quadruplicate (or in such other number of copies as the OWNER may prescribe) accompanied by the PRELIMINARY ACCEPTANCE CERTIFICATE to the OWNER for payment.

10.4 All monies payable under the CONTRACT for WORKS to be performed and MATERIALS to be supplied up to and including successful completion and final tests and commissioning of the system and performance tests shall become due and payable to the CONTRACTOR only after submission to the OWNER of the Final Bill prepared in accordance with the provisions of Clause 10.1 hereof and associated provisions there under accompanied by the PRELIMINARY ACCEPTANCE CERTIFICATE in respect of the WORKS.

10.5 Payments of the amount(s) due on the Final Bill to the extent certified by the ENGINEER-IN-CHARGE, shall be made within 84 (Eighty Four) days from the due date as specified in Clause 10.4 hereof, subject to the deductions provided in Clause 10.6.

10.6 All payments due to the CONTRACTOR on the Final Bill shall be subject to, tax deductions as provided for in Clause 11.0 and associated clauses there under and any other deduction provided in the CONTRACT or required to be made under any law, rule or regulation having the force of law for the time being applicable, or elsewhere provided for in the CONTRACT documents.

11.0 Deleted

12.0 Deleted

13.0 **STATUTORY VARIATION IN TAXES AND DUTIES**

13.1 No variation on account of taxes and duties, statutory or otherwise, (other than due to change in turnover) shall be payable by OWNER to CONTRACTOR, except for GST. Any statutory variation in GST, shall be payable up to COMPLETION PERIOD against documentary evidence. Any reduction in the amount of GST resulting from a reduction in the rate of GST or remission or exemption from GST with respect to Goods and Services provided to the OWNER shall be refundable to the OWNER at actuals within the COMPLETION PERIOD and also during the delayed contractual Project completion, if any. The CONTRACTOR shall submit a copy of the 'Government Notification' to evidence the rate as applicable on the Bid due date and on the date of revision.

13.2 Any new taxes, duties, cess, levies notified or imposed after the submission of Price Bid but before COMPLETION PERIOD shall be to OWNER's Account.

13.3 In case of delayed completion beyond the COMPLETION PERIOD, even though extension of completion time is allowed by OWNER, for reasons solely attributable to Contractor, all extra costs on account of changes of statutory regulations/ acts shall not apply to the Contract price and shall be borne by the CONTRACTOR.

However, any decrease in taxes and duties during the delayed period shall be passed on to the OWNER.

In case the COMPLETION PERIOD is extended for reasons solely attributable to OWNER, then any increase on account of statutory changes in GST until the extended period shall be borne by OWNER. Further, any new taxes, duties, cess, levies notified or imposed after the submission of Price Bid during such extended COMPLETION PERIOD shall be to OWNER's Account.

13.4 Claim for payment of GST (CGST & SGST/UTGST or IGST)/ Statutory variation, should be raised within two [02] months from the date of issue of 'Government Notification' for payment of differential (in %) GST (CGST & SGST/UTGST or IGST), otherwise claim in respect of above shall not be entertained for payment of arrears.

The base date for the purpose of applying statutory variation shall be the Bid Due Date.

14.0 TERMS OF PAYMENT

14.1 Payments shall be made by OWNER to the CONTRACTOR through RTGS / NEFT.

14.2 **MOBILISATION ADVANCE**

The CONTRACTOR shall be paid an interest bearing recoverable Mobilisation Advance on request, limited to maximum 10% (Ten percent) of the TOTAL CONTRACT PRICE (excluding GST) provided Bank Guarantee is submitted by the CONTRACTOR for 110% of advance (including GST).

The interest rate shall be at Marginal cost of fund based landing rate (MCLR) for Six Month charged by SBI (applicable on the date of disbursement of Moblisation Advance) plus 2.0% per annum on reducing balance basis.

The interest bearing Mobilization Advance shall be paid in two installments. The first installment of advance shall be maximum 50% of the Mobilisation Advance. Further the disbursal of second installment of balance amount can be made at the end of 3 months from the first installment subject to utilization certificate of first installment but not earlier than 3 months from the date of disbursal of first installment.

Mobilization Advance shall be paid subject to fulfillment of the following conditions:

a) Unconditional Acceptance of Fax of Acceptance (FOA) by CONTRACTOR.

b) Submission of Bank Guarantee(s) for 110% value of the said advance(s) including GST, valid for 15 months from date of FOA, as per format F-18. The CONTRACTOR shall, at the request of the OWNER, suitably extend the validity of the Bank Guarantee (s) for such period or periods as may be required to fully recover the amount of the Advance Payment not recovered before the expiry of the validity of such Bank Guarantee, failing which, without prejudice to any other right or remedy available to the OWNER, the OWNER shall be entitled to encash the Bank Guarantee (s)."

c) Submission of Bank Guarantee(s) by way of Contract Performance Security as stipulated in Clause 8.0 of the GENERAL CONDITIONS OF CONTRACT. The CONTRACTOR shall at the request of the OWNER extend the validity of the Bank Guarantee(s) for such further period or periods as may be required failing which, without prejudice to any other right or remedy available to the OWNER, the OWNER shall be entitled to encash the Bank Guarantee(s).

Notes:

1. The CONTRACT PRICE for the purpose of Contract cum Performance Security would be derived on date of CONTRACT and would not be revised except in case scope of work is altered.

2. The advance paid to the CONTRACTOR shall be used only for execution of this CONTRACT and the CONTRACTOR shall satisfy the OWNER in this regard whenever required. If it is found that the said advance has been utilised by the CONTRACTOR in whole or part for any other purpose, the OWNER may at its discretion forthwith recall the entire advance and without prejudice to any other right or remedy available to the OWNER, recover the same by recourse to any Bank Guarantee(s).

3. Mobilization Advance (principal plus interest) shall be recovered from the Running Account Bills and shall be fully extinguished within 12 months from the date of disbursement of first instalment of advance. The percentage deduction from each RA bill shall be arrived at based on the total cumulative payment for 12 months as per billing schedule. The percentage deduction from each RA bill shall be made @ 8.33% of Mobilization Advance per month which would be recovered from the said bill.

Note: Further incase the certified RA bill is not sufficient to recover the Mobilisation advance due on that particular month, then the unadjusted balance will be recovered in the subsequent certified RA bill.

4. Bank Guarantee furnished by the Contractor towards mobilization advance may be reduced quarterly subject to adjustment made from Contractors running bill. The BG against Mobilization advance shall be returned immediately after full recovery of advance.

5. In case of termination of CONTRACT due to default by CONTRACTOR, advance Bank Guarantee shall be encashed and unadjusted advance payment recovery will become interest bearing (the interest rate shall be simple interest of Six Month MCLR + 5.25%) calculated from the date of disbursement of first installment of advance.

14.3 Subject to the other provisions of the Contract documents, payments shall be made as follows:

14.3.1 Mobilization Advance :

Interest bearing Mobilization advance limited to 10% of Contract value shall be given, if asked by the Bidder, as indicated above.

Successful Bidder to indicate their requirement as to the quantum of first installment of Mobilization Advance (not more than 5% of the contract price) and the second installment of Mobilization Advance such that first installment and the second installment add up to 10% of the CONTRACT PRICE.

14.3.2 A FOR SUPPLIES:

i) 10% (Ten Percent) of Total Supply value excluding GST (excluding, spares, construction material and consumables) will be released on placement of all purchase orders as per the list of major tagged items. Major tagged items list to be finalised within 45 days from date

of issuance of FOA. This payment shall be released after submission of Bank Guarantee for equivalent value(i.e. 10% (Ten Percent) of Total supply value excluding GST (excluding, spares, construction material, consumables).The Bank guarantee to be submitted 21 days prior to claim of advance. This Bank Guarantee shall be valid upto 3 months after the COMPLETION PERIOD and may be renewed, as per the instruction of OWNER for such extended period. However, this Bank Guarantee shall be released after receipt of supply of all major tagged items (excluding, spares, construction material, consumables) at SITE and acceptance of same.

ii) **AGAINST PROOF OF SHIPMENT / DESPATCH OF MATERIALS:**

35% (Thirty five percent) on pro-rata basis as indicated in the approved Billing schedule (refer clause 15.0 below). Stage payment against "Proof of despatch of Materials" shall be released on submission of the following documents:

a) Signed Invoice(s)
b) Delivery Challan
c) Packing list.
d) Manufacturer's certificate of inspection for shipment duly approved by the CONTRACTOR in one original and one photocopy
e) Third Party Inspection Release Note clearly indicating that material has been inspected and accepted as per QAP approved by OWNER/PMC, or waiver certificate issued by OWNER/PMC.
f) Railway Receipt/LR
g) Certificate of Insurance Policy
h) Guarantee certificate (wherever applicable)
i) Operation & Maintenance manual (wherever applicable)

iii) **AGAINST RECEIPT OF MATERIAL AT SITE** :

40% (Forty Percent) on pro-rata basis as indicated in the approved Billing schedule on submission of:

(a) Signed Invoices.
(b) Photocopy of Third Party Inspection certificate as per QAP approved by OWNER along with Test Certificate.
(c) Entry gate pass duly endorsed by OWNER's security for verification of physical entry of material to SITE.
(d) Certificate of Verification and Good Condition after receipt of material at site by Owner.

iv) 5% (Five percent) as indicated in the approved Billing schedule on issue of MECHANICAL COMPLETION Certificate against CONTRACTOR's certified running Accounts Bill(s).

v) 8% (Eight percent) as indicated in the approved Billing schedule on issue of PRELIMINARY ACCEPTANCE CERTIFICATE against the CONTRACTOR's certified Running Account Bills.

vi) 2% (Two percent) as indicated in the approved Billing schedule on completion of balance jobs, if any, against the CONTRACTOR's Certified Final Bill.

B FOR SPARES& LUBRICANTS:

i) **AGAINST PROOF OF SHIPMENT / DESPATCH OF MATERIALS :**

40% (Forty percent) on pro-rata basis as indicated in the approved Billing schedule. Stage payment against "Proof of despatch of Materials" shall be released on submission of the following documents with the CONTRACTOR's invoice.

(a) Signed Invoice(s)
(b) Delivery Challan
(c) Packing list.
(d) Manufacturer's certificate of inspection for shipment duly approved by the CONTRACTOR in one original and one photocopy
(e) Third Party Inspection Release Note clearly indicating that material has been inspected and accepted as per QAP approved by OWNER, or waiver certificate issued by OWNER.
(f) Railway Receipt/LR
(g) Certificate of Insurance Policy
(h) Materials Safety Data Sheet (MSDS) for Chemicals (if applicable)

ii) **AGAINST RECEIPT OF MATERIAL AT SITE.** :

45% (Forty Five percent) on pro-rata basis as indicated in the approved Billing schedule on submission of:

(a) Signed Invoices.
(b) Photocopy of Third Party Inspection certificate as per QAP approved by OWNER along with Test Certificate.
(c) Entry gate pass duly endorsed by OWNER's security for verification of physical entry of material to SITE.
(d) Certificate of Verification and Good Condition after receipt of material at site by Owner.

iii) 5% (five percent) as indicated in the approved Billing schedule on issue of MECHANICAL COMPLETION Certificate against CONTRACTOR's certified running Accounts Bill(s).

iv) 8% (Eight percent) as indicated in the approved Billing schedule on issue of PRELIMINARY ACCEPTANCE CERTIFICATE against the CONTRACTOR's certified Running Account Bills.

v) 2% (Two percent) as indicated in the approved Billing schedule on completion of balance jobs, if any, against the CONTRACTOR's Certified Final Bill.

14.3.3 FOR SERVICES (including transportation, insurance, installation erection & commissioning and excluding training of owner's personnel)

i) 85% (Eighty Five Percent) of the Services Price component shall be paid on pro-rata basis against progress of Service duly certified by the Owner for the quantum of work completed and field quality billed as per the approved Billing Schedule/monthly progress report

ii) 5% (five percent) on issue of MECHANICAL COMPLETION Certificate against CONTRACTOR's certified running Accounts Bill(s).

iii) 8 % (Eight percent) as indicated in the approved Billing schedule on issue of PRELIMINARY ACCEPTANCE CERTIFICATE against the CONTRACTOR's certified Running Account Bills.

iv) 2% (Two percent) on completion of balance jobs, if any, against the CONTRACTOR's Certified Final Bill.

14.3.4 TRAINNING OF OWNERS PERSONNEL

100% (Hundred Percent) of payment shall be released on completion of training as indicated in the approved Billing schedule.

14.3.5 2 MONTHS SUPERVISORY ASSISTANCE

100% (Hundred percent) on monthly basis as indicated in the approved Billing schedule.

14.4 All payments shall be released only after finalization of the planning and monitoring documents and Progress Schedule.

14.5 PAYMENT METHODOLOGY

CONTRACTOR shall enclose all documents as per check list issued by PMC/OWNER. After receipt of complete RA Bill as per terms and conditions of the contract and duly certified by Engineer-in-Charge (EIC) / PMC, on-account payment equivalent to seventy percent (70%) of the net payable certified amount of the RA Bill will be released to the Contractor within a period of seven (07) working days from submission of certified bill by

PMC to TFL. The balance amount will be released within a period of 15 days from submission of certified bill by PMC to TFL.

14.6 All invoices shall be submitted in quadruplicate to EIC by the Bidder. The payment shall be released within 30 days of submission of invoice Complete in all respect.

15.0 **BILLING SCHEDULE**

The CONTRACTOR shall submit all invoices for a particular month under a single covering letter (once in a month) based on the billing schedule duly certified by OWNER with related documents.

The Billing Schedule shall consist of the following Heads:

1.0	**SUPPLIES (Break-up in line with the Material Control Index-MCI)**
a.	Total of Supplies (excluding Spares , Chemicals(if applicable), Lubricants)
b.	Mandatory/Insurance Spares as per list enclosed in Section VI-6
c.	Lubricants
d.	Others
2.0	**SERVICES**
a.	Basic Engineering(Break-up In line with the Document Control Index-DCI)
b.	Detailed Engineering(Break-up In line with the Document Control Index-DCI)
c.	Installation
d.	Erection
e.	Mechanical completion
f.	Commissioning
g.	PGTR
h.	Insurance
i	Others
3.0	Training of Owner's Personnel
4.0	2 months supervisory assistance after successful commissioning

The CONTRACTOR shall raise "Tax Invoices" on the OWNER against the GST to enable OWNER to reimburse the same

The GST paid on the local procurements by the CONTRACTOR have to be shown separately with all the supporting documents to enable the owner to reimburse the same.

Note:

1. Bidder shall indicate all Prices in INR only
2. Spares for Start-up / Commissioning and Mandatory Spares / Insurance Spares are in CONTRACTOR's scope of supplies and are to be included in the quoted TOTALCONTRACT PRICE.
3. It will be the responsibility of the contractor to include prices of all materials / equipments/ Services &Technological Structure Works required for completion of work as per the CONTRACT.
4. The total price payable under the CONTRACT shall be restricted to TOTALCONTRACTPRICE.
5. TotalpriceofSUPPLIESshallnotexceed60%oftheTOTAL CONTRACT PRICE. The SUPPLIES shall include but not limited to the Price of all materials complete in all respect including Commissioning and Mandatory Spares, etc.
6. TotalpriceofBasicEngineeringandDetailedEngineeringquotedinshallnotexceed10%oftheTOTAL CONTRACTPRICE. The supply of Services shall include but not limited to the Price of all services complete in all respect including Basic Engineering, Detailed Engineering, installation/Erection Services including site fabrication, Transportation, Insurance, Pre-Commissioning, Commissioning, Performance Guarantee Test Run (PGTR), etc.
7. CONTRACTOR shall be entirely responsible for all taxes, cess, stamp duties, and other such levies applicable, on performance of WORK under CONTRACT, outside OWNER's country. CONTRACTOR and shall also be responsible for payment of all taxes, duties and levies such as custom duty, GST, income tax, etc. as applicable on performance of WORK under CONTRACT, in India. All such taxes, stamp duties, cess, licence fees, and other such levies applicable shall be included in the quoted TOTAL CONTRACT PRICE.

16.0 DEEMED ACCEPTANCE

In case COMMISSIONING& PGTR of a PLANT is delayed by 12 months from successful MECHANICAL COMPLETION of the PLANT due to reasons solely attributable to the OWNER, the PLANT shall be considered as DEEMED ACCEPTED with a DEFECT LIABILITY PERIOD of another 12 months from DEEMED ACCEPTANCE.

In case of DEEMED ACCEPTANCE, a reasonable cost for conductance of Performance Guarantee Tests shall be worked out mutually and shall be retained by OWNER. Payment against PRELIMNARY ACCEPTANCE, less the aforesaid retention amount shall be released upon DEEMED ACCEPTANCE of the PLANT. The CONTRACT PERFORMANCE SECURITY

shall be extended by the CONTRACTOR so as to ensure validity of three (03) months beyond the date of completion of DEFECT LIABILITY PERIOD.

This provision of DEEMED ACCEPTANCE shall not be applicable in case reasons for delay solely attributable to the OWNER are resolved before the completion of 12 months from successful MECHANICAL COMPLETION. In that case, remaining activities including PERFORMANCE GUARANTEE TEST RUN shall be completed as per the terms & conditions of the CONTRACT and CONTRACT PERFORMANCE SECURITY shall be extended, accordingly, by the CONTRACTOR so as to ensure minimum validity of 3 months beyond the expiry of DEFECT LIABILITY PERIOD.

Even after the DEEMED ACCEPTANCE, CONTRACTOR shall not be absolved from his obligations of carrying out COMMISSIONING including PGTR. However, in such case, the CONTRACTOR shall have no obligation to prove the Performance Guarantee Parameters.

The CONTRACTOR may, in consultation with the OWNER, demobilise the team from the Site. It shall remobilise at the time of conductance of COMMISSIONING& PGTR by OWNER which shall be within DEFECT LIABILITY PERIOD. The OWNER shall reimburse the reasonable cost to be incurred by the CONTRACTOR for remobilization.

In case of DEEMED ACCEPTANCE, OWNER shall be responsible for care, custody and proper maintenance of the PLANT. However, OWNER, at its option, may retain the CONTRACTOR's services for watch, ward and preservation of the PLANT and reimburse the CONTRACTOR a mutually agreed reasonable cost incurred to do so.

After Deemed Acceptance, on performance of PGTR by the CONTRACTOR, if the Guaranteed parameters are not achieved, then the CONTRACTOR shall furnish the Recommendation/Report for corrective action to be implemented by OWNER to achieve the desired Guaranteed parameters.

17.0 DEFECT LIABILITY PERIOD AND LIABILITY FOR DEFECT

17.1 The DEFECT LIABILITY PERIOD shall be for a period of 12 (Twelve) months from the date of PRELIMINARY ACCEPTANCE/DEEMED ACCEPTANCE

If at any time before the PRELIMINARY ACCEPTANCE or during the DEFECT LIABILITY PERIOD stated below, the OWNER:

(a) Claims that any matter is a DEFECT; and

(b) as soon as reasonably practicable gives to the CONTRACTOR notice of the particulars of the DEFECT; the CONTRACTOR shall as soon as possible make good the DEFECT so notified and the OWNER shall so far as may be necessary place the PLANT at the CONTRACTOR's disposal for this purpose. The CONTRACTOR shall, if so required by the EIC, submit his proposals for making good any DEFECT to the EIC for his approval.

17.2 If any DEFECT arises from any breach of the CONTRACT by the CONTRACTOR, the CONTRACTOR shall bear his own cost of making good the DEFECT. In the case of any other matter made good by the CONTRACTOR, the work done by the CONTRACTOR shall be the subject of CHANGE ORDER.

17.3 The performance guarantees are demonstrated only through the performance tests carried out before the achievement of the PRELIMINARY ACCEPTANCE CERTIFICATE.

CONTRACTOR shall carry out further test(s) on the repaired/replaced item during the DEFECT LIABILITY PERIOD having the sole purpose to verify that said item is capable of working in compliance with contractual requirements. Such test(s) shall not be intended as a repetition of the performance tests already performed.

If DEFECT is made good after the issue of a PRELIMINARY ACCEPTANCE CERTIFICATE, the EIC may require the CONTRACTOR to repeat any appropriate performance test for the purpose of establishing that the DEFECT has been made good. The CONTRACTOR shall be responsible for the cost of any repeat inspection or test in the event of an inspection or test failure.

17.4 If in the course of making good any DEFECT which arises during the DEFECT LIABILITIES PERIOD and CONTRACTOR repairs, replaces or renew any part of the PLANT, this Clause 17 shall apply to the repair or to that part of the PLANT so replaced or renewed and shall further apply until the expiry of a period of 12 months from the date of such repair, replacement or renewal (the extended DEFECT LIABILITY PERIOD). However, extended DEFECT LIABILITY PERIOD shall have an upper limit of 24 months, starting from the date of Commissioning. .

17.5 If the CONTRACTOR does not make good with a reasonable time any DEFECT which he is liable to make good under Sub-Clause 17.1 then the OWNER may, in addition to any other remedies or relief available to him under the CONTRACT, proceed to do the work, provided that the OWNER gives at least fourteen DAYS notice of his intention.

17.6 If the OWNER reasonably requires that any DEFECT notified to the CONTRACTOR under Sub-clause 17.1 which arises during the DEFECT LIABILITY PERIOD be made good urgently and the CONTRACTOR is unable or refuses to comply within a reasonable time, the OWNER may, in addition to any other remedies or relief available to him under the CONTRACT, proceed to do the work in such a manner as the ENGINEER-IN-CHARGE may decide, including the employment of a third party.

17.7 If the OWNER has made good a DEFECT in accordance with Sub-clause 17.5 or 17.6, the CONTRACTOR shall reimburse the OWNER his reasonable cost of so doing provided that the OWNER gives a notice to the CONTRACTOR of his intention and submits a claim supported by DOCUMENTS. The ENGINEER-IN-CHARGE and the CONTRACTOR may agree the amount to be paid by the CONTRACTOR, or in the absence of agreement the ENGINEER-IN-CHARGE shall decide such amount as may be reasonable. Such amount shall be:

a) deducted from any money that would otherwise be payable under the CONTRACT; or

b) paid by the CONTRACTOR to the OWNER

17.8 If the PLANT cannot be used because of a DEFECT to which this Clause 17 applies, the DEFECT LIABILITY PERIOD, or if applicable the extended DEFECT LIABILITY PERIOD, shall be extended by a period equal to the period during which it cannot be used. Similarly the DEFECT LIABILITY PERIOD, or if applicable the extended DEFECT LIABILITY PERIOD shall be extended by any period wherein the PLANT cannot be used by reason of the CONTRACTOR putting the PLANT into such condition that it passes any relevant performance test or attempting to do so.

18.0 PERFORMANCE TESTS

18.1 The performance tests to be carried out on the PLANT shall be as specified in Technical, Section VI-8.0 of NIT.

18.2 The performance test shall be carried out by the CONTRACTOR in the presence of OWNER/PMC.

The CONTRACTOR shall give a notice to the EIC/OWNER about his readiness to carry out the performance tests, including a proposal for the time at which the tests would commence. The CONTRACTOR shall then confirm, at least fifteen (15) DAYS before the commencement of the performance tests.

18.3 Every performance test shall be carried out to completion unless the EIC or the CONTRACTOR shall order it to be stopped because its continuance would be unsafe or unacceptable to either party.

18.4 If PGTR fails due to any reason, CONTRACTOR has to make necessary adjustments and modifications and take all remedial measures at his own cost and demonstrate PGTR.

The OWNER shall permit to CONTRACTOR to make adjustments and modifications to any part of the Plant before the repetition of any performance test.

The CONTRACTOR shall submit details of the adjustments and modifications which he proposes to make.

18.5 If any performance test is stopped before its completion, due to reasons attributable to OWNER, such test shall be repeated as soon as practicable thereafter. However, the OWNER shall have the option to operate the plant in accordance with the Operating Manuals provided by CONTRACTOR, whereupon care and custody of the PLANT shall pass on to the OWNER and DEFECT LIABILITY PERIOD shall start. The OWNER shall exercise the option to allow CONTRACTOR to carry out the Performance Tests with grant of extension of time by such number of days of deferment. Such deferment shall not exceed more than 90 days. In case the deferment exceeds 90 days, the Owner shall

reimburse the additional cost of remobilisation incurred due to such deferment. However, the outer limit of such deferment shall be 12 months from COMMISSIONING and the provisions of Clause 16 shall apply thereafter. If the PLANT fails to pass any performance test, such test shall, subject to Sub-clause 18.7, be repeated as soon as practicable thereafter. The OWNER shall permit to CONTRACTOR to make adjustments and modifications to any part of the Plant before the repetition of any performance test and shall, if the CONTRACTOR reasonably requires, shut down any part of the PLANT for such purpose and restart it after completion of the adjustments and modifications, which shall be made by the CONTRACTOR with all reasonable speed.

The timing of such shutdown shall be agreed between the CONTRACTOR and the EIC, provided that if any or both i.e. the timing of shutdown or repetition of Performance Test, is required to be deferred, the agreed period of Performance Test Period shall be accordingly extended.

The CONTRACTOR shall, if so required by the EIC, submit to the EIC for his information details of the adjustments and modifications which he proposes to make.

The CONTRACTOR shall make such adjustment and modifications at his own cost.

18.6 The result of the performance tests shall be compiled by the CONTRACTOR and to be submitted to OWNER/PMC for evaluation.

18.7 If the PLANT passes performance tests towards meeting all Performance Guarantees specified at Section VI-8.0 (TECHNICAL) of NIT, but does not pass the performance test towards meeting Works Guaranteed cost for reasons which are the responsibility of the CONTRACTOR, then

i) If, the results of the performance tests towards meeting Guaranteed Works Cost are within the limits for the application of MUTUALLY AGREED DAMAGES, CONTRACTOR shall at its option either:

(a) may carry out remedial measures necessary to attain the Guaranteed Works Cost and repeat the performance test; or

(b) pay the applicable MUTUALLY AGREED DAMAGES in terms of clause 31 GCC.

Upon payment or allowance of such sum the CONTRACTOR shall become entitled to PRELIMINARY ACCEPTANCE CERTIFICATE which shall inter alia state that applicable MUTUALLY AGREED DAMAGES have been paid in respect of shortfall in performance and CONTRACTOR shall be released from all liability with respect to PGTR.

Further, in case of a) above, the CONTRACTOR will be allowed only one more chance to pass the performance test towards meeting Guarantee Works Cost.

ii) If the results of the performance tests towards Guaranteed Works Cost are outside the limits for application of MUTUALLY AGREED DAMAGES specified in the CONTRACT, OWNER may at his option:

a) instruct the CONTRACTOR to investigate or to co-operate with the EIC or others in the investigation of the reasons in its WORK for the shortfall in the performance;

b) instruct the CONTRACTOR to propose remedial measure and work necessary to correct the shortfall whether as the result of any such investigation or not;

and/or

c) Recommend the CONTRACTOR to carry out, at CONTRACTOR'S option, whatever remedial measures and work within its scope of WORK may be necessary to correct the shortfall.

Thereafter the EIC or CONTRACTOR may require that the PERFORMANCE GUARANTEE TEST RUN be repeated, the result of which shall be subject to this Sub-clause 18.7 (i).

The CONTRACTOR shall bear his own cost of work undertaken in accordance with (a), (b) or (c) above.

iii. After 3 (three) failed Performance Tests as specified at Technical Section VI-8.0 of NIT for reasons attributable to the CONTRACTOR, the OWNER shall have right to proceed with the encashment of Contract Performance Security and other provisions also take all action as per Clause 34 of GCC shall further apply.

19.0 FINAL ACCEPTANCE CERTIFICATE

19.1 As soon as DEFECT LIABILITIES PERIOD for the PLANT has expired or the CONTRACTOR has made good all DEFECTS that have within such period appeared in the PLANT in accordance with Clause 17 (Liability for Defects), whichever is later, the EIC shall issue a FINAL ACCEPTANCE CERTIFICATE to the CONTRACTOR certifying that the CONTRACTOR has performed his obligations in respect of the DEFECT LIABILITY PERIOD and associated clauses there under, and until issue of such FINAL ACCEPTANCE CERTIFICATE, the CONTRACTOR shall be deemed not to have performed such liabilities notwithstanding issue of the PRELIMINARY ACCEPTANCE CERTIFICATE or payment of the Final Bill by the OWNER.

19.2 The FINAL ACCEPTANCE CERTIFICATE shall constitute conclusive evidence for all purposes and in any proceedings whatsoever between the OWNER and the CONTRACTOR that the CONTRACTOR has completed the PLANT and made good all DEFECTS therein in all respects in accordance with his obligations under the CONTRACT.

No FINAL ACCEPTANCE CERTIFICATE shall be conclusive as stated above if FINAL ACCEPTANCE CERTIFICATE was issued in reliance upon any fraudulent act, misrepresentation or concealment.

19.3 In the event that OWNER fails to issue the FINAL ACCEPTANCE CERTIFICATE, or fails to notify CONTRACTOR the reason for not issuing said certificate of acceptance, within a period of 60 days from CONTRACTOR's application, the FINAL ACCEPTANCE CERTIFICATE shall be deemed as issued by OWNER for all contractual purposes.

19.4 Upon application for the FINAL ACCEPTANCE CERTIFICATE, the CONTRACTOR shall:

(i) Be deemed to have warranted that it had been fully paid and satisfied all claims for or arising out of the WORK, labour, MATERIALS, supplies and EQUIPMENT used in or connected with the CONTRACT and all other liabilities whatsoever touching or affecting the CONTRACT, or its performance, including in relation to SUB-CONTRACTORS and suppliers, and

(ii) To have undertaken to indemnify and keep indemnified the OWNER from and against all claims, demands, debts, liens, obligations and liabilities whatsoever arising there from or relating thereto.

19.5 Upon issue of the FINAL ACCEPTANCE CERTIFICATE, the CONTRACTOR shall be deemed to have released, acquitted and discharged the OWNER from and against all claims (known or unknown), liens, demands or causes of action of any kind whatsoever arising out of or relating to the CONTRACT or otherwise howsoever touching or affecting the same.

19.6 Forthwith on application made by the CONTRACTOR in this behalf accompanied by the FINAL ACCEPTANCE CERTIFICATE, or within 84 (Eighty Four) days of the OWNER passing the CONTRACTOR's Final Bill, whichever shall be later, the OWNER shall cancel and return to the CONTRACTOR all previous Bank Guarantees remaining unutilised in the hands of the OWNER, and upon such cancellation and return, the OWNER shall stand discharged of all obligations/ liabilities under the CONTRACT provided that the cancellation and return of any Bank Guarantee(s) furnished by the CONTRACTOR as and by way of Contract Performance Security shall be subject to the CONTRACTOR replacing such Bank Guarantee(s) covering 10% (ten percent) of the value (or as determined by the OWNER) of equipments/works replaced or repaired during the DEFECT LIABILITY PERIOD for the unexpired term of extended defect liability period in respect thereof plus a 6 (six) months period. The claims or demands made during such additional 6 months period shall refer to events which has occurred before the expiry of the DEFECT LIABILITY PERIOD.

20.0 COMPLETION PERIOD:

Completion period for the entire package shall be 20 (Twenty) months from the date of FOA/DLOA.

21.0 MUTUALLY AGREED DAMAGES (MAD)

21.1 For Delay in Completion

21.1.1 The CONTRACTOR agrees that the work shall be commenced and carried on at such points, and in the order of precedence and at such times and seasons as may be directed by the OWNER in accordance with the schedule for the completion of work as outlined in the CONTRACT. The CONTRACTOR declares that he has familiarised himself with the site and rights of way, ground conditions, with all the local conditions, and with all the circumstances which may or are likely to affect the performance and completion of the work and that he has allowed for such conditions in the preparation of this schedule. The progress of work shall be checked at regular monthly intervals and the percentage progress achieved shall be commensurate with the time elapsed after the award of the CONTRACT.

21.1.2 However, it is not incumbent upon the ENGINEER-IN-CHARGE to notify the CONTRACTOR when to begin or to cease or to resume work, nor to give early notice of the rejection of a faulty work, nor in any way to superintend so as to relieve the CONTRACTOR of responsibility of any consequence of neglect or carelessness by him or his subordinates.

21.1.3 The time stipulated in the CONTRACT for the execution and completion of the works ~~is~~ shall be deemed to be of utmost importance of the CONTRACT. In the event the CONTRACTOR fails to attain the PRELIMINARY ACCEPTANCE of PLANT within the CONTRACTUAL COMPLETION PERIOD due to the reasons not attributable to OWNER, then the CONTRACTOR shall pay to the OWNER as MAD at the rate of 0.5% of the TOTAL CONTRACT PRICE (excluding taxes) per week of delay or part thereof. The total deductions under this head shall not exceed 5% of the TOTAL CONTRACT PRICE (excluding taxes).

The OWNER may, without prejudice to any method of recovery, deduct the amount for such damages from any amount due or which may become due to the CONTRACTOR. In the event of extension of time being granted by the OWNER in writing for completion of the WORKS without levy of MAD (Mutually Agreed Damages), this clause will be applicable after expiry of such extended period. GST at the prevailing rate, if applicable on “MUTUALLY AGREED DAMAGES” shall be recovered extra from the CONTRACTOR on the amount of such MUTUALLY AGREED DAMAGES levied as per the Contractual terms.

OWNER shall raise separate Tax Invoice for recovery of MAD along with applicable GST.

Mutually Agreed Damages represent, without prejudice to the respect of the contractual obligation under the CONTRACT by CONTRACTOR, the sole and exclusive remedy of OWNER for such delay.

The decision of the OWNER on the applicability of MAD shall be final and binding on the CONTRACTOR.

21.2 **For Failing to Meet Guaranteed Works Cost**

LSTK bidder shall guarantee overall consumption of Utilities so as to guarantee the works cost for all the facilities provided by the CONTRACTOR as detailed in Technical Sec. VI-8.

In the event works cost is more than 100% but upto 102.5% of the Guaranteed Works Cost for PLANT, then the CONTRACTOR will pay to OWNER Mutually Agreed Damages for the applicable PLANT as under:

For every 0.50% increase in Works cost above the Guaranteed Works Cost or part thereof, CONTRACTOR will pay Mutually Agreed Damages equal to 1.0% of the TOTAL CONTRACT PRICE (excluding taxes).

If the Guaranteed Works Cost as demonstrated during the performance test is more than /102.5% of the Guaranteed Works Cost, then CONTRACTOR at their own cost shall take corrective action irrespective of the cost involved. In case the Guaranteed Works Cost is more than 102.5% even after taking the corrective action, the same shall be considered as breach of Contract and necessary action as per clause 34 of GCC shall be taken by OWNER.

22.0 OVERALL CEILING ON TOTAL LIABILITY

22.1 The Maximum Overall Liability under the CONTRACT on account of (a) Delay in execution of project (b) Contractor failing to meet the Guaranteed Works Cost up to 102.5 % (c) Termination of CONTRACT (d) Carrying out balance work at the risk and cost of the CONTRACTOR, re-engineering, make good, mechanical warranty (e) Patent infringement and (f) any other liabilities (if any) defined in the NIT shall be capped to 100% of the TOTAL CONTRACT PRICE.

22.2 Except for criminal negligence or wilful misconduct, the Contractor shall not be liable to the Owner, whether in contract, tort, or otherwise, or any indirect or consequential loss or damage, loss of use, loss of production, or loss of profit or interest cost, provided that this exclusion shall not apply to any obligation of the Contactor to pay liabilities to the Owner, as defined in clause 22.1 above.

23.0 STANDARD CONDITIONS OF SCC: PART I TO PART III

The Contractor has to fully comply with all applicable Labour Laws and Regulations passed, modified and notified from time to time by the Central, State and Local Government agencies/authorities. Brief guidelines and Annexures related to labour laws/Acts for Workmen/labour are enclosed as STANDARD CONDITIONS OF SCC: PART I to PART IV.

24.0 PLANNING AND DESIGNING IN PURVIEW OF VULNERABILITY ATLAS OF INDIA

Vulnerability Atlas of India (VAI) is a comprehensive document which provides existing hazard scenario for the entire country and presents the digitized State / UT-wise hazard, maps with respect to earthquakes, winds and floods for district-wise identification of vulnerable areas. It also includes additional digitized maps for thunderstorms, cyclones and landslides. The main purpose of this Atlas is its use for disaster preparedness and mitigation at policy planning and project formulation stage.

This atlas is one of its kind single point source for the various stakeholders including policy makers, administrators, municipal commissioners, urban managers, engineers, architects, planners, public etc. to ascertain proneness of any city/location/site to multi-hazard which includes earthquakes, winds, floods thunderstorms, cyclones and landslides. While project formulation, approvals and implementation of various urban housing, buildings and infrastructures schemes, this Atlas provides necessary information for risk analysis and hazard assessment.

The Vulnerability Atlas of India has been prepared by Building Materials and Technology Promotion Council under Ministry of Housing and Urban Affairs, Government of India and available at their website www.bmtpc.org.

It is mandatory for the bidders to refer Vulnerability Atlas of India for multi-hazard risk assessment and include the relevant hazard proneness specific to project location while planning and designing the project in terms of:

i) Seismic zone (II to V) for earthquakes,
ii) Wind velocity (Basic Wind Velocity: 55, 50, 47, 44, 39 & 33 m/s)
iii) Area liable to floods and Probable max, surge height
iv) Thunderstorms history
v) Number of cyclonic storms/severe cyclonic storms and max sustained wind specific to coastal region
vi) Landslides incidences with Annual rainfall normal
vii) District wise Probable Max. Precipitation.

STANDARD CONDITIONS OF SCC: PART I

Compliances under various Labour Laws

The Contractor has to fully comply with all applicable Labour Laws and Regulations passed, modified and notified from time to time by the Central, State and Local Government agencies/authorities. Specific attention of the Contractor is drawn to the following obligations amongst others:

1. **The Minimum Wages Act, 1948, Payment of Wages Act, 1936 and Payment of Bonus Act 1965** or **The Code on Wages, 2019 (after it comes into force)**

1.1. **Minimum Wages:**

a. During the tenure of the contract, the Contractor must ensure the payment of minimum wages, as notified by the Central Government or State Government whichever is higher, as per the provisions of the Minimum Wages Act, 1948 / Code on Wages, 2019 (after it comes into force).

b. **Wage period and monthly wages**: Wage period shall be monthly and wages for a month shall be calculated by multiplying daily rate of Minimum Wages by 26. The monthly wages include the wages of the weekly days of rest as applicable to the office/establishment of TFL. Deduction in case of any days of absence other than weekly days of rest shall be calculated using the following formula:

Deduction for absence = days of absence x (monthly wages / number of days in the relevant month)

However, in case the resource has worked for less than 7 working days in a particular month, the payment of wages is to be made as per the actual number of days worked based on notified wage rate per day.

Illustration I (05 days per week working pattern):

Sl. No.	Month	Nos. of days in the month	Nos. of weekly off	Nos. of days absence	Nos. of days present	Daily wage as notified	Monthly wage	Deduction	Wage to paid
1	Feb.	28	8	2	18	603	15678	1119.86	14558.14
2	March	31	10	5	16	603	15678	2528.71	13149.29
3	April	30	8	10	12	603	15678	5226	10452.00
4	May	31	10	-	4	603	2412	0	2412.00

Illustration II (06 days per week working pattern):

Sl. No.	Month	Nos. of days in the month	Nos. of weekly off	Nos. of days absence	Nos. of days present	Daily wage as notified	Monthly wage	Deduction	Wage to paid
1	Feb.	28	4	2	22	603	15678	1119.86	14558.14
2	March	31	5	5	21	603	15678	2528.71	13149.29
3	April	30	4	10	16	603	15678	5226	10452.00
4	May	31	5	-	4	603	2412	0	2412.00

1.2. **Payment of Wages:**

The Contractor shall disburse monthly wages **through e-banking / digital mode through cashless transaction only**, and avoid illegitimate deductions and maintain records /returns as prescribed. The Contractor shall be solely responsible for the payment of wages and other dues to the resources, if any, deployed by him latest by 7th day of the subsequent month as per the provisions of the Payment of Wages Act, 1936 / as applicable under Code on Wages, 2019 (after it comes into force) in the presence of Engineer In-charge (EIC) or authorized representative of TFL. After disbursement of wages, the representative of the Contractor and EIC/ authorised representative of TFL have to certify the payment of wages to the resources and sign the Wage Register - Form B (under The Ease of Compliance to Maintain Registers under various Labour Laws Rules, 2017) / FORM-I of Code on Wages, 2019 (after it comes into force) with specific seal detailing name/designation/Company.

1.3. **Payment of Bonus:**

Contractor shall ensure payment of bonus as per the provisions of the Payment of Bonus Act, 1965 / Code on Wages, 2019 (after it comes into force). Present minimum rate of payment of Bonus as per the Payment of Bonus Act, 1965 is 8.33% of minimum wages per month or 8.33% of Rs.7,000/- per month whichever is higher. The rate shall be subject to amendments made from time to time to the legislation.

Payment of Bonus / ex-gratia (if Bonus is not applicable) shall be made preferably before Deepawali festival falling after the end of relevant financial year(s) and the balance payment at the time of closure of contract.

The amount towards the payment of bonus/ex-gratia shall be released / reimbursed to the contractor, after submission of proof of payment.

2. Leaves/ Leave with wages/ Holiday:

The Contractor shall comply with all the applicable leave Rules including leave with wages in terms of applicable labour legislations i.e. Factories Act, 1948 / Shops & Establishment Act/ Industrial Establishment (national & festival holidays, casual & sick leave) Act, 1965.

The Contractor shall extend the leave with wages and maintain the Register of Leave pertaining to the resource deployed. The payment towards un-availed leave, as per the Factories Act, 1948

/ Shops & Establishment Act, shall be settled with the resource at the time of closure of the contract or separation of resource from the contract by the contractor.

i. As per the **Factories Act, 1948 (if applicable)**:-Annual Leave with Wages @ 01 day for every 20 days of work performed by him in the previous calendar year becomes due.

ii. As per the **Shops & Establishment Act (if applicable)** : Privilege Leave not less than 15 days and Sickness/Casual Leave not less than 12 days (this provision may vary from state to state).

iii. As per the **Industrial Establishment (national & festival holidays, casual & sick leave) Act, 1965 (if applicable)**: (a) three national holidays of one whole day each on the 26th January, 15th August and 2nd October (b) five other holidays on any of the festivals specified in the - Schedule appended to this Act. (c) Every worker shall in each calendar year, be allowed by the employer 07 casual leave and 14 sick leave in such manner and on such conditions as may be prescribed (This provision may vary from state to state).

3. The Employees' Provident Fund & Miscellaneous Provisions Act 1952

a) The Contractor shall have independent PF code no. with the RPFC as required under the Employees' PF & Misc. Provisions Act, 1952.

b) The Contractor has to ensure compliance (as per prevailing rates) and extend benefits under the Employees' Provident Fund Scheme 1952, the Employees' Pension Scheme 1995 & the Employees' Deposit Linked Insurance Scheme, 1976 to the resources deployed by him.

c) The Contractor is required to submit copies of ***separate e-Challans / ECR alongwith proof of payment/receipt*** in respect of resources engaged through this contract only, on monthly basis. **Common challans would not be acceptable in TFL**. The Contractor should submit copies of previous months EPF e-Challans / ECR alongwith current month's bill. The TRRN. No. of the ECR would be verified online from EPFO portal by the Engineer-in-charge to confirm the status of payment and names of the resources deployed.

d) **PF is mandatory irrespective of the number of resources deployed** by the Contractor under this contract. PF membership and deposit of PF contribution is also mandatory even if the wage payment to the resource is exceeding the prescribed monthly wage ceiling (i.e. Rs. 15,000/-) under the Employees' PF & Misc. Provisions Act, 1952 and in such case the liability of the Contractor towards PF contribution shall be limited to the prescribed monthly wage ceiling notified from time to time (i.e. Rs. 15,000/- currently).

e) In case, the Contractor deploys any "**International Worker**", the Contractor should also make compliance under para 83 of EPF Scheme, 1952 i.r.o the "International Workers" and must register on the ***International Worker Portal of EPFO***.

4. The Employees' State Insurance Act, 1948 (If applicable and as per prevailing rates)

a) The Contractor shall have his own ESI code No. allotted by Employees' State Insurance Corporation (ESIC) as required under the Employees' State Insurance Act, 1948.

b) The Contractor has to arrange **Smart Cards (i.e. ESI Identity Card) /e-Pehchan Card** for the resource(s) engaged by him from the Corporation.

5. The Employees' Compensation Act 1923 (wherever applicable)

In case, the work place is out of the notified coverage area under ESIC i.e. ESIC is not implemented in the area **or** in case of excluded employees under ESIC, the Contractor is required to take Employee Compensation / Workmen Compensation Policy from IRDAI approved Insurance Company taking into consideration the **maximum compensation liability** as per provisions of Employees' Compensation Act, 1923. It must be ensured that the contractor/contracting firm should extend coverage to the contract workers through Employee Compensation Policy, to meet the **Compensation Liability** under **Employee's Compensation Act, 1923** along with **Medi-claim Policy** within the overall premium @ 3.25 % of Minimum wages (i.e. employer contribution towards ESI).

6. Group Personal Accident Insurance Policy

The Contractor is required to take a Group Personal Accident Insurance Policy with coverage of **Rs. 3 Lakhs** per resource for the entire period of contract covering all resources deployed under the contract.

7. **The Payment of Gratuity Act, 1972**

In case of Death or permanent disablement of a resource during execution of work under the contract, the Contractor has to pay the Gratuity as per the provision under the Payment of Gratuity Act, 1972 to the nominee(s) of the resource as per the details maintained in the duly signed Nomination Form maintained by the Contractor. The proof of disbursement may be submitted to the EIC for claiming reimbursement of amount paid towards death Gratuity from TFL.

8. **The Contract Labour (R&A) Act, 1970**

a) The Contractor is required to obtain Labour license under the provisions of the Contract Labour (R&A) Act, 1970 from the office of Licensing Officer, Central Labour Authority, Ministry of Labour and Employment, Govt. of India having jurisdiction of the Region.

b) The Contractor shall discharge obligations as provided under the Contract Labour (R&A) Act, 1970 rules and regulations framed under the same and enforced from time to time.

c) The Contractor shall ensure regular and effective supervision and control over the resources deployed for which a supervisor / representative of the Contractor should be available at all the times for giving suitable direction for undertaking the Contractual Obligations.

d) The Contractor is solely responsible for payment of wages to each resource deployed by him and such wages shall be paid before the expiry of such period as may be prescribed.

e) It shall be the duty of the Contractor to ensure the disbursement of wages to resource(s) through e-banking/digital mode. In case the resource does not have a bank account, the disbursement of wages may be made in cash in the presence of the Engineer-in-charge /

authorized representative of TFL initially and Contractor shall simultaneously arrange for opening the bank account of each contract labour deployed by him.

f) In case, the Contractor fails to make payment of wages and deposit of PF contribution within the prescribed period or makes short payment of wages / short deposit of PF contribution, then TFL, as Principal Employer, will make payment of wages in full or the unpaid balance due, as the case may be, to the resource(s) deployed by the Contractor and deposit the PF contribution with PF authorities. Such amounts will be recovered from the Contractor either by deduction from any amount payable to the Contractor under any contract or as a debt payable by the Contractor.

9. The contractor is required to comply with all applicable labour laws and regulations including, but not limited to the following:

a) The Factories Act, 1948 / The Shops & Establishment Act, 1948 (which ever applicable)
b) The Maternity Benefit Act, 1961
c) The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act 1979 & Building and Other Construction Workers Welfare Cess Act, 1996
d) The Inter State Migrant Workmen (RECS) Act 1979 (if applicable)
e) Contract Labour (R&A) Act-1970
f) Employees' Provident Fund & Misc. Provisions Act- 1952
g) Employees' State Insurance Act-1948
h) Employees' Compensation Act, 1923
i) Payment of Gratuity Act, 1972
j) Minimum of Wages Act,1948
k) The Payment of Wages Act,1936
l) The Payment of Bonus Act,1965

STANDARD CONDITIONS OF SCC: PART II

Responsibilities of the Contractor

1. The Contractor shall be solely responsible and indemnify TFL against all charges, dues, claim etc. arising out of the disputes relating to the dues and employment of resources, if any, deployed by him.

2. The Contractor shall indemnify TFL against all losses or damages, if any, caused to it on account of acts of the resource(s) deployed by him.

3. The Contractor shall indemnify TFL from all claims, demands, actions, cost and charges etc. brought by any court, competent authority / statutory authorities against TFL.

4. The Contractor shall also indemnify TFL for any action brought against him for violation, non-compliance of any act, rules & regulation of center / state / local statutory authorities.

5. All resources deployed by the Contractor are deemed to be on the rolls of the Contractor.

6. **Age**: No resource below the age of **18 years** and above age of **58 years** shall be deployed by the contractor for the execution of the contract.

7. **Appointment/Nomination of supervisor:**
   As a part of the contract, the Contractor is required to appoint/nominate a supervisor (s) who will supervise, control and give directions to the resource(s) for discharging the contractual obligations. Accordingly, the Contractor has to give in writing the name and contact details of the supervisor (s) to the EIC. A copy of the same is also to be sent to HR In-charge and Security In-charge for records.

8. A copy of the Letter of Acceptance (LOA) should be submitted to the Security Department by the Contractor / his representative or supervisor for facilitating the movement of resource(s) including machine & materials involved in the contract.

9. The resources to be deputed/ deployed by the Contractor shall observe all security, fire and safety rules of TFL while at the site/work. All existing and amended safety / fire rules of TFL are to be followed at the work site by the Contractor and his deployed resource(s).

10. **Personal Protective Equipment / Safety Kit and Liveries**: Contractor shall ensure adequate supply of personal protective equipment / Safety Kit and Liveries as mentioned in the Scope of Work to all such resources deployed.

11. In case of accident, injury or death caused to the resource(s) while executing the Work under the contract, the Contractor shall be solely responsible for payment of adequate compensation, insurance money etc. to the next kith & kin of injured / diseased. Contractor shall indemnify TFL from such liabilities.

12. The Contractor shall not deploy any resource suffering from any contagious or infectious disease. The Contractor shall get the deployed resource(s) examined from a civil Govt. Doctor / TFL's Doctor.

13. No resource(s) or representatives of Contractor (including Contractor) are allowed to consume alcoholic drinks or any narcotics within the premises of TFL (including Plant, Office and Residential etc.). If found under the influence of above, the Contractor shall immediately replace that resource(s) with intimation to the EIC.

14. While engaging / deploying the resources, the Contractor is required to make efforts to provide opportunity of employment to resources belonging to **Schedule Caste, Schedule Tribe** and **Other Backward Class** in order to have a fair representation of these sections of the society.

15. While engaging the resources, the Contractor is required to make efforts to provide an **opportunity to** candidates with experience of **apprentice training in TFL** under the provisions of the Apprentices Act, 1961.

16. The Contractor is required to maintain all Registers and other records in an **office** within the premises of TFL or at a place **within a radius of three kilometers**.

17. Contractor shall provide proper **Employment cards (FORM XII)** for the resource to be deployed by him, duly signed by the Contractor or authorized person on behalf of Contractor.

18. **Gate/ Entry Pass or Authorization:**
    Entry to the premises of TFL is restricted and is subject to appropriate entry authorization in the prescribed format of a Gate Pass or any other entry authorization w.r.t police verification as per instruction of Security department from time to time. Similarly, entry for material/ equipment's/ tools/ tackles etc. is restricted & subject to entry authorization by security department.

19. The Contractor shall issue **Identity cards** in his firm's name to the resource deployed.

20. Discipline of the resource(s) during discharge of duties must be regulated by the Contractor himself or by his representative.

21. **Police verification**
    a) The Contractor (including his sub-Contractors/Petty Contractors etc, if allowed) will undertake police verification in respect of the resource(s) engaged by him in TFL's premises. Such verification will have to be carried out from concerned police station of their permanent place of residence/present place of residence.
    b) Further, the Contractor is advised not to deploy any resource having past criminal record in the establishment/premises of TFL under this contract awarded to him.
    c) In the event of violation of above clauses at (a) and (b), the Contractor will be solely responsible for the same.
    d) If any such resource(s) having criminal record is deployed by the Contractor in the premises of TFL and has come to the notice of TFL at any point of time, the Contractor shall immediately replace that resource(s), failing which that particular resource(s) of the Contractor will not be allowed to enter into the premises of TFL.

22. While confirming to any of these conditions, the Contractor must ensure that all applicable Laws of State regarding labour, their welfare, conduct etc. are complied.

STANDARD CONDITIONS OF SCC: PART III

Compliance of Government of India Directives

1. Pradhan Mantri Suraksha Bima Yojna (PMSBY) and Pradhan Mantri Jeevan Jyoti Bima Yojna (PMJJBY)

Contractor shall, ensure that all its resources deployed under this contract have obtained additional insurance coverage under the Pradhan Mantri Suraksha Bima Yojana (PMSBY) and Pradhan Mantri Jeevan Jyoti Bima Yojana (PMJJBY) through the participating banks and submit the proof of such insurance coverage to the satisfaction of TFL. The cost has been included in the estimate mentioned in SOR and the Contractor shall submit evidence / proof to TFL in this respect. Both the schemes are to be regulated continuously on yearly basis and the same should be renewed on each successive relevant date in subsequent years during the period of the contract.

2. Labour Identification Number (i.e. LIN) Registration (Mandatory)

The Unified Shram Suvidha Protal, developed by Government of India, facilitates reporting of Inspections & submission of Returns and has also been envisaged as a single point of contact between employer, resources and enforcement agencies bringing in transparency in their day-to-day interactions. For integration of data among various enforcement Agencies, the Contractor, as an inspectable unit, is required to register and obtain Labour Identification Number (i.e. LIN) from Shram Suvidha Portal and submit the same in TFL.

3. Pradhan Mantri Rojgar Protsahan Yojna (PMRPY) – if applicable

In order to support the Govt. of India's Initiative on Employment Generation, the Contractor must register for Pradhan Mantri Rojgar Protsahan Yojna (PMRPY) Scheme. The Contractor shall inform TFL/Engineer in Charge about the benefit availed, if any, against the scheme for adjustment against the invoice(s) / bill(s).

Annexure-i

Details in support of RA Bill for the Month of _____, 20__

(1) Name of the Firm/Agency/Contractor _____
(2) Nature of Contract: Job/ Service _____
(3) Period of Contract: From _____to _____
    (a) Extension Period of Contract, if any from _____to _____
    (b) Place where contract workmen are working _____
(4) Postal address of the Contractor: _____
(5) Phone No. of the Contractor: _____
(6) Fax No. and Email of the Contractor: _____
(7) Name and Address of PF office from where EPF Code No. has been allotted: _____
(8) EPF Code No. allotted by PF office: _____
(9) Name and Address of ESIC office from where ESI Code No. has been allotted: _____
(10) ESI Code No. allotted by ESIC office: _____
(11) Labour License No. _____ dated _____
(12) Validity period of Labour License from _____to _____
(13) Detail of Resource engaged by the Contractor:

Category	**No. of Resources**		**Prevailing Minimum Wages**
	Male	**Female**	
Unskilled			
Semi-skilled			
Skilled			
Highly skilled			
Total			

(14) Copy of Wage Register in FORM – B (to be replaced by FORM-I as per Code on Wages-2019, after it comes into force)
(15) Details of deposit of contribution towards EPF:
    a) EPF Challan No. _____Amount _____ Date_____
(16) Details of Deposition of contribution towards ESI
    a) ESI Challan No. _____Amount _____ Date _____
(17) Whether any arrangement / agreement has been entered with any resource for extending benefits under Inter-state Migrant Workmen (RE&CS) Act, 1979: ____ (Yes / No)
    If Yes, No. of such Inter-state Migrant Workers: _____

SIGNATURE OF CONTRACTOR/AUTHORIZED REPRESENTATIVE

Place:
Date:

Annexure- ii

UNDERTAKING

(To be submitted along with un-priced bid)

I/We hereby undertake that I/We have completely understood the terms & conditions of the Tender including minimum resources required to be deployed and the cost involved thereof in deployment of resources.

I/We further undertake to ensure all compliances of the tender conditions. Any non-compliance may be construed as deficiency in the performance of the contract. If such non-compliance is noticed TFL/owner is at liberty to take action in line with the tender conditions including termination of the contract.

Signature of Bidder……..
Name of Bidder……..

Annexure - iii

Summary of Insurance Policies

Contractor is required to cover all resources deployed by him with the following insurances / schemes:

Sl. No.	SCHEME	APPLICABILITY	PREMIUM/ CONTRIBUTION	SUM ASSURED/ BENEFITS	REMARKS
1	The Employees' State Insurance Act, 1948	Applicable to all resources of the Contractor (within ESI wage limit) working in notified area.	3.25% of wages by employer 0.75% of wages by employees	Benefits under the Employees' State Insurance Act, 1948.	
2	The Employees' Compensation Act, 1923 (in lieu of ESI – mentioned at Sl. 1)	Applicable to excluded employees under ESI and those who are working in non-notified area to extend similar benefits as available under ESI Act, 1948	Premium to be calculated considering wage limit under EC Act, 1923 (i.e. Rs. 15,000/- p.m currently)	Maximum **Compensation Liability** under Employee's Compensation Act, 1923 along with **a Mediclaim policy** within overall premium @ 3.25 % of Minimum wages (i.e. employer contribution towards ESI)	Provides compensation and medical facility to resources.
3	Group personal Accident Insurance	Applicable to all resources of the Contractor	Based on the coverage	Insured value: Rs. 3 Lakh to cover expenses associated with any accident.	Death, permanent disablement, temporary total disability or any other medical expenses related to accident.
4	Pradhan Matri Suraksha Bima Yojana (PMSBY)	Eligibility – age group 18 to 70 years	Rs. 12/- per annum	**Accidental** death and permanent disability: (i) Permanent total disability – Rs. 2 lakhs. (ii) Permanent partial disability – Rs. 1 Lakh.	
5	Pradhan Mantri Jeevan Jyoti Bima Yojana(PMJJB)	Eligibility – age group 18 to 50 years. (can continue upto 55 years)	Rs. 330/- per annum.	Risk coverage – Rs. 2 Lakhs- in case of **death due to any reason**	

SECTION VI- INDEX

UREA HANDLING & BAGGING PACKAGE

[UREA (NEEM OIL COATED) HANDLING SYSTEM, BULK SILO AND BAGGING SYSTEM INCLUDING FILLED BAGS STACKING/ LOADING TO WAGON & TRUCK]

PLANT: AMMONIA-UREA PLANT BASED ON COAL GASIFICATION

PROJECT: INTEGRATED ROM BASED FERTILISER COMPLEX AT TALCHER, ANGUL DISTRICT, ODISHA (INDIA)

NIT NO. : PNMM/PC-183/E- 4010/NCB

CONTENTS

SECTION VI- 1.0

PROJECT DESCRIPTION

UREA HANDLING & BAGGING PACKAGE

[UREA (NEEM OIL COATED) HANDLING SYSTEM, BULK SILO AND BAGGING SYSTEM INCLUDING FILLED BAGS STACKING/ LOADING TO WAGON & TRUCK]

PLANT: AMMONIA-UREA PLANT BASED ON COAL GASIFICATION

PROJECT: INTEGRATED ROM BASED FERTILISER COMPLEX AT TALCHER, ANGUL DISTRICT, ODISHA (INDIA)

CONTENTS

LIST OF ATTACHMENTS

Sl. No.	Description	Drg./Document No.
1.0	Overall Plot Plan	17125-331000-PL15
2.0	Flow Diagram- Product Handling system	PC183-1300-0020
3.0	Layout for Product Urea Handling System	PC183-1311-0001
4.0	Proposed Scheme for Product Urea Silo & Screen House	PC183-1311-0002
5.0	Proposed Scheme for Urea bagging Plant	PC183-1312-0001

1.0 INTRODUCTION:

Talcher Fertilizers Ltd. (TFL), herein after also referred to as "OWNER" A joint venture company of four major Public Sector Units – M/s GAIL (India) Limited (GAIL), M/s Rastriya Chemicals & Fertilizers Ltd. (RCF), M/s Coal India Ltd. (CIL) and M/s Fertilizers Corporation of India Ltd. (FCIL) has decided to build a world class based fertilizer complex. The fertilizer complex is to be built at Talcher, Angul District, Odisha (India) and will consist of Coal Gasification Plant, Ammonia Plant and Urea Plant along with Offsite and Utility Plants. Talcher Fertilizers Ltd., intend to invite quotations from eligible contractors on single point responsibility basis for Urea handling system, Bulk storage Silo and bagging system including filled bags stacking/ loading to wagon/truck etc.

Projects & Development India Ltd. (PDIL) has been retained by M/s Talcher Fertilizers Limited as Project Management Consultant for selection of a suitable LSTK Contractor for execution of the package as detailed in subsequence sections of this NIT on Single point responsibility basis.

Scope of work of the LSTK Contractor shall include Basic Engineering and Detailed Design/Engineering, Procurement, Supply, Fabrication, Inspection by Third Party Inspection Agency (TPI) as applicable, Route survey for ODCs, Insurance, Transportation of all equipment / materials to work site, Storage, construction and erection of all mechanical, electrical and instrumentation works, assembly and Installation, obtaining all necessary statutory approvals (as applicable), Testing, Mechanical Completion, Pre Commissioning, Commissioning, Performance Guarantee Test Run (PGTR) including Total Project Management and handing over of the plants and facilities under contractor scope of work duly completed on single point responsibility basis.

2.0 PLANT LOCATION:

The proposed project package will be located within the premises of existing closed coal based Ammonia-Urea complex of FCI Limited, Talcher Unit.

The total land area of the site is 933.60 acres out of which lease hold land from Government of Odisha is 923.27 acres and land purchased from private parties is 10.33 acres. The area is not falling under coal bearing zone up to a depth of 200-250 meter. FCIL had full-fledged fertilizer complex of Ammonia-Urea plants at this site which was in operation for over a period of 25 years and closed down since December 2002.

Talcher site is located at Vikrampur in Angul district of Odisha on the Cuttack –Sambalpur National Highway NH-42. NH-42 is passing at about 8 km from the site. The nearest railway station is Talcher at about 7 km from the site. Nearest airport, Bhubaneswar is 150 km, 3 hours journey by

road/ rail. Nearest port is Paradip, 200 km by rail/road. Talcher is situated at 21o 10" N Latitude and 82o 5" E Longitude.

3.0 PLANT/SYSTEM CAPACITY & CONFIGURATION:

The overall project would essentially consist of new Ammonia and Urea plants and related off-site and utility facilities.

The broad provision of plants and facilities envisaged for the LSTK contractor has been presented in following Tables:

Sl. No.	Plants & Facilities	Capacity	Remarks
1.	Urea Plant (Prilled)	Rated - 3850 MTPD Design- 4235 MTPD	By others
2.	Bulk Urea (Neem coated) Conveying (ET-1 & ET-2) / (ET-3 & ET-4) / (ET-5 & ET-6 series)	Rated - 161/ 180 / 280 TPH Design- 193/ 220/ 340 TPH	Variable
3.	Bag handling conveyors	Rated - 1000 bags/hr. Design- 1200 Bags/hr.	
4.	Bunker/Hopper in Bagging Plant	Approx. 60 MT each, Total – approx.480 MT	
5.	Bagging & Stitching Machine	Rated - 45 TPH / 1000 bags/hr. Design- 54 TPH / 1200 Bags/hr.	
6.	Wagon & Truck Loader	Rated - 45 TPH / 1000 bags/hr. Design- 54 TPH / 1200 Bags/hr.	
7.	Filled bag	45 Kg each	

4.0 DESIGN PARAMETERS:

4.1 Site Metrological Data (Talcher)

1.	**Atmospheric Pressure**	
	Maximum	1008.0mbar
	Minimum	984.1 mbar
2.	**Ambient Temperature**	
	Dry bulb (Summer)	46.3
	Dry bulb (Winter)	1.0
	Average Temperature	31.9

	wet bulb	32.0
	Max for Mechanical / Civil / Structural	35.0
	Minimum for winterization (Average)	18.7
3.	**Min. Design Air Temperature, unless otherwise mentioned in respective design specification**	
	For Mechanical Equipments	35 Degree Celsius
	For Electrical Equipment, Max/Min	50 Degree Celsius
4.	**Rainfall**	
	Annual rainfall	1329.00 mm
	Design rainfall (per hour)	116 mm
5.	**Wind Velocity**	
	Basic design Wind Velocity (Structures)	50m/sec
6.	**Relative Humidity**	
	Maximum	100%
7.	Seismic zone	III(Three)
8.	Elevation above mean sea level	It should be established in consultation with owner/consultant based.
9.	Site co-ordinates	N-23122910.151, E-308680.833

4.2 Urea Characteristic

Sl. No.	Parameters	Units	Value
1.	Particle shape	-	Prilled
2.	Particle size -	mm	
	Above 2.8	mm	5% wt. max.
	Between 1.4 to 2.8	mm	91.5% wt. min.
	Less than 1	mm	1.5% wt. max.
3.	Bulk Density	Kg/m3	650-700
4.	Angle of Repose	Degree	23^0

5.0 TIME SCHEDULE/ COMPLETION PERIOD:

5.1 Contractor/Bidder shall furnish programme in form of master network identifying main phases in various areas of total work like design, engineering, procurement of materials and bought out items, manufacture of equipment, delivery and field activities.

For the time schedule/ completion period required for design, engineering, manufacture, supply, transportation, erection and commissioning of Urea (Neem coated) Handling and Bagging package (Urea handling system, Bulk Silo and Bagging system including filled bags stacking/ loading to wagon & truck) with all related equipment & system contractor to refer to SCC (Special Conditions of Contract) section.

5.2 Master network shall be prepared in Primavera software, discussed and agreed upon. Engineering drawings and data submission schedule shall also be discussed and finalised before issue of letter of intent. Liquidated damages leviable for delays shall be effective from the dates mentioned above.

5.3 After award of contract, the contractor/bidder shall plan sequence of work of manufacture and erection to meet the plant commissioning dates given above and shall ensure that all work/manufacture, shop testing and shipment of equipment is in accordance with required construction/execution sequence.

5.4 Within fifteen days after award of letter of intent contractor/bidder shall submit for review and approval of detailed network schedules based on master network as mutually agreed upon, showing logic and duration of activities in following major areas: Detailed engineering, procurement, manufacture, shop inspection, testing, despatch/shipment and receipt at site.

SECTION VI- 2.0

SCOPE OF WORK

UREA HANDLING & BAGGING PACKAGE

[UREA (NEEM OIL COATED) HANDLING SYSTEM, BULK SILO AND BAGGING SYSTEM INCLUDING FILLED BAGS STACKING/ LOADING TO WAGON & TRUCK]

PLANT: AMMONIA-UREA PLANT BASED ON COAL GASIFICATION

PROJECT: INTEGRATED ROM BASED FERTILISER COMPLEX AT TALCHER, ANGUL DISTRICT, ODISHA (INDIA)

1.0 CONTRACTOR'S GENERAL SCOPE OF WORK:

i. Contractor's/Bidder's Scope of work shall include but not limited to the followings:-

a) Basic Engineering and Detailed Design/Engineering

b) Manufacturing of the complete system

c) Procurement, Fabrication & Supply of the complete system

d) Inspection by Third Party Inspection Agency (TPI) of the complete system from TUV/ BV/ Lloyds/ DNV

e) Packing & forwarding of each item of the complete system

f) Transportation of each item of all equipment / materials to work site

g) Unloading & storage at site of each item for complete system

h) Painting of complete system

i) Insurance of complete system

j) Construction and Erection of all Mechanical, Electrical and Instrumentation items/works of complete system

k) Assembly and Installation of each item for complete system

l) Obtaining all necessary statutory approvals (as applicable)

m) Testing of complete system

n) Mechanical Completion, Pre-Commissioning, Commissioning of complete system

o) Performance Guarantee Test Run (PGTR)

p) Guarantee of Complete system

q) Project Management and handing over of the plants and facilities under contractor's/bidder's scope of work duly completed on single point responsibility basis.

ii. The following plants and facilities, excluding civil works shall be under the scope of the Contractor/Bidder:

a) Urea (neem coated) handling system from transfer tower-2 to storage silo, from storage silo to bagging plant and filled bag stacking/ loading to wagon & truck.

b) Product Urea storage in silo, reclaiming from silo, screen & delump in screen house.

c) Product Urea bagging and filled bag stacking/ loading to wagon & truck system/facilities.

d) Neem oil separation system/facilities (Filters, urea solution tank, pumps etc) to recover/separate urea dust from neem oil near to prilling tower / any suitable location and

transfer the neem oil free urea solution to main urea solution tank (other's scope) near to prilling tower.

e) Dust extraction system (Wet & Dry type) at all appropriate location as mentioned.

f) Air Compressor & Piping required for service air at all appropriate location.

g) Road Weigh Bridges required for the plant including control system/facilities.

h) All Electrical items and systems required for Urea handling & bagging package as mentioned in Electrical specification.

i) All Instrumentation items and systems required for Urea handling & bagging package as mentioned in Instrumentation specification.

j) Required piping of all utility lines from battery limit to the required locations.

iii. Following raw material & utility piping lines shall be made available to the contractor/bidder at one point of battery limit (at the nearest point of mentioned block) of bagging plant building and transfer tower TT-2; further distribution to all the required locations (inside bagging building, platform area, conveyor gantry, all transfer towers, bulk urea silo, neem oil serapartin system area etc.) considering attached piping specification shall be under scope of contractor/bidder.

a) Drinking Water

b) Service Water

c) Instrument Air

d) DM water / Steam Condensate.

iv. For detail scope of works refer following respective section –

- Material Handling –PC183/E-4010/SEC VI/ 3.1.1
- Rotating equipment - PC183/E-4010/SEC VI/ 3.1.2
- Static equipment - PC183/E-4010/SEC VI/ 3.1.3
- Piping - PC183/E-4010/SEC VI/ 3.1.4
- Process - PC183/E-4010/SEC VI/ 3.2
- Electrical - PC183/E-4010/SEC VI/ 3.3
- Instrumentation - PC183/E-4010/SEC VI/ 3.4

Note:- Contractor has to visit the project site and collect the data of existing silo to envisage & develop actual layout of the system.

SECTION VI- 3.0

DESIGN SPECIFICATION/PHILOSOPHY

UREA HANDLING & BAGGING PACKAGE

[UREA (NEEM OIL COATED) HANDLING SYSTEM, BULK SILO AND BAGGING SYSTEM INCLUDING FILLED BAGS STACKING/ LOADING TO WAGON & TRUCK]

PLANT: AMMONIA-UREA PLANT BASED ON COAL GASIFICATION

PROJECT: INTEGRATED ROM BASED FERTILISER COMPLEX AT TALCHER, ANGUL DISTRICT, ODISHA (INDIA)

1.0 DESIGN PHILOSOPHY/SPECIFICATION:

Contractor/Bidder to follow Design specifications applicable for the scope as attached herewith –

i. DESIGN PHILOSOPHY/SPECIFICATION - MATERIAL HANDLING
ii. DESIGN PHILOSOPHY/SPECIFICATION - ROTATING EQUIPMENT
iii. DESIGN PHILOSOPHY/SPECIFICATION - STATIC EQUIPMENT
iv. DESIGN PHILOSOPHY/SPECIFICATION - PIPING
v. DESIGN PHILOSOPHY/SPECIFICATION - PROCESS
vi. DESIGN PHILOSOPHY/SPECIFICATION - ELECTRICAL
vii. DESIGN PHILOSOPHY/SPECIFICATION - INSTRUMENTATION

SECTION VI- 3.1.1

DESIGN SPECIFICATION- MATERIAL HANDLING

UREA HANDLING & BAGGING PACKAGE

[UREA (NEEM OIL COATED) HANDLING SYSTEM, BULK SILO AND BAGGING SYSTEM INCLUDING FILLED BAGS STACKING/ LOADING TO WAGON & TRUCK]

PLANT: AMMONIA-UREA PLANT BASED ON COAL GASIFICATION

PROJECT: INTEGRATED ROM BASED FERTILISER COMPLEX AT TALCHER, ANGUL DISTRICT, ODISHA (INDIA)

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LIST OF ATTACHMENTS

SL. NO.	DOCUMENT/DRG. NO.	DESCRIPTION
1.0	PC183-DD-1300- ET-XX-1	Combined Data Sheet of Bulk Urea Handling Conveyor
2.0	PC183-DD-1300- ET-XX-2	Combined Data Sheet of Bulk Urea Handling Conveyor
3.0	PC183-DD-1300- ET-XX-3	Combined Data Sheet of Bulk Urea Handling Conveyor
4.0	PC183-DD-1300- ET-PP	Combined Data Sheet of Bagged Urea Handling Conveyor
5.0	PC183-DD-1300- BM	Data Sheet of Bagging Machine
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10.0	PC183-DD-1300- DL	Data Sheet of Delumper

1.0 INTENT

This specification together with all enclosures cover the requirements for detailed design, engineering, manufacturing, inspection, testing, painting, supply, packing & forwarding, transportation to site, unloading & storage at site, erection/installation, assembly, trial run on no load, commissioning, smooth & trouble free operation and guarantee test run and acceptance of complete system including guarantee of complete Neem oil coated Urea Handling & Bagging package from transfer tower- 2 (TT-2) to Bagging Plant including bulk urea storage silo system, bagging system, filled bags loading / stacking with conveyors & all related equipments and dust extraction system along with supply of spares for commissioning and 2 years' operation on LSTK basis for M/S TFL at Talcher.

2.0 SCOPE OF WORK

The scope of work of Material handling system (Neem Oil coated Urea handling) shall consists of, but not limited to the following :-

a) Complete Urea (neem oil coated) handling system from Transfer Tower-2 (TT-2) to Silo system, Bagging plant and filled bag stacking/ loading to wagon & truck.
b) Product Urea storage system/facilities with the help of tripper conveyor.
c) Product Urea reclaiming with the help of Salt scraper type scraper reclaimer.
d) Product Urea screening & crushing/delumping system/facilities with the help of vibrating screen & de-lumper/ lump breaker.
e) Product Urea bagging (bagging & stitching machine) and filled bag stacking/ loading (wagon & truck loader) to wagon & truck system/facilities.
f) Neem oil separation system/facilities at mentioned location.
g) Dust extraction system at all appropriate location as mentioned.
h) Road Weigh Bridge required for the plant including control system/facilities.

Contractor/Bidder to follow below mentioned tender purpose drawings :-

i. PC183-1300-0020 - Flow Diagram- Product Handling system
ii. PC183-1311-0001 – Proposed Layout for Product Urea Handling System
iii. PC183-1311-0002 – Proposed scheme for Product Urea Silo & Screen House
iv. PC183-1312-0001 – Proposed scheme for Product Urea Bagging plant & Platform area

Bidder/Contractor to note that, complete system shall be suitable for handling Neem Oil coated Urea.

Layout of Conveyor gantry, Transfer towers, Silo & Screen House, Bagging plant etc, levels of conveyors/ height of transfer towers, screen house, size, capacity and number of equipment mentioned in tender documents/shown in the conceptual drawings / layout are minimum requirements and tentative. The same shall be adjusted accordingly by the Contractor/bidder during detail engineering to suit design as required to meet the bid requirement. All such changes pertaining to change in elevation, height, levels and any increase in capacity/ size/ number of equipment etc. shall implemented by the contractor without any cost and time implication to Owner/Consultant and with prior approval from Owner/Consultant.

In this regard, contractor has to visit the project site and collect the data of existing silo to envisage & develop actual layout of the system.

The data sheets and drawings indicate service requirements of proposed system and these shall be in no way relieve the bidder of his responsibility for providing equipment capable of meeting the required performance.

3.0 EXTENT OF SUPPLY

The extent of supply for complete urea handling system and bagging plant including filled bags loading stacking with conveyors & related equipments shall consist of, but not limited to the following :-

1. Conveyors system (ET-1; ET-2; ET-3; ET-4; ET-5; ET-6 series; ET-7 series; ET-8 series; ET-9 series; ET-10 series) including all relevant components/parts
2. Scraper Reclaimer of Salt Scraper type
3. Vibrating Screen
4. De-lumper / lump breaker
5. Bagging & Stitching m/cs
6. Wagon & truck loaders
7. Road weigh bridges
8. Air compressor
9. Bucket Elevator
10. Continuous belt weighers
11. Electric Hoists/ Chain pulley blocks
12. Bag Testing Machine
13. Neem oil separation system/arrangement
14. Dust Extraction system at required place including urea solution tank
15. All bunkers (approx. 60 MT capacity each) with load cells and ultrasonic level indicator, vibrators (electrically operated), motorised gate etc

16. All Chutes with motorised flap gate/ prism gate (with provision of manual operation) wherever applicable
17. All diverters (Electric operated, with provision of manual operation)
18. Check weigh m/cs
19. All Electrical Motors, MCC and various other related items & system etc. as per Electrical specifications.
20. All field & control room instrumentation including PLC/DCS, Control Desk, Monitors etc. as per Instrumentation specifications.
21. All technological structure of equipment. Contractor/ Bidder to note that, fixing of all equipments at floor shall be done with the help of Hilti chemical fasteners (Min. SS-304 grade), no pockets/insert plate shall be provided/considered in this regard.

Any other items/equipments not mentioned here, but required for the system, has to be mentioned & supplied by contractor/bidder. Completeness of the system is the responsibility of the contractor/bidder. If Contractor/Bidder feels that, hilti fixation is not technically suitable/proven for equipments like – Pumps, Fans, Vibrating screen, De-lumper, he has to take approval for the same from owner during detail engineering, but owner's decision shall be final in this regard.

4.0 EXTENT OF ERECTION & COMMISSIONING

Extent of Supply including erection & commissioning of Equipment shall consist of, but not limited to the following:-

1. Complete Conveyors system including all other relevant components/parts.
2. Scraper Reclaimer of Salt Scraper type
3. Vibrating Screen
4. De-lumper / lump breaker
5. Bagging & Stitching m/cs
6. Wagon & Truck loaders
7. Road weigh bridges
8. Air Compressor
9. Bucket Elevator
10. Continuous belt weighers
11. Electric Hoist
12. Bag Testing Machine/ Chain pulley blocks
13. Neem oil separation system/arrangement

14. Dust Extraction system at required place including urea solution tank
15. All bunkers (approx. 60 MT capacity each) with load cells and ultrasonic level indicator, vibrators (electrically operated), Electric operated gate etc
16. All Chutes with motorised flap gate/ prism gate (with provision of manual operation) wherever applicable.
17. All diverters (Electric operated, with provision of manual operation)
18. Check weigh m/cs
19. All Electrical Motors, MCC and various other related items & system as per Electrical specifications.
20. All field & control room instrumentation including PLC/DCS, Control Desk, Monitors etc as per Instrumentation specifications.
21. All technological structure of equipments.
22. Any other items required for the system.

However, supply, installation & commissioning of the equipment shall not be limited to the above only and the contractor/bidder have to provide all the equipment / items required to make the system complete for safe, satisfactory and smooth commissioning of the system & trouble-free operation including ease of maintenance.

5.0 EXCLUSIONS

Civil works of "Urea (neem oil coated) Handling & Bagging Package" as mentioned below shall not be under contractor's scope.

a) All Conveyor gantry & transfer tower buildings.
b) Bagging Plant Building & Platform.
c) Filled Bag Storage Sheds on Platform.
d) Foundation & cabin of Road weigh bridge.
e) Railway siding works.
f) Foundation for DE system.
g) Foundation & shed of Neem oil separation system.
h) Supply and Laying of Rail and Rail Fixing arrangement for Hoist/chain pulley block mono rail, Scraper, Wagon Loader and Truck Loaders.

However, proper layout/Mechanical G.A drawings of conveyors gantry, Transfer towers, Bagging building & platform, bulk urea storage Silo, screen house etc and specification with size of rail for each equipment with fixing detail & load data to be provided by bidder during detail engg. stage. Also, contractor to check/vet all Civil drgs. of Client/ Consultant

from Mechanical/Electrical/Instrumentation point of view.

6.0 DESIGN CODES & STANDARD

Conveyor System	"Conveyor Equipment Manufacturer's Association" (CEMA) or IS : 11592 latest edition
Conveyor Belting	IS : 1891 latest edition or equivalent / ISO
Flat Belt/Slat Conveyors	IS : 8597 latest edition or equivalent / ISO
Conveyor Pulleys	IS : 8531 latest edition or equivalent / ISO
Conveyor Idlers	IS : 8598 latest edition or equivalent / ISO
Conveyor safety	IS : 7155 latest edition or equivalent / ISO
Troughed Belt Conveyors	IS : 4776 latest edition or equivalent / ISO
Use & Selection of Bucket Elevator	IS : 7167 latest edition or equivalent / ISO
Code of practices for selection of belt feeder	IS : 12215 latest edition or equivalent / ISO
Belt conveyors - Travelling tripper - Motorised-for belt widths 650 mm to 1600 mm - Dimensions	IS : 14386 latest edition or equivalent / ISO
Vibrating Screen	IS : 12213 latest edition or equivalent / ISO
Dust Extraction system	ACGIH latest edition or equivalent /ISO

7.0 LIST OF MAJOR NOMENCLATURE

NOMENCLATURE	DESCRIPTION
TT	Transfer Tower
ET	Conveyor
BC	Bunker / Hopper
BE	Bucket Elevator
SS	Salt Scraper
VS	Vibrating Screen
DL	Delumper/ Lump Breaker

NOMENCLATURE	DESCRIPTION
BM	Bagging m/c
WL	Wagon Loader
TL	Truck Loader

8.0 DESCRIPTION OF THE SYSTEM

"Urea (neem oil coated) Handling & Bagging Package" shall be started from transfer tower TT-2 (after Urea plant's LSTK contractor scope, which is others scope) upto bagging plant including silo system, bagging & stitching machines, provision of stacking of filled bag on the platform, wagon & truck loading facilities and all related & necessary equipments with all accessories & auxiliaries. Integration with the incoming belt conveyor (others scope) near prilling tower shall be done by contractor/bidder. The system shall be designed in analytical/logical manner and the equipment shall be so designed & sized that the specified material through-put is achieved without belt overloading, material degradation or spillage.

From the discharge of incoming belt conveyor (others scope), on-spec product urea shall be transferred directly to bagging plant through series of conveyor systems with a provision to divert the product to bulk urea storage/ Silo.

There shall be proper product reclaiming system from silo. Reclaiming conveyor shall have the provision to feed the product either to conveyor system that goes to bagging plant or to feed the material to Vibrating feeder-Vibrating screen-De-lumper arrangement at screen house. Screened product shall be transferred to conveyor system that goes to bagging plant. Oversize product shall be recycled through de-lumper/lump breaker and undersize product shall be collected for transfer to dissolving tank at the bottom of prilling tower for recycle.

Within the bagging plant, there shall be proper distribution system to feed the product into the series of bunkers. Below each bunker there shall be dedicated semi-automatic weighing/bagging machine and bag stitching machine where product shall be filled into bags. Filled bags (3 nos. of streams) shall have the provision to distribute either to truck loading side or to Wagon loading side and filled bags shall only travel to wagon loading side for rest 5 nos. of streams. At the Wagon loading platform there shall be platform distribution conveyors, which shall cover the entire length of platform and feed the filled bag to the respective wagon loaders. Wagon loader shall have the facility to load the bags into standard wagons as well as to stack the filled bags on the platform. Wagon loading platform length and width shall be fixed in such a manner so that proper area for filled bag storage shall be created. At the Truck loading platform there shall be Truck loader which shall load the bags into standard trucks.

For the complete Product Handling system 2 years spares parts of all necessary equipments shall be considered for smooth & trouble free operation of the complete system.

Broad system description is mentioned hereunder –

i) Contractor's battery limit shall be started from connecting flanges at the discharge hood of conveyor MT-2 (other's scope). At the discharge of MT-2's head pulley (other's scope) at Transfer Tower TT-2, urea (neem coated) shall be received on either conveyor- ET-1 for silo storage or to conveyor ET-5 for transfer to bagging plant. Two way flap gate & discharge chute to feed conveyor ET-1 & ET-5 from/after the connecting flanges at the discharge hood of conveyor MT-2 (other's scope) shall be under this contractor's scope. Contractor/bidder to also consider Electrical & Instrumentation interlock including necessary cabling for interfacing with conveyor MT-2 (others scope).

ii) Conveyor ET-1 shall discharge urea to travelling tripper conveyor ET-2 at TT-3 for silo storing purpose.

iii) Conveyor cum travelling tripper ET-2 shall discharge product urea throughout the length/width of the storage silo.

iv) Scraper reclaimer (salt scraper type) shall reclaim product urea from storage silo & feed to the reclaiming conveyor ET-3. Reclaimer shall travel throughout the length of the silo to reclaim urea from anywhere inside the silo.

v) Reclaiming Conveyor ET-3 shall discharge urea to either vibrating screen at screen cum de-lumper house or to Conveyor ET-4 through two way chute with flapper Gate. Magnetic separator shall be provided at the screen-delumper house (TT-4) above conveyor ET-3 to separate any unwanted particle from silo reclaim product urea.

vi) At TT-4, vibrating screen shall separate oversize material and transfer the lump to de-lumper. From second deck/layer of screen, product shall be transferred to the conveyor ET-4 and dust shall be separated out.

vii) Conveyor ET-4 shall start from TT-4 and shall be upto TT-2. Conveyor ET-4 shall collect product from conveyor ET-3, de-lumper discharge and vibrating screen discharge as applicable.

viii) Conveyor ET-5 shall start from TT-2 and shall be upto Bagging plant. Conveyor ET-5 shall collect product from conveyor MT-2 (other's scope) and conveyor ET-4. Prism Gate/ Flow

diverter to be considered at the discharge of conveyor ET-5 to feed both the conveyors series ET-6a & ET-6b simultaneously.

ix) Inside bagging plant, different conveyor series shall be there to transfer and distribute urea to 8 nos. of storage bunkers/hoppers with the help of fixed chute & flapper gate/prism gate wherever required.

x) Each Bunker (BC-1 to BC-8) shall have one/two spouts, where each Bagging Machine shall be connected for discharging of measured quantity of 45kg Urea. Total 8 sets/numbers of Semi-automatic Bagging & Stitching machine shall be installed in the Bagging Plant.
Discharged Urea from spouts of each Bunker shall be received by Bagging Machine & shall be discharged in empty bags on Slat/flat Conveyor which shall be further moved to near Bag Stitching Machines installed by the side of slat/flat conveyor at both ends or single end of Pulley where filled bags shall be Stitched.
Bagging (Slat) Conveyors (3 nos. as marked in layout drg.) shall have reversible drive which can move both side for further discharge of filled bag onto truck loading purpose or wagon loading purpose as per the requirement with the help of Conveyors, Bags Diverter and Spiral Chutes etc. Other Bagging (Slat) Conveyors (5 nos. as marked in layout drg.) shall have normal irreversible drive which shall transfer filled bag onto wagon loading purpose with the help of Conveyors, Bags Diverter and Spiral Chutes. Thus, total 8 Nos. of Bagging (Slat/flat) Conveyors shall be there.

xi) 3 Nos of Bagging/Slat Conveyors shall discharge the filled bags either directly on the platform, just below the bagging area through spiral chutes for truck loading or discharge the filled bags on the next conveyor series for wagon loading/ platform stacking purpose. Rest 5 nos. of Bagging/Slat Conveyors shall discharge the filled bags directly on the next conveyor series for wagon loading/ platform stacking purpose.

xii) Filled bags shall be distributed throughout the platform with the help of series of Belt conveyors & wagon loaders. Whenever wagon is available, filled bags shall be directly loaded to wagon with the help of wagon loader; otherwise filled bags shall be stacked on platform.

xiii) Each Transfer Tower (TT) & storage silo shall be provided with travelling chain pulley blocks (for each applicable floor) of adequate capacity (min. 2 Te capacity each) to lift heaviest part for maintenance purposes.
Within Bagging Plant, travelling chain pulley block of adequate capacity (min. 2 Te capacity each) to lift heaviest part shall be provided at all required places e.g- beneath the 135.800 m

level, 132.300 m level, 128.800 m level, 125.300 m level, 111.800 m level, 108.300 m level, for Pumps, Fans etc for maintenance purpose.

In addition to above, Electric Hoist of adequate capacity (3 nos and 3 Te each) shall be provided beneath the 115.300 m level at empty bag storage area to carry empty bags at Bagging floor within Bagging Plant.

xiv) Wet type Dust extraction system shall be provided at Bagging Plant for all suction points.

Transfer Tower-2 (TT-2) and Transfer Tower-3 & Transfer Tower-4 shall be provided with Dry type (Bag filter type) dust extraction system.

All dust generating points / All discharge & receiving points of conveyors & other machineries shall be connected to duct hood which shall create suction / negative pressure for collection of dust with the help of blower/fan and dust shall be collected in wet scrubber or in Bag filter. Contractor/bidder to consider neem coated urea dust dissolving system including tank.

xv) Total 62 nos. Industrial re-circulating fans (8 nos of bagging floor and 54 nos in platform area) to be provided.

xvi) Instruments / Electrical interlock system (logic control for tripping & restart of the system) to be considered & provided by contractor/bidder.

xvii) Minimum Flow path/ assumed continuous running equipment to arrive guaranteed power consumptions shall be considered as follows:-

Conveyor ET-1, ET-2, ET-3, ET-4, ET-5, ET-6a1, ET-6a2, ET-6b1, ET-6b2, Salt scraper, vibrating screen, delumper/crusher, Bagging m/c and stitching machine including slat/flat conveyor (6 nos.)- BM-2, BM-3, BM-4, BM-5, BM-6, BM-7, Bucket Elevator(BE), Conveyor ET-7a2, ET-7a3, ET-7a4, ET-7b2, ET-7b3, ET-7b4, ET-8a1 series, ET-8a2, ET-8b1 series, ET-8b2, ET-9a1, ET-9a2, ET-9b1, ET-9b2, ET-10a1, ET-10a2, ET-10a3, ET-10b1, ET-10b2, ET-10b3, Wagon Loaders (6 nos.)- WL-1, WL-2, WL-3, WL-4, WL-5, WL-6, De-dusting systems (Wet & dry type both) at all transfer towers & Bagging plant, Air compressor, Neem Oil removing/separating system.

9.0 DESIGN REQUIREMENTS

9.1 The equipment and the system shall be generally designed to suit the following :

9.1.1 Proposed Layout for Product Urea Handling System drg. - PC183-1311-0001

9.1.2 Proposed Scheme for Product Urea Bagging Plant & Platform area drg.- PC183-1312-0001

9.1.3 Proposed Scheme for Urea storage Silo & Screen-cum-delumper house area drg.- PC183-1311-0002

9.1.4 Data sheets of all the equipments. Equipments for which data sheets are not provided; those shall be provided by contractor/bidder.

9.2 Related specifications, standards and codes referred to in this Technical Specification / drawings shall be of the latest issue including all addenda and supplements there to.

9.3 Enclosed drawings/data sheets indicate only the concept of the complete system as envisaged by Owner/consultant. It will be the sole responsibility of the Contractor/Bidder to supply the suitable equipment and ensure that the system is complete and adequate for the specified requirement.

If anything extra is required to complete system, the same shall have to be provided by the contractor/bidder.
The Contractor/Bidder is advised to spell-out clearly in their offer regarding any such additional equipment required. No extra claim shall be entertained after placement of LOI / P.O.

9.4 One filled bags transfer chute shall be first fabricated and installed at site. After its satisfactory operation / performance, balance chutes shall be fabricated and installed.

The filled bags transfer chutes shall be tried for:

I) HDPE bags, filled with 45 kg urea.
II) PP bags, filled with 45 kg urea.

The size of empty bags - approx. 900 mm x 500mm (stitched width)

9.5 Minimum 1.0 mm corrosion allowance shall be considered in the designing the structural supports of the mechanical equipment.

9.6 The contractor/bidder shall provide adequate facilities for carrying out maintenance of the system/individual equipment, its accessories etc. This would include provision of adequate handling equipment, working space, platforms, access ladders, stair cases and safety devices.

9.7 All equipments should be capable to start / run on full loaded condition with material. Complete system should be smooth & trouble-free operational.

9.8 MOC of all equipments/parts in contact with urea shall be of min. SS-304.

10.0 DETAILS OF EQUIPMENT

10.1 CONVEYORS SYSTEM INCLUDING RELATED ITEMS

10.1.1 Conveyors System

i) All Conveyors shall include structural supports, all drives, pulleys, idlers, belting, skirt boards, emergency switches, protective devices, take-up etc.

The belt conveyors shall be complete with but not limited to the following:

Belting
Drives along with base frame
Pulleys
Bearings
Belt take-up
Idlers
All chutes (SS 304 material only)
Belt cleaner, both external (primary & secondary) as well as internal
Conveyor props (Short Support)
Conveyor Stringers
Decking plate
Safety guards
Belt sway switches, Pull Cord Switches, zero speed switches, gravity take-up switches etc.
All required Electrical & Instrumentation system.

ii) All conveyors outside buildings shall be in enclosed galleries having main walk-way of min.1050 mm clear width on one side and min. 750 mm clear width on other side of conveyors.

iii) All conveyors' Gantry which crosses plant access roads should have a minimum head-room of 12 metres wherever possible, in other case head-room shall not be less than 10 metres. Adequate stairs, walk-ways, platforms and hand rails shall be provided on all handling equipment for ease in access and maintenance.

iv) The belt speed shall be optimum so as to minimise material degradation, spillage and generation of dust. Conveyor Belt speed shall not generally exceed 1.0 m/sec., however if needed it may exceed 1.0 m/sec, but speed to be limited to as less as possible.

v) All conveyors shall be equipped with stainless steel (SS-304) deck plate (4 m length at receiving end and 2m length at discharge end) for all conveyors (except bag handling conveyors), to be installed under the belt and should not be in contact with the carrying belt at any diverting point.

vi) The conveyors receiving Urea from another conveyor shall be horizontal at those transfer point as far as possible.

vii) Conveyor inclination shall be generally limited to 12^0 with horizontal. In special conditions, if required, it may be limited to 13^0 with horizontal.

viii) Bulk Urea shall be handled in troughed belt (30^0 troughed) and bagged urea in the flat belt conveyors.

ix) All inclined conveyor shall be equipped with hold back to prevent reverse run of the belt under load.

x) The skirt boards and sealing with overlapping block design shall be provided.

xi) All the conveyors shall be provided with identical designed frame size, roller size, pulley size etc. as far as possible to have better interchangeability and reducing the inventory.

xii) All conveyors' belts shall be fitted with multi-blade sprung type external belt scraper/cleaner (both primary & secondary) with SS tip below head pulley and V-type internal belt scraper. All cleaning including urea lumps from the belt shall fall within the head chute

xiii) All supporting technological structure / frames for supporting equipments (battery limit: from the floor or ceiling of buildings and galleries or from ground).
All nuts, bolts, fasteners, gaskets, required flanges, washers etc. shall be of minimum SS-304 grade material and required to guarantee good and safe operation at the guaranteed capacity.
All fixing shall be done by chemical fasteners of Hilti (Min. SS-304 grade) – no pockets /insert plate to be provided.

xiv) All Conveyors shall be provided with hooters before start & stoppage of the conveyor.

xv) The bulk conveyor system should run with ZERO spillage of urea.

xvi) The arrangement of the bag handling conveyor shall be of "in line" type & the distance between conveyors shall be as minimum as possible. Rollers, preferably rubber lagged shall be installed in the free space between end pulleys in order to allow a proper transfer of the bags from one conveyor to the other conveyor.

xvii) Within bagging plant & platform area, vertical gravity take-up shall not be considered and only screw type/ loop type take-up shall be acceptable for conveyors belt. For this if required, bidder have to split conveyors in platform area.

xviii) Discharging chutes (with smooth transition surfaces) of bag handling conveyors shall be designed in order to allow a proper and smooth transfer of filled bags from one flat belt conveyor to other flat belt / loading platform / portable conveyor.

xix) For bulk handling conveyors, top of belt shall be considered as min. 1200mm from floor level for belt width of 1200mm & min. 1000mm from floor level for belt width of 1000mm, unless otherwise any layout issue occurs and for bag handling conveyors (flat belt) top of belt shall be considered as min. 800mm from floor level unless otherwise any layout issue occurs. Accordingly, Conveyors short support shall be considered. This is the minimum requirement and contractor/bidder to design as per calculation & standard.

xx) The conveyors shall be suitable for 24 hours continuous running/duty.

xxi) Material of construction of all the items required for the system and in contact with urea shall be of min. SS-304.

10.1.2 Capacity

The handling capacities of all proposed conveyors have been mentioned in the conveyor Specification/data sheets. Conveyor capacity [Rated 161 TPH & Design 193 TPH upto silo storage (Conveyor ET-1 & ET-2), Rated 180 TPH & Design 220 TPH from silo reclaim to Transfer Tower-2 (TT-2) (Conveyor ET-3 & ET-4), Rated 280 TPH & Design 340 TPH from TT-2 to bagging plant upto bunker distribution (Conveyor ET-5 & ET-6 series)] shall be such that it shall be adequate to handle the material/product coming from prilling tower to bagging plant. Required conveyors shall be provided with variable feed drive to adjust the capacity. These may be changed by bidder to suit the design requirements with specific approval from Owner/Consultant.

Design capacity shall be considered as min. 20% more than the rated capacity.

10.1.3 Belting

All belting shall be of Nylon x Nylon of adequate strength, free of longitudinal & transverse buckling, wavy coard or any other unevenness that cause localized points of flexing when belt

is in service. Factor of Safety shall be taken as 10. Width tolerances shall not exceed 1%. All plies shall be mildew inhibited. Belting with repaired carcass, brow-ups shall not be acceptable. All belting constructions will be standardized as far as practically possible. The belt construction will be of nylon/nylon carcass with rubber covers anti-abrasive type. Heat & Oil resistant belts (OHR grade) for handling product like Neem coated urea shall be considered for bulk urea handling. Other bulk handling belt, if any shall be of HR grade. Temperature of HR OHR grade (upto 100 degree C of product) shall be considered. For bag handling conveyor M24 grade belt shall be used. Unless other-wise specified, belt splices shall be field Hot vulcanized and the belt shall include sufficient length for the splice. The belting shall be tested as per IS: 1891.

10.1.4 Drives

a) The Conveyor drive shall be directly coupled through helical gear box. Uniform type gear box units should be provided for all similar conveyors.

b) All the drives shall preferably be consisting of electric motor, gear box, coupling, shaft and terminal board.

c) Cast steel or Welded steel housing shall be considered for gear box.

d) Input coupling shall be considered as Pin & Bush type for Conveyor Motor rating up to 30Kw & for more than 30Kw motor, fluid coupling shall be used for all conveyors. For output coupling gear/resilient coupling shall be considered.

e) Service factors for all mechanical power transmission equipment/ gear box shall be 1.5 to 1.6 of the absorbed power.

f) Minimum service factor for flexible coupling shall be taken as 2.0 on the absorbed power.

10.1.5 Pulleys and Shafts

a) All pulleys and shafts are to be designed for worst conveyor loading conditions and should be standardized as far as practically possible.

b) Pulleys shall be of welded steel construction, statically balanced, stress relieved after welding before machining, continuous rim, two end disc type. Pulleys shall be balanced and concentric about the shafts.

c) All head/drive pulleys shall be lagged in herring-bone/diamond pattern. Head/Drive pulleys shall be lagged with min. 12 mm thk. Neoprene. The hardness of the lagging shall be 65 to 70 shores "A" scale

d) All Tail & rest of pulleys shall have min. 10 mm thick smooth plain neoprene lagging with a hardness of 60 to 65 shores "A" scale.

e) Pulley faces shall be at least 200 mm greater than belt width for bulk handling and 150 mm greater than belt width for bag handling.

f) Shaft deflection shall be limited to 0.066% of bearing centres. All shafts shall be provided with accurately machined key seats.

g) Shaft ends shall be flush with bearings edge, unless the extension is required for mounting components.

h) Shell thickness of the pulley drums shall be suitable for taking bending load on the drums. This will not be less than 16 mm for drive & discharge drums, 12 mm for tail pulleys and 10 mm for other pulleys.

i) Minimum shaft diameters at bearing shall be 50 mm for all conveyor pulleys. Shaft diameter calculations should be submitted to Owner/ Consultant for their approval before manufacturing.

10.1.6 Idlers

a) All idlers- carrying, return, impact idlers/rollers shall be of ERW tubes construction unless otherwise specified. Idlers shall be permanently lubricated & sealed for life. Seize resistant type anti-friction bearings and dust proof seals shall be used on all idlers, selected for life of 40,000 hours minimum.

b) Carrying idlers of bulk handling conveyors shall be of neoprene lagged type (min.6 mm thk.) in plain pattern. Carrying idlers of bag handling conveyors shall be of non-lagged type. Impact idlers of all conveyors shall be of rubber lagged type (min. 25 mm thk.). Vertical guide rollers of all conveyors shall be of rubber lagged type (min.6 mm thk.).

c) Transition idlers, preferably rubber lagged shall be provided for bag transfer between in line conveyors.

d) Self-aligning (training) idler spacing to be considered as – max. 15m for carrying side & max. 30m for return side.

e) Idler face width shall be considered as per standard. However, idler face width of bag handling conveyor that transfers bag to wagon loader shall be selected in such a way that filled bags shall smoothly transfer to wagon loader receiving chute.

f) Troughing idler shall be with grease packed sealed deep groove anti-seize type ball bearings. Idler bearings shall be provided with multi-labyrinth seals. Troughing angle of 30^0 shall be used for bulk urea handling.

g) Impact idlers (minimum 5 nos.) shall be provided at loading points at spacing of max. 300 mm.

10.1.7 Bearings and Pillow Blocks

a) All bearings shall be of seize resistance type, normally double spherical, ball or roller and shall have a minimum life rating of 40,000 hours under the total loads imposed.

b) All bearing, to be used in equipments/assemblies shall be fitted in Plummer block. Cast steel construction shall be considered for Plummer block.

c) All pillow blocks shall be fully self-aligning with one fixed end and one expansion type for each shaft assembly. They shall include enclosures caps where non drive shafts terminate at bearings.

Grease seals shall be triple labyrinth type to effectively exclude micron size dust, dirt.

10.1.8 Belt Tensioning device (Take-Ups)

All belt take-up (Gravity, Screw, loop type) shall be properly designed with functional & maintenance approach. Screw take ups shall be heavy-duty protected screw type. The amount of travel for take ups shall be based on belt manufacturer's recommendations but shall not be less than 2% of pulley centres.

Counter weight material for gravity take-up shall be considered as C.I.

10.1.9 Bulk Transfer Chutes

a) Chutes transferring Urea from one conveyor to another shall be designed in such a way that material fall height is minimum and the change in direction is achieved as smoothly as possible.

b) All transfer chutes shall be provided with Stainless Steel (SS304) material of construction of min. 6mm thick adequately stiffened.

c) Chutes shall be closed type. Inspection holes/window with covers shall be provided at all convenient locations.

d) Speed of the material falling on conveyor belt in the direction of belt travel should be almost the same as that of the conveyor.

e) The valley angle of chutes shall be 55^0 as far as possible but in no case less than 50^0.

f) Discharging chutes of conveyors shall be designed in order to allow a proper and smooth flow of material from one belt conveyor to the other belt conveyor / other item. Excessive direct fall of material to be avoided.

g) Flap gate in chute shall be provided at desired location as mentioned. Flap gate shall be of SS304 material with minimum thickness of 8mm.

10.1.10 Bag Chutes

Bag handling chutes shall be made from stainless steel (SS304) plate of min. 6mm thick adequately stiffened. Speed arrestor system/roller chain shall be provided at necessary locations.

10.1.11 Bag diverters

Bag diverters for diverting or discharging filled bags from one belt conveyor to another belt conveyor in bagging plant shall be used. Filled bags shall be diverted to respective areas by bag diverter to meet the requirements shown in layout drg.

10.1.12 Bunkers/Hoppers

a) The bunkers/hoppers shall be of round shape and fabricated from carbon steel plates (min. 12 mm thk.) conforming to IS: 2062 or equivalent / ISO and shall be lined with mirror finished SS 304 liner of adequate thickness from inside (min. 4 mm) not only on bottom conical portion but also on vertical portion for free flow of material.

b) The capacity of each bunker shall be approx. 60 MT. Total 8 nos. of bunkers are there.

c) Bunkers/Hoppers shall be provided with load cells and ultrasonic level indicator, vibrators (electrically operated), motorised gate, poking hole etc.

d) Bunkers/Hoppers shall be supported/provided with load cells and ultrasonic level indicator, vibrators (electrically operated) etc. The filling of bunkers should be automatic on selective basis.

The angle of conical portion of bunkers / hoppers shall be kept as min. 55^0 with the horizontal.

10.1.13 DE-Dusting system

Contractor/Bidder to consider following Dust Extraction system :-

a) One Wet De system for complete Bagging Plant.
b) Two Dry type De systems at Transfer tower TT-2 and at transfer tower TT-3 & TT-4.

a) Wet type Dust extraction system shall be provided for extracting / collecting dust from bagging building/plant (All discharge/receiving points of conveyor system, Bagging machines including net weigher, bunkers & other dust generating sources).

Suitable neem coated dust dissolving system (Venturi scrubber) shall also be provided within bagging plant. Dissolving tank of adequate capacity shall be provided to collect off spec urea/urea lump & urea dust from all dusting generating sources and then neem oil mixed urea solution shall be sent through pumping from bagging plant to urea solution tank(others scope) at the bottom of / near to prilling tower for reprocessing after neem oil removal at neem oil removing/separating system near to prilling tower.

Wet type dust extraction system shall include but not limited to following- hoods, ducting/piping (size shall be considered as per calculation but min. 4mm thk), centrifugal fans/blowers, Scrubber unit, Urea solution tank, pumps, motors etc.

Rotating equipments of Wet De system – Fans, Pumps shall be considered as one working + one standby.

b) Dry type dust extraction system (Bag Filter type) shall be provided at above mentioned Transfer Towers.

Dry type dust extraction system shall include but not limited to following- hoods, ducting/piping (size shall be considered as per calculation but min. 4mm thk), centrifugal fans/blowers, bag house, bag filter, rotary valve, motors etc.

c) MOC of all the Dust Extraction system/equipment shall be of appropriate grade for handling urea. All liquid urea handling parts (venturi scrubber, pipings, valves, tanks etc.) shall be of SS-316L and dry urea handling parts (hoods/dedusting piping, fan/blower, Bag filter house etc) shall be of min. SS-304. Thickness of scrubber & Bag filter house body shall be considered as per calculation but min. 6 mm thk.to be considered.

Emission level shall be less than 50 mg/Nm^3 / applicable statutory norms.

10.1.14 Access to Machinery

a) Special attention shall be given in providing adequate access to all machinery for safe operation / maintenance and cleaning purpose.

b) Gravity take-up shall be provided with the platform and access ladder for maintenance.

c) Provision shall be made for lifting out and replacing equipments such as motors, gearboxes, conveyor pulleys, idlers parts and other heavy machinery in the Transfer Tower and bagging building with the help of electric hoist/ travelling chain pulley block. Capacity of the hoist/chain pulley block would be based on the weight of the heaviest part to be lifted.

d) Electric Hoist shall be provided for lifting of empty bag bales from ground floor to bagging floor and storing to empty bag storage area.

10.1.15 Safety Guards

Safety guards shall be provided for operating equipment. Guards shall completely enclose moving parts so that physical contact with the moving parts can not be made with the guard in place. Guards shall be constructed of steel wire net casing. Design and construction of guards shall permit easy removal and shall be of the hinged type.

10.1.16 Extent of Shop Assembly

The structural elements shall be despatched loose to be bolted in field. Head, tail and take-up frames shall be fully shop assembled, in order to check the correct manufacture and shall be shipped in partially assembled elements in order to reduce the shipping volume. Pulley shall be despatched complete with bearings and pillow blocks.

10.1.17 Other Design Factor

a) Belt conveyors shall be able to operate continuously for 24 hours/day throughout the year

at the service requirements.

b) Belt conveyors with associated steel works design shall conform to the relevant Codes and Standards. Conveyor drives shall be designed for adequate start/stop operations and start with full load.

c) The following noise limit shall be considered - 85 dBA max. (At 1 meter distance from the emitting noise source)

d) Conveyors shall be designed in order to avoid accidents to operators and maintenance personnel.

e) Conveyors shall be designed in order to avoid any bags damaging and urea spillage.

f) Environment regulation shall be followed for stack emission and stack height etc.

g) The following status (minimum) shall be signalled to the bagging plant control room: -
- start/stop of the motors
- pull cord switches actuated
- zero speed switches actuated
- Neem coating system signal, etc.

Electrical & Instrumentation Design Philosophy shall be followed for the same.

10.2 BULK UREA STORAGE SILO SYSTEM (EXISTING REFURBISHED RCC SILO)

10.2.1 Design features

For storage of bulk urea, bidder to use existing refurbished RCC silo of “parabolic” type of approx. size 192m x 37m.

a) Bulk urea silo shall be fed by storing conveyor with travelling tripper unit and material from silo shall be reclaimed with the help of salt scraper unit. Salt scraper type scraper reclaimer has been considered to maximize the storage capacity of bulk silo, accordingly bidder to select/design the scraper system in such a manner that, maximum storage capacity in silo can be achieved. Bidder to furnish silo layout including silo storage capacity for client’s approval.

b) The stacking of the urea in the bulk store shall be carried out in such a way that the creation of dust and degradation of the material is minimized. The height of the urea store pile shall be limited to 13 meters so as to minimize crushing of product.

c) Material of construction of all the items required for the system and in contact with urea shall be of min. SS-304.

10.2.2 Travelling Tripper conveyor unit

a) Rail mounted movable/travelling Tripper shall be provided on the storing conveyor to store Urea at desired location in Urea silo.

b) Tripper conveyor shall be suitable to operate at any desired position within the range of travel with positive arrangement to ensure locking/stoppage of travel at particular location.

c) Adequate & safe means for locking the tripper conveyor to the rails in a stationary position shall be provided.

d) Heavy duty end stopper/buffer shall be provided on travelling tripper conveyor to arrest the movement at the extreme points.

10.2.3 Salt Scraper

a) Adequate reclaiming of urea from the urea storage Silo shall be done with the help of suitable salt scraper.

b) Rated capacity/ operating range of salt scraper shall be approx. 120-180 TPH and design capacity shall be min. 200 TPH. Scraper shall be designed in such a manner that, rated capacity shall be varied from 120-180 TPH.

c) Salt Scraper shall feed the material to reclaiming conveyor installed at the edge of the silo at elevation.

d) Salt Scraper shall be of robust & compact design to withstand heavy shock loads.

e) Salt Scraper shall be provided with delumper if applicable.

f) All parts shall be conveniently arranged for ease of access with special attention being paid to the requirements for maintenance of the various parts/machinery. Adequate walkways, ladders, etc are to be provided for convenient approach for operation & maintenance.

g) The Salt Scraper shall be preferably operated by three (3) types of modes – auto operation, manual operation & local (maintenance) operation. Each operation mode shall be performed by methods of selector switch. The operation of Salt Scraper shall be controlled by common

PLC of the system and shall have provision to operate on automatic as well as manual override mode.

h) Salt Scraper shall be equipped with hard & software to enable a reclaiming procedure from all side of the stockpile. The reclaimer will travel the full length of the bulk storage stockpile on rails.

i) The Salt Scraper shall be operated from operator's cabin. The operator cabin shall consists of necessary electrical panels & facilities, operator console desk with chair, air conditioning facility of enough capacity & dust filter to ensure proper working conditions to the personnel, lighting facility, wipers for front glass etc.

j) Independent drive system should be there for bucket elevator and boom driver.

k) The Salt Scraper shall be stable during the operations & shall be able to reclaim the material from both ends urea heap.

l) All structures & mechanisms shall be designed to bear the dynamic load, static load, horizontal load & impact load. Besides the calculation for strength, rigidity and fatigue, the calculation for the whole and partial stability shall be performed by the contractor/bidder.

m) A hooter with led light shall be provided which shall be blown prior to starting operation of the equipment.

n) Heavy duty end stopper/buffer shall be provided on scraper to arrest the movement at the extreme points.

o) In case of any malfunctioning at any drive unit when moving the Salt Scraper, the following shall be effected automatically – Acoustic signalling by means of a bell or horn and lighting up malfunction signal lamp for respective drive unit on the panel in the cabin.

p) Adequate safety system to be provided to avoid derailment of the Salt Scraper.

q) MOC of all parts & components of Salt Scraper shall be suitable for urea (neem oil coated) application.

r) Bidder to submit MoU(s) with the Salt Scrapper supplier for supply of spares for the system alongwith their Bids. The MoU shall cover provisions for "Supply & Service of Spare Parts for a minimum period of 5 (five) years" from the date of PAC with standard engineering drawings for all major spares/components.

10.2.4 Inline Magnetic/Metal Separator

a) Inline magnetic/metal separator (suspended/hanging type) shall be provided inside the screen-cum-delumper house (TT-4) for continuous and automatic extraction & discharge of

tramp magnetic pieces from urea being reclaimed from silo with the help of reclaiming conveyor (ET-3). The sets shall be complete in all respects with drives, magnets, hoppers, chutes, tramp-iron boxes, access ladders, handrails and all electrical ancillaries like control panels etc.

b) The equipment shall have sufficient capacity to lift pieces of:

- Iron pieces of weight up to a maximum of 25 kg, with an operating height of min. 400mm, from the bottom of the maximum burden depth of material being conveyed by the conveyor.
- MS/SS cube of 20mm size
- Reclaimer plate
- MS/SS nuts and bolts

c) In general the equipment shall have all necessary technical features for its efficient and successful operation. It shall be complete with all accessories and facilities including, magnet coil, rectifier set, control panel along with supporting chain and power supply system. The equipment shall be self-cleaning type. A suitable arrangement shall be made to discharge the trapped iron pieces.

d) Magnetic core material shall be pure annealed iron or equivalent high permeability magnetic material. The coil shall be of aluminum wire class-H insulation, to limit the absolute temperature of the winding to 140º C.

e) The cross section of magnet shall be suitably designed to provide sufficient area for magnetizing the coil effectively covering full cross section of the material. The in-line magnetic separator shall be located such that it picks up tramp iron from urea on the belt.

f) ON/ OFF control push button with indicating lamps shall be provided at the local station.

g) Suitable arrangement shall be provided in the magnet for keeping the coil of the magnet dry from atmospheric condensation when the magnetic separator is not in use.

h) The design of the electromagnetic separator shall be such that tramp metal pieces do not fall back onto the material stream being conveyed. Contractor shall note that the electromagnetic separator shall be energized once the belt conveyor starts at no-load and will remain so continuously till power to the conveyor is cut-off.

i) The portion of the conveyor & technological structure coming in the field of the electromagnet shall be made of non-magnetic material.

10.3 SCREEN & DE-LUMPER/LUMP BREAKER HOUSE SYSTEM

10.3.1 Design features

a) If reclaimed urea is having agglomerate/lump, then it shall pass through vibrating screen & delumper. If reclaimed urea is free from any lump/agglomerate, it shall follow the bypass route to bagging section.

b) Urea screening facility with feeder, vibrating screen and de-lumper/lump breaker shall be provided in order to break lumps and separate fines from the silo reclaiming conveyor. On-spec urea shall be sent to the bagging area and off-spec fines shall be recycled.

c) Urea shall be transferred by reclaiming belt conveyors from urea silo to the screening area. The location of the de-lumper/lump breaker & screening area shall be as close as possible or contiguous to urea silo.

d) Lump size (produced inside silo) considered to be handled as approx. 300 mm.

10.3.2 Vibrating Screen

a) Rated Capacity of Vibrating screen shall approx. 180 TPH and design capacity shall be min. 200 TPH. Efficiency of screen shall be minimum 98%.

b) Preferably Vibrating screen shall be double deck linear motion type. However, bidder to mention the suitable type of screen for mentioned application in the bid.

c) Screens shall be designed for the duty specified and shall be capable of performing at optimum efficiency continuously without blinding.

d) The complete vibrating unit shall be of enclosed type to preclude any ingress of dust. Screens shall be provided with suitable inspection openings with covers to facilitate inspection of the screen during operation

e) The supporting arrangement shall be designed to minimize the transmission of vibrations to the supporting floor / foundation.

f) The supporting structure and frame shall be generally of welded construction. All fastener used shall be of self locking type or equal to ensure that they do not get loosened due to vibrations in operations.

g) Material of construction of all the items required for the system and in contact with urea shall be suitable for urea application & be min. SS-304.

10.3.2 De-lumper / Lump Breaker

1. Rated Capacity of de-lumper shall approx. 50 TPH and design capacity shall be 60 TPH. Efficiency of de-lumper shall be mentioned by contractor/bidder in bid.

2. Preferably, De-lumper shall be double roll type. However, bidder to mention the suitable type of de-lumper for mentioned application in the bid.

3. The de-lumping members which require frequent attendance / replacement shall be easily accessible from the casing. It would be also preferable, where the size of de-lumper permits to do so, to have inspection doors with dust seal covers provided on the casing.

4. The de-lumper shall preferably be able to handle small pieces of tramp iron without causing serious damage to de-lumping members.

5. The de-lumper shall be designed to operate with a low noise level.

6. Material of construction of all the items required for the system and in contact with urea shall be suitable for urea application.

10.4 UREA BAGGING SYSTEM

10.4.1 Design features

a) The Bagging Plant shall have facilities for receiving the product urea from the Urea plant directly.

Urea received in bagging plant shall be distributed in 8 nos. of Urea bunkers with the help of a series of belt conveyors.

b) The bagging and loading capacity shall be designed for min. approx. 6500 MT per day (considering bagging in 3 shifts of 8 hours each per shift) and min. approx. 5000 MT per day (considering bagging in 3 shifts of 6 effective hours each per shift)

c) There shall be 8 Nos. Bagging Streams (6 nos. working and 2 no. stand by). Each bagging stream shall comprise of feeding conveyors, bunker, bagging & stitching m/c, bag handling conveyor.

d) A bag turning device/ roller conveyor/suitable arrangement shall be considered after stitching of filled bags. The design shall be such that the stitched side of bag shall fall on backward direction.

e) Bagging line should be capable of delivering the filled bag to filled bags storage area on platform or to rail wagons or to truck loading. Three (3) nos. of bagging line (as marked in layout drg.) shall have reversible slat/flat conveyor at the discharge of bagging machine to transfer the filled bag either to truck loading side or to both wagon loading side on selective basis. Rest five (5) nos. bagging line (as marked in layout drg.) shall have provision to transfer the filled bag to both side of wagon loading platform and platform stacking purpose on selective basis. All the bagging lines shall have the facility to feed the conveyors that runs on the storage/stacking platform an both side of bagging building to distribute the filled bags throughout the storage/stacking platform.

Each stream shall be interchangeable for loading into railway wagons on both sides of platform, on selective basis.

f) The bagging operation shall be done at first floor. Empty bags storage area and all necessary facilities/rooms shall be at first floor as marked in layout drg. However, empty bags unloading, air compressor and MCC room are kept as ground floor as marked in layout drg.

g) Filled bags from bagging station shall be loaded to truck with the help of spiral chute & truck loader. Filled bags from bagging station shall be loaded to wagon with the help of series of conveyors and wagon loader. Most mechanised and easy Truck/Wagon loading facility shall be provided with minimum manpower requirement.

h) Recovery & recycling facility of good urea collected from cut & torn bags / spilled urea / soiled urea shall be considered through bucket elevator as per the layout drg.

i) Filled bags from bagging area shall be transferred to wagon loading side with the help of series of belt conveyors as per layout drg.. Provision of interchangeability of bags from one stream to another in case any stream is out of order shall be there.

j) The Empty Bags Storage area shall be there to accommodate 15 lakh empty bags. Proper electric hoisting facility (3 nos., each 3 MT capacity) shall be there to lift empty bag from ground floor and to store in the marked location at bagging floor.

k) Provision of suitable system for proper ventilation at bagging area and in filled bag storage area at wagon loading platform shall be kept. Total 62 nos. Industrial fans (8 nos of bagging floor and 54 nos in platform area) to be provided. Wall mounted heavy duty Industrial fan (air circulator) of suitable capacity (min. 150 m3/min) to be considered.

l) Four (04) nos. movable trolleys shall be provided for movement of bags on bagging station.

m) The operation of bagging shall be automatic with minimum manual intervention. Broad requirements of bagging system are tabulated hereunder :-

Sl. No.	Parameter	Value
1.	Urea Plant Capacity :	3850 MTPD i.e approx. 161 TPH (Rated) & 193 TPH (Design)
2.	Urea Bagging Plant capacity :	270 TPH (Rated) & 324 TPH (Design)
3.	No. of bagging Streams :	6 working + 2 standby
4.	Total Bunker Capacity :	480 MT (6+2 nos. i.e. 60 MT each)
5.	Bagging machine per stream : Bag holding arrangement per stream :	1 no. / 2 nos. **Two (2) nos.,** so that two persons can load empty bag to bag holder simultaneously to achieve desired bagging rate.
6.	Bag Stitching machines per stream :	1 No. / 2 Nos.
7.	Plant operation :	Automatic through PLC
8.	Bagging Operation :	Semi-Automatic (Only bag placement to holder shall be manual, rest all activity shall be automatic)
9.	Bag Placement to the bag holder :	Manual
10.	Wagon Loading platform size :	660 m long (approx.), for loading of rake without split. (e.g 58 wagons BCHNL type with side door)
11.	Wagon Loading :	Maximum approx. 3200 MT in 6 hrs [Min. 1620 MT (approx.) in 6 hrs, through Wagon loader (Semi-automatic with minimum manual intervention), Remaining, approx. 1600 MT in 6 hrs manually from platform storage area]
12.	Truck Loading :	3 nos. of truck loading bay shall be considered with the help of truck loader.

10.4.2 Bagging Machine

a) Weighing & Bagging Machines shall be electronic type and shall be suitable to weigh 45 kg Urea and bag it in HDPE / PP bags of open mouth pillow type. Empty bag dimension shall be approx. 900mm x 500mm.

b) The accuracy of weighing shall be min. ±30 gms for achieving minimum 2 sigma capability for individual weighment.

c) Rated capacity of each weighing & bagging machine shall be 1000 bags/hr. and design capacity shall be 1200 bags/hr. The system shall ensure seamless bagging operation at the mentioned rate.

d) Each Weighing & Bagging Machines shall be such that, two nos. of persons can load empty bag to bag holder simultaneously to achieve desired bagging rate.

e) All parts/equipment of machine must be designed for continuous full load operation, under the conditions specified.

f) Bagging machine shall consists of but not limited to – Electronic net weigher, weighing controller & instrumentation, discharge chute, bag holder etc.

- Net weigher shall comprise of gate to regulate main & dribble feed rates to weigher, pneumatic cylinder within dustproof enclosure to give positive gate closure & consistent cut-off with provision of manual adjustment for initial setup, load cell, weigh hopper etc.
- Weighing controller/measuring system shall be suitable for semi-automatic bagging machine.
- The bag holder shall consist of a filler spout with clamping arrangement for securely holding the bag. Operation shall be pneumatic and shall ensure non slippage of bag after filling. The bag holder shall be rugged in construction with suitable safety switches to ensure bag clamping and operator safety.
- Quantity of load cell shall be considered as per OEM design, but minimum 2 nos. of loadcell shall be provided in each bagging machine.

g) The operation of the weighing-cum-tipping machine shall be semi-automatic, only manual operation shall be placement/clamping of empty bag to bag holder. All the following operations shall be automatic in the proper sequence i.e. -Gravity signal for effective discharge of pre weighed material (coarse feeding & fine feeding) to the clamped bag, Giving signal for closing the discharge gate of weighing receptacle and then starting the filling-in of fresh charge of

material for the following receptacle, simultaneous signaling for release of filled bag on slat/flat conveyor.

h) Components shall be designed to meet various mechanical properties such as hardness, strength, rigidity, wears resistance, resistance to vibration or shock etc

i) All assembly parts/equipment shall be easily accessible for maintenance.

j) Location of dust generation sources for all the equipment of the system and also the dust loading shall be considered for dust extraction system.

k) Empty bag table shall be provided at each filling station to keep at least 1200 empty bags.

l) Separate offline check weigher/ weigh scale (4 nos.) of 100 Kg capacity shall also be provided.

m) Material of construction of all the items/parts required for the system and in contact with urea shall be of min. SS-304.

10.4.3 Stitching Machine

a) Bag stitching machines shall be heavy duty industrial double headed & double stitching type.

b) Rated capacity of each stitching machine shall be 1000 bags/hr. and design capacity shall be 1200 bags/hr. The system shall ensure seamless stitching operation at the mentioned rate.

c) Stitching machine shall be designed to stitch 45 kg. of urea bag. The width of each bag to be stitched shall be approx. 500 mm. The bag material shall be HDPE / PP.

d) The stitching machine shall have a telescopic column arrangement with manual height adjustment feature.

e) Stitching Machine shall have double head. In case of one machine requires maintenance, system shall allow seamless maintenance of the system without affecting the bagging operation.

f) Stitching machine shall have vertical acting presser foot system, variable pitch pulley/hand wheel, internal forced lubrication, auto thread cutting facility etc.

g) Material of construction of all the items/parts required for the system and in contact with urea shall be of min. SS-304.

10.4.4 Wagon and Truck Loader

a) Wagon/ Truck loader is a machine used to place the bagged material into the Wagon/ truck or to stack the bag on the platform. The loading operation shall be done by means of a movable and telescopic arm allowing a stroke of desired length for Wagon/Truck loader.

b) Rated capacity of each wagon & truck loader shall be 1000 bags/hr. and design capacity shall be 1200 bags/hr.

c) The Wagon/Truck loader system shall have variable geometry which shall permit fast, simple positioning of its end with different kind of motions like – slewing, Luffing, retractable/expandable telescopic type etc.

d) The operator shall have the facility of full control of the movements of the loader.

e) The wagon loader shall be such that it can be able to rotate 90° on its pivot to facilitate wagon loading on one side as well as platform stacking.

f) Wagon loader shall be equipped with a movable chute which shall collect filled bags from the conveyor running at a height of approx. 3.0 m (refer layout drg.)

g) The boom of the truck loader shall have the facility to distribute the bags on the total length & width of the truck and its raising devices should allow adjusting the height of the piling up to the top level of the truck.

   For wagon loading, the boom of the loader shall reach upto the mouth of the wagon.

h) Generally Standard truck can be loaded through back doors and Standard covered Railway Wagon can be loaded through relatively narrow side doors. Accordingly, wagon & truck loader shall be designed.

i) The wagon & truck loading system shall have variable geometry which shall permit fast, simple positioning of its end. The positioning movements shall be motor-driven permitting different movements

j) System should have the flexibility to move the Wagon loader parallel to Wagon/platform through rails and in the right position in front of doors. For truck loader, it shall only move forward & backward in perpendicular to platform, no parallel movement is required.

k) Push button shall be provided at the last loading arm segment of Wagon/ Truck loader for controlling the loader easily by the operator. The push buttons shall be able to operate the relay, which shall be located on the back of machine.

l) All driving motors shall be amply dimensioned and adapted for rough handling.

m) Location of Wagon & Truck loader shall be inside the shed (on the platform).

n) The entire wagon & truck loader shall be well-dimensioned with a well designed carriage and a very low centre of gravity to prevent tipping.

o) Wagon & Truck loading machine shall have the facility to handle all type of standard 45 kg bags of approx. 800 mm x 500 mm dimension.

p) Bag counter with display shall be provided for wagon & truck loader.

q) The travelling speed of the Wagon loader shall be synchronized automatically to complete the loading of one Wagon and then travel rapidly to the second Wagon to minimize filling time of the rake.

r) MOC of the equipment shall be of appropriate grade for handling bagged Urea.

10.4.5 Bucket Elevator

a) Chain type Bucket elevator to be provided to transfer the spillage urea from bagging floor to one bunker as shown in layout. Provision in the elevator shall be made at the ground floor to transfer spillage urea of platform area.

b) Bucket elevator system shall consist of, but not limited to the following:-

- Bucket elevator shall be designed for continuous duty at full load as specified under operating conditions and the various components shall conform to relevant codes.
- Rated capacity of bucket elevator shall be 10 MT/hr. and design capacity shall be 12 MT/hr.
- Bucket elevator shall be of approx. 28-30m of height; however, height shall be finalized as per layout.
- Top cover in pieces, easy to disassemble for the maintenance and inspection of whole drive assembly and for assembly/ disassembly.
- Housing shall be made dust tight. Dust proof seal for the drive & return shaft.
- The housing shall be provided with inspection opening at appropriate location.
- Elevator shall be provided with positive holdback in order to prevent it from rotating backwards.
- Bucket shall be made of SS-304 material and shall be fixed in a way that loosening & detachment is impossible while in services.
- Hoods & safety guard shall be provided for the coupling and any other exposed rotating components.
- All safety switches shall be provided.

- Material of construction of all the items required for the system and in contact with urea shall be of min. SS-304.

10.5 CHAIN PULLEY BLOCK

a) Travelling Chain Pulley Blocks complete with plain trolleys, adequate length of hand chain & load chain etc.

b) Capacity and number of Chain Pulley Blocks with travelling trolley shall be worked out by contractor for M2 duty in conformity with IS: 3832 and submitted with bid.

c) Required manual effort for Chain Pulley Block shall be as per the stipulations of IS:3832

10.6 ELECTRIC HOIST

a) Electrical hoists shall be considered where the requirement is to handle the critical equipment/component during maintenance, in case of long hoisting/traveling time and heavy loads. For empty bags handling, contractor/bidder to consider electric hoists (3 nos.) of 3 Te capacity each mandatorily.

b) For electric hoists festoon type cable trolleys shall be considered. Also the hoist shall be operated from a push button type pendent from the floor. Separate main shall be considered for electrical supply for each hoist.

c) Capacity and number of Electric Hoist shall be worked out by contractor for M2 duty in conformity with IS: 3938 and submitted with bid.

10.7 ROAD WEIGH BRIDGE

a) Two (2) Nos. Electronic type road Weigh Bridge (Pitless type) of 80 MT capacity each of platform size minimum 18m x 4m (approx) each with boom barrier along with weigh bridge cabin facility shall be provided for weight recording and transfer of urea dispatched via road.

b) Weigh bridge shall complete with all parts/mechanism including weighbridge platform, load cells, indicator, barriers, safety devices, Lighting & Surge Protection devices etc.

c) Load cells and digitizers of electronic weighbridge shall be very robust in construction and suitable for urea environment. Load cell shall be with high protection class & with lightning protection. Load cells should have self diagnostics capabilities to identify problems and predict failures before it occurs.

d) Broad specification of load cell is as under -
Hermetically sealed and Lightening protected
Protection :- min. IP 68
Safe load:- 150% of nominal capacity
Ultimate load:- 300% of nominal capacity
Load cell Accuracy :- +/- 0.01% of Nominal capacity (minimum)
Combined error:- ±0.03%
Covering:- Stainless Steel

e) Weigh bridge cabin shall be provided with necessary Desktop computer with compatible control software as required, printer, paper, consumables for six (6) months of operation and associated instrumentation & Control system.

f) Weigh Bridge Control system shall be interfaced/hardwired with Bagging Control System (inside Bagging Control Room) for all electrical and instrumentation interface.

g) Location/Co-ordinates of Weigh Bridge Control room shall be followed as per overall plot plan.

10.8 BROAD SPECIFICATION FOR EQUIPMENT STRUCTURAL

a) All structural steel work shall be designed in strict accordance with the latest relevant Indian standard code of practice. All structural steel shall conform to IS: 2062.

b) A corrosion allowance of 1 mm shall be taken over the designed thickness of all structural steel support.

c) All welding shall conform to IS: 813 and IS: 816. All fasteners shall conform to IS: 1363 and IS: 1367.

d) All Steel structures shall be painted as per painted specification mentioned.

e) Bidder shall keep one copy of all approved drawings and specifications of the works in good order, which will be made available to the Engineer in-charge or his representative, whenever required.

f) Bidder shall ensure that the fabrication works are carried out in a sequential order as per their requirements during erection at site i.e. the items required first for erection are fabricated first and despatched to site in the order.

g) Owner / Consultant may check the design calculations, design drawings and fabrication drawings before actual fabrication work starts. This shall not absolve the bidder of its responsibility for the design and proper safety of the structures. The bidder must guarantee about the stability of the structures. Any fabrication done before final approval of the drawings shall be of bidder's responsibility.

h) Preparation and supply of designs, drawings and subsequent revisions / changes thereof shall be made at no extra payment.

10.9 OTHER RELATED SYSTEMS

Contractor/Bidder to consider & provide following other systems related to urea handling & bagging package –

i) Air Compressor

a) Two (2) nos air compressors (air cooled type) with single air receiver shall be provided at bagging plant for supply of service air at required locations.

b) Air compressor capacity shall be considered as 250 Nm^3/hr each. Two Compressors shall be connected to single air receiver of 8 m^3 capacity. For the compressor, discharge pressure required is min. 7.5 kg/cm^2.

c) Service air point shall be provided at following locations –

- Drive/head end & Tail end of conveyor ET-1, ET-2, ET3, ET-4, ET-5, ET-6 series
- At every 25m (approx.) inside gantry of each conveyor ET-1, ET-2, ET3, ET-4, ET-5
- Service air points at all the suitable points on each bagging floor.
- One point at empty bag storage area
- Three points at Wagon loading platform area
- One point at Truck loading platform area
- Service air for vibrating screen & crusher at screen house (TT-4)
- Service air for Salt Scraper inside urea bulk silo
- Appropriate length hose pipe to be considered at each location

d) For design specification of air compressor refer to DESIGN SPECIFICATION - ROTATING EQUIPMENT (PC183/E-4010/SEC VI/3.1.2)

ii) Neem oil separation system including urea dissolving tank

Refer to DESIGN SPECIFICATION – PROCESS (PC183/E-4010/SEC VI/3.2) & STATIC EQUIPMENT (PC183/E-4010/SEC VI/3.1.3)

iii) Piping of all required services

Following raw material & utility piping lines shall be made available to the contractor/bidder at one point of battery limit (at the edge of each block) of bagging plant, transfer towers; further distribution to the required location considering attached piping specification shall be under scope of contractor/bidder.

a) Drinking Water
b) Service Water
c) DM water / Steam Condensate
d) Instrument Air
e) Service air as mentioned above (complete piping scope from compressor to required location)

Refer to DESIGN SPECIFICATION – PIPING (PC183/E-4010/SEC VI/ 3.1.4)

Bidder to provide/mention in the bid following utility requirements for applicable individual equipments/system –

a) Instrument air
b) DM water / Steam Condensate

iv) Electrical system required for the complete urea handling & bagging package

Refer to DESIGN SPECIFICATION – ELECTRICAL (PC183/E-4010/SEC VI/3.3)

v) Instrumentation system required for the complete urea handling & bagging package

Refer to DESIGN SPECIFICATION – INSTRUMENTATION (PC183/E-4010/SEC VI/3.4)

11.0 INSPECTION & TESTING

11.1 All components of the system shall be subjected to inspection and testing at different stages of manufacture as applicable as per approved QAP.

11.2 Contractor/Bidder to submit Quality Assurance Plan (QAP) for approval of Owner / Consultant to identify stages of inspection, acceptance criteria and extent of inspection.

11.3 Contractor/Bidder, on demand from Owner/Consultant shall carryout such tests in an appropriate manner in the presence of Owner / Consultant free of charge to owner.

11.4 If the equipment / part of equipment are to be manufactured at any other premises, the Contractor/bidder shall obtain permission for owner / Consultant to inspect and test.

11.5 In all cases where tests are to be carried out, the contractor/bidder shall provide free of charge

such as labour, materials, apparatus and instruments and supervisory staff, as may reasonably be demanded, to carryout efficiently such tests of equipment, material or workmanship in accordance with the contract.

The equipment / part of equipment shall be immediately rectified / replaced if not found satisfactory by Owner/Consultant and refurnish it for re-inspection at the earliest possible date.

11.6 After assembly of each unit, it shall be subjected to tests as per the manufacturer's standard test procedure. This shall include a functional test of the smooth running of the equipment. The functional test may be witnessed by Owner/consultant at Vendor's shop. Contractor shall furnish necessary notice for witnessing shop tests to Owner/consultant in due course. If dismantling is required for improvement of performance in the tests, the initial test shall not be acceptable and the final test must be done after corrections are made.

11.7 The contractor/bidder shall dispatch the equipment only after getting dispatch clearance from Consultant / Owner / Third Party.

11.8 The contractor/bidder shall give at least 15 days clear notice to Owner/Consultant when the different parts / complete equipment are ready for inspection. If the equipment / parts are not provided for inspection on the appointed dates, the Owner / Consultant reserves the right to recover all the expenses incurred on their inspector's visit from the bidder.

11.9 No inspection test or acceptance during the course of manufacture or at final stages shall relieve the contractor/bidder from his responsibility for any failure to conform to the contract Specifications or for faulty design, material or workmanship which may subsequently develop up to the guaranteed period.

11.10 The contractor/bidder shall furnish necessary test certificates, drawings, radiographic examination reports and other relevant data as may be required for Owner/Consultant review. Such inspection by Owner / Consultant / Third Party shall however not relieve the bidder of their responsibility for the quality and workmanship guarantee of the equipment.

11.11 Inspection at contractor/bidder's / sub-vendor's works by Consultant / Owner / Third Party shall not prejudice owner's claim for rejection of equipment / part or further inspection at site.

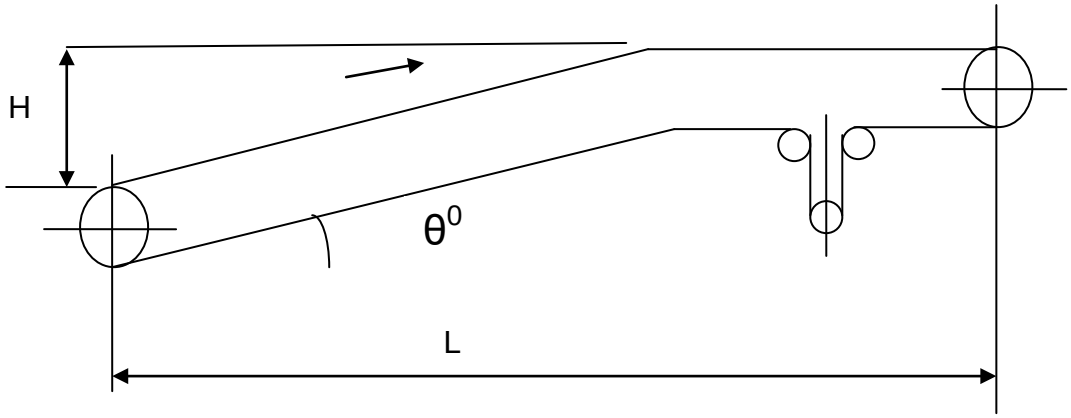
If the equipment are not of contract specification or fail to perform specified duties or otherwise not found satisfactory by Owner/Consultant, owner shall be entitled to reject the equipment / material or part thereof and ask for free replacement within reasonable time, failing which the

owner has all the powers to obtain his requirements elsewhere at contractor/bidder's cost and risk.

In the event of such rejection the owner shall be entitled to the use of equipment in a reasonable and proper manner for a time reasonably sufficient to enable him to obtain replacement.

Equipment rejected by Owner shall be removed by contractor/bidder at his own cost within 14 days of notice.

Nothing in these clauses shall be deemed to deprive the owner of his right or in any way relieve the contractor/bidder of his obligation under the contract.



LINE SKETCH (Refer attached layout Drawing)

APPLICATION DATA

Applicable to :- Purchase □ Proposal □ Date:	
Conveyors: - ET-1, ET-2 with travelling tripper	
Manufacturer :-	**Quantity Required :-** 1 No.
Type :- Troughed, 3 equal rolls	**Duty :-** Continuous, 24 hrs/day
Troughing Angle :- 30^0	**Relative Humidity: -** 100 % max.
Surrounding :- Dusty & Corrosive	**Temperature :-** Ambient

MATERIAL HANDLED DATA

Material :- Urea prills	**Angle of Repose :-** 23^0
Average Size, mm **:-** 1.0 to 2.8	**Moisture: -** 0.5 % max.
Max. Size, mm **:-** 5.0	**Temperature :-** 100^0
Percentage of Large Pieces :- 3% Max., Occasional	**Abrasiveness :-** Mild
Bulk Density (Kg / m^3) **:-** 650-700	**Chemical Activity :-** Hygroscopic, Highly corrosive

TECHNICAL SPECIFICATION

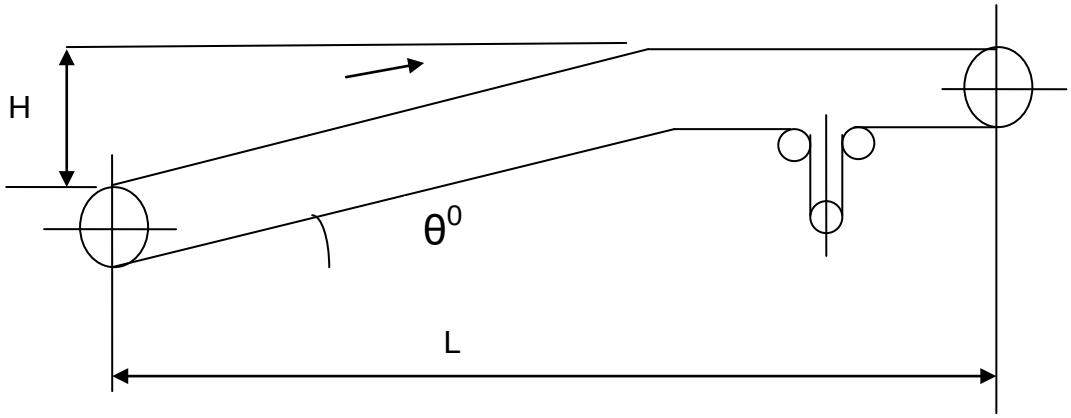
Capacity, Te / hr **:**	**Electric Motor :**
Normal/ Rated :- 161	Make & Type :-
Peak :-	Rating, K.W :-
Design :- 193	Speed, R.P.M :-
Belt Speed, m/sec **:-**	**Reduction Gear Box :**
Belt Specification :	Type :- Helical Gear Box
Width, mm :- 1200 (Note:- for ET-2 conveyor, belt width may be changed to 1000 mm considering existing silo's layout during detail engineering)	Make :-
Rating :-	Size :-
Construction :- Nylon / Nylon	Reduction ratio :-
Make :-	Efficiency, Min :- 85%
Duty :- HD	Lubrication :-
Cover grades :- OHR	Weight, Kg :-
Cover Thickness, mm :- Top : 5 Bottom : 3	

Conveyor Lift, H (in mm):-					
Conveyor Length, L (in m):-	**Secondary Reduction:**				
Conveyor Inclination, θ^0 (in Degree):	Type :-				
Wrap angle :- 210^0	Make :-				
Coupling :	Size :-				
Type :- Flexible -Pin & Bush	Ratio :-				
Make :-	Sprocket :-				
Size :-	Pinion :-				
Pulleys :					
Material :- MS	Lagging: - 12 mm thk. Neoprene for head pulley / drive pulleys (herring-bone/diamond pattern) 10 mm thk. plain neoprene lagging for tail & other pulley				
Width, mm :- 1400					
	Head	Tail	Snub	Take-up	Bend
Diameter, mm :-					
Weight, Kg :-					
Shaft :					
Material :- EN-8					
Diameter, mm :-	Head	Tail	Snub	Take-up	Bend
At bearing :-					
At pulley :-					
Bearing :	Head	Tail	Snub	Take-up	Bend
Type & No.:-					
Make :-					
Size :-					
Idlers :					
Make :-					
Material :- M.S					
Lagging thickness, mm :-	Lagging: - Min. 6 mm thk. Neoprene lagging for carrying idlers (plain pattern). Min. 25 mm thk. rubber lagging for Impact idlers (plain pattern). Lagging in Guide roller to be provided.				
	Carrying side			Return side	
Type :-	3 roll			Single roll	
Diameter, mm :-					
Spacing, mm :-	1000			3000	
Bearing type :-	Self Aligning			Anti Friction	
Weight, Kg :-					
Training Idlers :	**Hold Back Type :-** Roller				
Type :- Single roll	**Decking Plates :-** 4 m length at receiving end and 2m length at discharge end				
Diameter, mm :-	Material :- SS-304				
Spacing, mm :-	Thickness, mm :- Min. 1.5				
Take-Up :	**Skirt Board :**				

Type :- Gravity Take-up	Material :- S.S-304	
Weight, Kg :-	Length & Thickness: - min. 3m long & 6 mm thk.	
Location :- Head side	Type :-	
Movement, mm :-		
Belt Cleaner :- (Both Primary & Secondary external scraper/cleaner to be provided)	External	Internal
Type :-	Multi spring loaded type	V-type
Weight of complete conveyor, Kg **:-**		
Accessories, Tripper :- For ET-2 Type: Method of Drive: Tripper Speed, mm/min: Duty: Max. Slope of Belt: Distance between centre of Rails ,mm: Rail Size: Distance between top of Stringer and top of rail, mm: Type of discharge: Centre of tripper to centre of spout, mm: H.P required to Propel: Side from which to operate: Pulley Diameter,mm:	Particulars of Drive to Travelling wheels: Particulars of Reversing Gears: Type of Brakes: Type of Mech-Interlock: Idlers: Type: Size: Bearing: Qty: Pulley Bearing: Type: Size: Make: Size: Weight: complete, Kg Cleaning: arrangement Incorporated: Y/N Sketch: showing Dimension Required (Y/N)	

REMARKS :-

1. This is a combined data sheet, contractor/bidder shall furnish filled in data sheet for each conveyor separately along with their offer.



LINE SKETCH (Refer attached layout Drawing)

APPLICATION DATA

Applicable to :- Purchase □ Proposal □ Date:	
Conveyors: - ET-3, ET-4	
Manufacturer :-	**Quantity Required :-** 1 No.
Type :- Troughed, 3 equal rolls	**Duty :-** Continuous, 24 hrs/day
Troughing Angle :- 30^0	**Relative Humidity: -** 100 % max.
Surrounding :- Dusty & Corrosive	**Temperature :-** Ambient

MATERIAL HANDLED DATA

Material :- Urea prills	**Angle of Repose :-** 23^0
Average Size, mm **:-** 1.0 to 2.8	**Moisture: -** 0.5 % max.
Max. Size, mm **:-** 5.0	**Temperature :-** 100^0
Percentage of Large Pieces :- 3% Max., Occasional	**Abrasiveness :-** Mild
Bulk Density (Kg / m^3) **:-** 650-700	**Chemical Activity :-** Hygroscopic, Highly corrosive

TECHNICAL SPECIFICATION

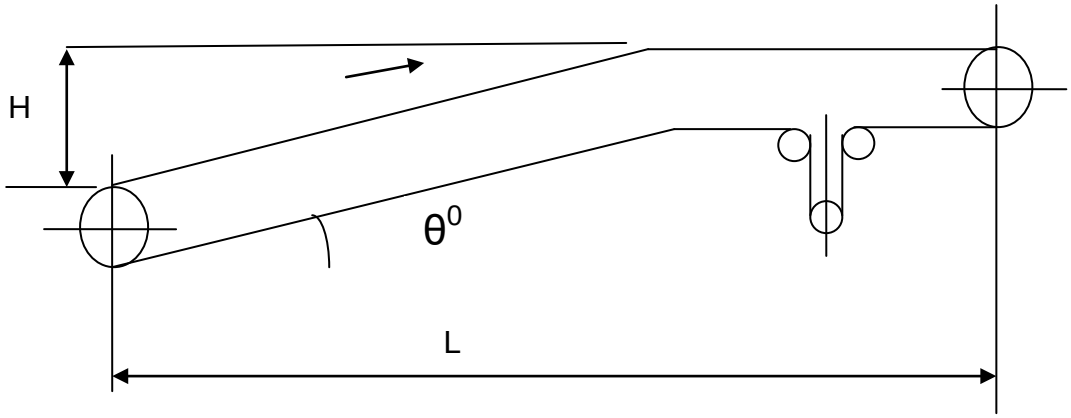
Capacity, Te / hr **:**	**Electric Motor :** Variable feed drive
Normal/ Rated :- 180	Make & Type :-
Peak :-	Rating, K.W :-
Design :- 220	Speed, R.P.M :-
Belt Speed, m/sec **:-**	**Reduction Gear Box :**
Belt Specification :	Type :- Helical Gear Box
Width, mm :- 1000	Make :-
Rating :-	Size :-
Construction :- Nylon / Nylon	Reduction ratio :-
Make :-	Efficiency, Min :- 85%
Duty :- HD	Lubrication :-
Cover grades :- OHR	Weight, Kg :-
Cover Thickness, mm :- Top : 5 Bottom : 3	
Conveyor Lift, H (in mm):-	

Conveyor Length, L (in m):-	**Secondary Reduction:**				
Conveyor Inclination, θ^0 (in Degree):	Type :-				
Wrap angle :- 210^0	Make :-				
Coupling :	Size :-				
Type :- Flexible -Pin & Bush	Ratio :-				
Make :-	Sprocket :-				
Size :-	Pinion :-				
Pulleys :					
Material :- MS	Lagging: - 12 mm thk. Neoprene for head pulley / drive pulleys (herring-bone/diamond pattern) 10 mm thk. plain neoprene lagging for tail & other pulley				
Width, mm :- 1400					
	Head	Tail	Snub	Take-up	Bend
Diameter, mm :-					
Weight, Kg :-					
Shaft :					
Material :- EN-8					
Diameter, mm :-	Head	Tail	Snub	Take-up	Bend
At bearing :-					
At pulley :-					
Bearing :	Head	Tail	Snub	Take-up	Bend
Type & No.:-					
Make :-					
Size :-					
Idlers :					
Make :-					
Material :- M.S					
Lagging thickness, mm :-	Lagging: - Min. 6 mm thk. Neoprene lagging for carrying idlers (plain pattern). Min. 25 mm thk. rubber lagging for Impact idlers (plain pattern). Lagging in Guide roller to be provided.				
	Carrying side			Return side	
Type :-	3 roll			Single roll	
Diameter, mm :-					
Spacing, mm :-	1000			3000	
Bearing type :-	Self Aligning			Anti Friction	
Weight, Kg :-					
Training Idlers :	**Hold Back Type :-** Roller				
Type :- Single roll	**Decking Plates :-** 4 m length at receiving end and 2m length at discharge end				
Diameter, mm :-	Material :- SS-304				
Spacing, mm :-	Thickness, mm :- Min. 1.5				
Take-Up :	**Skirt Board :**				
Type :- Gravity Take-up	Material :- S.S-304				
Weight, Kg :-	Length & Thickness: - min. 3m long & 6 mm thk.				

Location :- Head side	Type :-	
Movement, mm :-		
Belt Cleaner :- (Both Primary & Secondary external scraper/cleaner to be provided)	External	Internal
Type :-	Multi spring loaded type	V-type
Weight of complete conveyor, Kg **:-**		
Accessories, Tripper :- IF REQUIRED Type: Method of Drive: Tripper Speed, mm/min: Duty: Max. Slope of Belt: Distance between centre of Rails ,mm: Rail Size: Distance between top of Stringer and top of rail, mm: Type of discharge: Centre of tripper to centre of spout, mm: H.P required to Propel: Side from which to operate: Pulley Diameter,mm:	Particulars of Drive to Travelling wheels: Particulars of Reversing Gears: Type of Brakes: Type of Mech-Interlock: Idlers: Type: Size: Bearing: Qty: Pulley Bearing: Type: Size: Make: Size: Weight: complete, Kg Cleaning: arrangement Incorporated: Y/N Sketch: showing Dimension Required (Y/N)	

REMARKS :-

1. This is a combined data sheet, contractor/bidder shall furnish filled in data sheet for each conveyor separately along with their offer.



LINE SKETCH (Refer attached layout Drawing)

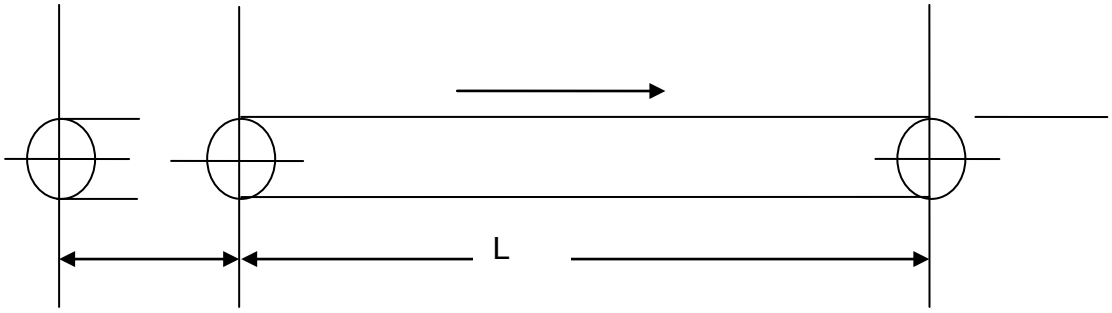
APPLICATION DATA	
Applicable to :- Purchase □ Proposal □ Date:	
Conveyors: - ET-5, ET-6 Series	
Manufacturer :-	**Quantity Required :-** 1 No.
Type :- Troughed, 3 equal rolls	**Duty :-** Continuous, 24 hrs/day
Troughing Angle :- 30^0	**Relative Humidity: -** 100 % max.
Surrounding :- Dusty & Corrosive	**Temperature :-** Ambient
MATERIAL HANDLED DATA	
Material :- Urea prills	**Angle of Repose :-** 23^0
Average Size, mm **:-** 1.0 to 2.8	**Moisture: -** 0.5 % max.
Max. Size, mm **:-** 5.0	**Temperature :-** 100^0
Percentage of Large Pieces :- 3% Max., Occasional	**Abrasiveness :-** Mild
Bulk Density (Kg / m^3) **:-** 650-700	**Chemical Activity :-** Hygroscopic, Highly corrosive
TECHNICAL SPECIFICATION	
Capacity, Te / hr **:**	**Electric Motor :** Variable feed drive
Normal/ Rated :- 280	Make & Type :-
Peak :-	Rating, K.W :-
Design :- 340	Speed, R.P.M :-
Belt Speed, m/sec **:-**	**Reduction Gear Box :**
Belt Specification :	Type :- Helical Gear Box
Width, mm :- 1200	Make :-
Rating :-	Size :-
Construction :- Nylon / Nylon	Reduction ratio :-
Make :-	Efficiency, Min :- 85%
Duty :- HD	Lubrication :-
Cover grades :- OHR	Weight, Kg :-
Cover Thickness, mm :- Top : 5 Bottom : 3	
Conveyor Lift, H (in mm):-	

Conveyor Length, L (in m):-	**Secondary Reduction:**				
Conveyor Inclination, θ^0 (in Degree):	Type :-				
Wrap angle :- 210^0	Make :-				
Coupling :	Size :-				
Type :- Flexible -Pin & Bush	Ratio :-				
Make :-	Sprocket :-				
Size :-	Pinion :-				
Pulleys :					
Material :- MS	Lagging: - 12 mm thk. Neoprene for head pulley / drive pulleys (herring-bone/diamond pattern) 10 mm thk. plain neoprene lagging for tail & other pulley				
Width, mm :- 1400					
	Head	Tail	Snub	Take-up	Bend
Diameter, mm :-					
Weight, Kg :-					
Shaft :					
Material :- EN-8					
Diameter, mm :-	Head	Tail	Snub	Take-up	Bend
At bearing :-					
At pulley :-					
Bearing :	Head	Tail	Snub	Take-up	Bend
Type & No.:-					
Make :-					
Size :-					
Idlers :					
Make :-					
Material :- M.S					
Lagging thickness, mm :-	Lagging: - Min. 6 mm thk. Neoprene lagging for carrying idlers (plain pattern). Min. 25 mm thk. rubber lagging for Impact idlers (plain pattern). Lagging in Guide roller to be provided.				
	Carrying side			Return side	
Type :-	3 roll			Single roll	
Diameter, mm :-					
Spacing, mm :-	1000			3000	
Bearing type :-	Self Aligning			Anti Friction	
Weight, Kg :-					
Training Idlers :	**Hold Back Type :-** Roller				
Type :- Single roll	**Decking Plates :-** 4 m length at receiving end and 2m length at discharge end				
Diameter, mm :-	Material :- SS-304				
Spacing, mm :-	Thickness, mm :- Min. 1.5				
Take-Up :	**Skirt Board :**				
Type :- Gravity Take-up	Material :- S.S-304				
Weight, Kg :-	Length & Thickness: - min. 3m long & 6 mm thk.				

Location :- Head side	Type :-	
Movement, mm :-		
Belt Cleaner :- (Both Primary & Secondary external scraper/cleaner to be provided)	External	Internal
Type :-	Multi spring loaded type	V-type
Weight of complete conveyor, Kg **:-**		
Accessories, Tripper :- IF REQUIRED Type: Method of Drive: Tripper Speed, mm/min: Duty: Max. Slope of Belt: Distance between centre of Rails ,mm: Rail Size: Distance between top of Stringer and top of rail, mm: Type of discharge: Centre of tripper to centre of spout, mm: H.P required to Propel: Side from which to operate: Pulley Diameter,mm:	Particulars of Drive to Travelling wheels: Particulars of Reversing Gears: Type of Brakes: Type of Mech-Interlock: Idlers: Type: Size: Bearing: Qty: Pulley Bearing: Type: Size: Make: Size: Weight: complete, Kg Cleaning: arrangement Incorporated: Y/N Sketch: showing Dimension Required (Y/N)	

REMARKS :-

1. This is a combined data sheet, contractor/bidder shall furnish filled in data sheet for each conveyor separately along with their offer.



LINE SKETCH (Refer attached layout Drawing)

APPLICATION DATA

Applicable to :- Purchase □ Proposal □ Date:	
Conveyors: - ET-7 (Series), ET-8 (Series), ET-9 (Series), ET-10 (Series),	
Manufacturer :-	**Quantity Required :-** 1 No.
Type :- Flat, Single roll	**Duty :-** Continuous, 24 hrs/day
Troughing Angle :- 0^0	**Relative Humidity: -** 100 % max.
Surrounding :- Dusty & Corrosive	**Temperature :-** Ambient

MATERIAL HANDLED DATA

Material :- Bagged Urea	**Abrasiveness :-** Mild
Moisture: - 0.5 % max.	**Chemical Activity :-** Hygroscopic, Highly corrosive urea bag
Temperature :- 50^0	

TECHNICAL SPECIFICATION

Capacity, Bags/hr **:**	**Electric Motor :**
Normal/ Rated :- 1000	Make & Type :-
Peak :-	Rating, K.W :-
Design :- 1200	Speed, R.P.M :-
Belt Speed, m/sec **:-**	**Reduction Gear Box :**
Belt Specification :	Type :- Helical Gear Box
Width, mm :- 800	Make :-
Rating :-	Size :-
Construction :- Nylon / Nylon	Reduction ratio :-
Make :-	Efficiency, Min :- 85%
Duty :- HD	Lubrication :-
Cover grades :- M24	Weight, Kg :-
Cover Thickness, mm :- Top : 4 Bottom : 2	
Conveyor Lift, H (in mm):-	
Conveyor Length, L (in m):-	**Secondary Reduction:**
Conveyor Inclination, θ^0 (in Degree):	Type :-
Wrap angle :- 210^0	Make :-
Coupling :	Size :-
Type :- Flexible -Pin & Bush	Ratio :-

REV	REV DATE	EFF DATE	PURPOSE	PREPD	REVWD	APPD
0	26.03.2021	26.03.2021	ISSUED FOR TENDER	EL	AM	PK

Make :-	Sprocket :-				
Size :-	Pinion :-				
Pulleys :					
Material :- MS	Lagging: - 12 mm thk. Neoprene for head pulley / drive pulleys (herring-bone/diamond pattern) 10 mm thk. plain neoprene lagging for tail & other pulley				
Width, mm :- 950					
	Head	Tail	Snub	Take-up	Bend
Diameter, mm :-					
Weight, Kg :-					
Shaft :					
Material :- EN-8					
Diameter, mm :-	Head	Tail	Snub	Take-up	Bend
At bearing :-					
At pulley :-					
Bearing :	Head	Tail	Snub	Take-up	Bend
Type & No.:-					
Make :-					
Size :-					
Idlers :					
Make :-					
Material :- M.S					
Lagging thickness, mm :-	Lagging: - Min. 25 mm thk. rubber lagging for Impact idlers (plain pattern). Lagging in Guide roller to be provided.				
	Carrying side			Return side	
Type :-	Single roll			Single roll	
Diameter, mm :-					
Spacing, mm :-					
Bearing type :-	Self Aligning			Anti Friction	
Weight, Kg :-					
Training Idlers :	**Hold Back Type :-** Roller				
Type :- Single roll	**Decking Plates :-** Not Required				
Diameter, mm :-	Material :-				
Spacing, mm :-	Thickness, mm :-				
Take-Up :	**Skirt Board :-** Not Required				
Type :- Gravity Take-up	Material :-				
Weight, Kg :-	Length & Thickness: -				
Location :- Head side	Type :-				
Movement, mm :-					
Belt Cleaner :- if applicable to be decided during Detail Engg.	External			Internal	
Type :-					
Weight of complete conveyor, Kg **:-**					
Accessories, Tripper :- Not Required Type:	Particulars of Drive to Travelling wheels:				

Method of Drive: Tripper Speed, mm/min: Duty: Max. Slope of Belt: Distance between centre of Rails ,mm: Rail Size: Distance between top of Stringer and top of rail, mm: Type of discharge: Centre of tripper to centre of spout, mm: H.P required to Propel: Side from which to operate: Pulley Diameter,mm:	Particulars of Reversing Gears: Type of Brakes: Type of Mech-Interlock: Idlers: Type: Size: Bearing: Qty: Pulley Bearing: Type: Size: Make: Size: Weight: complete, Kg Cleaning: arrangement Incorporated: Y/N Sketch: showing Dimension Required (Y/N)

REMARKS :-

1. This is a combined data sheet, contractor/bidder shall furnish filled in data sheet for each conveyor separately along with their offer.

Equipment Name:- Bagging /Weighing-Cum-Tipping Machine	**Quantity Required :-** 8 Sets

APPLICATION DATA

Applicable To :- □ Proposal □ Purchase □ As Built	
Service :- For Bagging /Weighing & tipping of 45 kg. Urea Fertiliser in HDPE/PP bag	**Make & Model :-**
Type :- Semi-Automatic	**Relative Humidity : -** 100% (Max.)
Duty :- Continuous, 24 hrs/day	**Surroundings :-** Dusty & Corrosive
Temperature :- Ambient	

MATERIAL HANDLED DATA

Material :- Urea Prills	**Angle of repose :-** 23°
Average Size, mm :- 1.0 to 2.8	**Moisture :-** Normal 0.3 %
Max. Size, mm :- 5.0	**Temperature :-** Max.50°C
Percentage of large pieces: - 3% Max.	**Abrasiveness :-** Mild
Bulk Density, kg / m³ :- 650 - 700	**Chemical Activity :-** Hygroscopic, Highly Corrosive

TECHNICAL SPECIFICATION

Capacity, kg (per tip) :- 45	**Accuracy :-** min. ± 30 gms at min. 2 Sigma
Bagging Capacity, Bags / hr :	**Coarse feeding,** kg **:-**
Normal/Rated **:-** 1000	**Fine feeding,** kg **:-**
Design **:-** 1200	**Overhead feeding :-** Bunker (60MT capacity)
Bag to be filled :- Open mouth Pillow type HDPE/PP bag	
Air Consumption, lit/min :-	**Power Consumption**, KW :-

CONSTRUCTIONAL FEATURES

Inlet Flange/Chute size :-	**Load Cell** :-
Discharge Flange/Chute size :-	Make :-
Protection from moisture/dust :- Yes / No	Type :-
Net Weigher :-	Range :-
Pneumatically operated feed gate :- Yes / No	Number :-
Bag filling systems detail :-	
Bag holder dimension & type :-	
Control Panel size :-	**Empty bag table** :- Yes / No
Degree of Protection :-	**Noise Level** :- < 85 dBA
CONTROL Location :- Local & Remote at CCR	
Total Wt. of Complete machine, Kg :-	**Overall Dimensions,** mm. :-
MATERIAL OF CONSTRUCTION :- All parts in contact with product shall be min. SS304 All fasteners – SS304	
REMARKS:- Contractor/bidder shall furnish filled in data sheet along with their offer. **NOTE :-** The bidder shall get all the machines stamped from weights & measures deptt. at the time of commissioning of the machine.	

Equipment Name:- Bag Stitching Machine	**Quantity Required :-** 11

APPLICATION DATA

Applicable To :- □ Proposal □ Purchase □ As Built	
Service :- For stitching of 45 kg. Urea filled bag	**Make & Model :-**
Type :- Double Headed & double stitching	**Relative Humidity : -** 100% (Max.)
Duty :- Continuous, 24 hrs/day	**Surroundings :-** Dusty & Corrosive
Temperature :- Ambient	

TECHNICAL SPECIFICATION

Stitching Capacity, Bags / hr :	
Normal/Rated **:-** 1000	**Synchronising with :-** Bagging machine
Design **:-** 1200	**Direction of stitch :-**
Bag Material :- HDPE /PP	**Bag type :-** Open mouth Pillow type
Empty bag size, mm (approx.) :- 900 x 550	**Power Consumption**, **KW** :-
No. of Stitching row :-	**Air Consumption, lit/min (if any) :-**
Distance between stitching, mm :-	**Range of head adjustment, mm** :-
No. of stitches/inch :-	**Noise Level** :- < 85 dBA
CONSTRUCTIONAL FEATURES	
Head mounting :- Table / Piller / Overhung	**Lubrication** :-
Needle detail :-	**Control** :-
Thread Cutting :-	
Total Wt. of Complete machine, Kg :-	**Overall Dimensions,** mm. :-
MATERIAL OF CONSTRUCTION :- All parts in contact with product shall be min. SS304 All fasteners – SS304	
REMARKS:- Contractor/bidder shall furnish filled in data sheet along with their offer.	

Equipment Name:- Delumper / Lump Breaker	**Quantity Required :-** 1

APPLICATION DATA

Applicable To :- □ Proposal □ Purchase □ As Built	
Service :- To delump the lumpy silo reclaim product	**Make & Model :-**
Type :-	
Duty :- Continuous, 24 hrs/day	**Relative Humidity : -** 100% (Max.)
Temperature :- Ambient	**Surroundings :-** Dusty & Corrosive

MATERIAL HANDLED DATA

Material :- Urea Lumps	**Angle of repose :-** 23°
Average Size, mm :- 1.0 to 2.8	**Moisture :-** Normal 0.3 %
Max. Size, mm :-	**Temperature :-** Max.50°C
Percentage of large pieces: - 3% Max.	**Abrasiveness :-** Mild
Bulk Density, kg / m³ :- 650 - 700	**Chemical Activity :-** Hygroscopic, Highly Corrosive

TECHNICAL SPECIFICATION

Capacity, Te / hr :	**Type of Screening** :- Dry
Normal/Rated **:-** 50	**Power Consumption**, KW :-
Design **:-** 60	

CONSTRUCTIONAL FEATURES

Type of De-lumper:-	
De-lumper Efficiency :-	**Shaft detail :-**
Shock absorber detail, if any :-	
Drive details :-	
Other details :-	
Overall dimension of machine, mm (L x W x H):-	
Noise Level :- < 85 dBA	
CONTROL Location :-	
Total Wt. of Complete machine, Kg :-	
MATERIAL OF CONSTRUCTION (Suitable for Urea application) :-	
REMARKS:- Contractor/bidder shall furnish filled in data sheet along with their offer.	

Equipment Name:- Vibrating Screen	**Quantity Required :-** 1

APPLICATION DATA

Applicable To :- □ Proposal □ Purchase □ As Built	
Service :- To screen silo reclaim product	**Make & Model :-**
Type :- Vibrating type suitable for urea screening of silo reclaim product	
Duty :- Continuous, 24 hrs/day	**Relative Humidity : -** 100% (Max.)
Temperature :- Ambient	**Surroundings :-** Dusty & Corrosive

MATERIAL HANDLED DATA

Material :- Urea prills including Lumps	**Angle of repose :-** 23°
Average Size, mm :- 1.0 to 2.8	**Moisture :-** Normal 0.3 %
Max. Size, mm :- 300	**Temperature :-** Max.50°C
Percentage of large pieces: - 3% Max.	**Abrasiveness :-** Mild
Bulk Density, kg / m³ :- 650 - 700	**Chemical Activity :-** Hygroscopic, Highly Corrosive

TECHNICAL SPECIFICATION

Capacity, Te / hr :	**Type of Screening** :- Dry
Normal/Rated **:-** 180	**Power Consumption**, KW :-
Design **:-** 200 (min.)	

CONSTRUCTIONAL FEATURES

Type of Screen :- Preferably Linear / Circular motion	
No. of Deck :- Two (2)	**Deck Opening :-**
Screen Efficiency :-	**Shaft detail :-**
Spring details :-	
Drive details :-	
Overall dimension of machine, mm (L x W x H):-	
Noise Level :- < 85 DBA	
CONTROL Location :-	
Total Wt. of Complete machine, Kg :-	

MATERIAL OF CONSTRUCTION (Suitable for Urea application) **:-**

- All parts in contact with product shall be min. SS304.
- All fasteners - min. SS304

REMARKS:- Contractor/bidder shall furnish filled in data sheet along with their offer.

Equipment Name:- Truck Loading Machine / Truck Loader	**Quantity Required :-** 3

APPLICATION DATA

Applicable To :- □ Proposal □ Purchase □ As Built	
Service :- To load 45 kg. Urea filled bag to Truck	**Make & Model :-**
Type :- Forward & backward movement, Retractable & Telescopic boom	
Duty :- Continuous, 24 hrs/day	**Relative Humidity : -** 100% (Max.)
Temperature :- Ambient	**Surroundings :-** Dusty & Corrosive

TECHNICAL SPECIFICATION

Loading Capacity, Bags / hr :	
Normal/Rated **:-** 1000	**Power Consumption**, **KW** :-
Design **:-** 1200	**No. of drive/motors with KW :-**
Bag size, mm (approx.) :- 800 x 500	1. 2. 3.
Bag Material :- HDPE /PP bag filled with urea	

CONSTRUCTIONAL FEATURES

Overall dimension of machine, mm (L x W x H):-	
Rail c/c distance, mm :-	**Rail load data, KN :-**
Length of inlet telescope, mm :-	**Length of outlet telescope, mm :-**
Maximum running of telescope, mm :-	
Shuttle Wheel detail :-	
Shuttle motion drive detail :-	
Telescopic receiving belt conveyor :	
No. of Telescope :-	No. of conveyors :-
Belt Width, mm :-	Take-up :-
Belt Detail :-	
Belt Drive :-	
Telescopic Drive :-	
Loading Belt Conveyor :	
Belt Width, mm :-	Belt Speed, m/sec :-
Belt Detail :-	
Drive detail :-	
Swivelling Motion :-	
Luffing Motion :-	
Electrical Data :-	
Total Wt. of Complete machine, Kg :-	
MATERIAL OF CONSTRUCTION :- All parts in contact with urea (except belt) shall be min. SS304	
REMARKS:- Contractor/bidder shall furnish filled in data sheet along with their offer.	

Equipment Name:- Wagon Loading Machine / Wagon Loader	**Quantity Required :-** 12

APPLICATION DATA

Applicable To :- □ Proposal □ Purchase □ As Built	
Service :- To load 45 kg. Urea filled bag to wagon	**Make & Model :-**
Type :- Travelling, Rotational, Retractable & Telescopic boom	
Duty :- Continuous, 24 hrs/day	**Relative Humidity : -** 100% (Max.)
Temperature :- Ambient	**Surroundings :-** Dusty & Corrosive

TECHNICAL SPECIFICATION

Loading Capacity, Bags / hr :	
Normal/Rated **:-** 1000	**Power Consumption**, **KW** :-
Design **:-** 1200	**No. of drive/motors with KW :-**
Bag size, mm (approx.) :- 800 x 500	1. 2. 3.
Bag Material :- HDPE /PP bag filled with urea	

CONSTRUCTIONAL FEATURES

Overall dimension of machine, mm (L x W x H):-	
Rail c/c distance, mm :-	**Rail load data, KN :-**
Telescopic receiving belt conveyor :	
No. of Telescope :-	No. of conveyors :-
Belt Width, mm :-	Take-up :-
Belt Detail :-	
Belt Drive :-	
Telescopic Drive :-	
Carriage / Loader trolley :	
No. of wheel :-	Wheel Dia, mm :-
Travel speed, m/sec :-	Load per wheel, KN :-
Drive detail :-	
Bag Diverter :-	
Electrical Data :-	
Total Wt. of Complete machine, Kg :-	
MATERIAL OF CONSTRUCTION :- All parts in contact with filled bag (except belt) shall be min. SS304	
REMARKS:- Contractor/bidder shall furnish filled in data sheet along with their offer.	

SECTION VI- 3.1.2

DESIGN PHILOSOPHY – ROTATING EQUIPMENT

UREA HANDLING & BAGGING PACKAGE

[UREA (NEEM OIL COATED) HANDLING SYSTEM, BULK SILO AND BAGGING SYSTEM INCLUDING FILLED BAGS STACKING/ LOADING TO WAGON & TRUCK)

PLANT: AMMONIA-UREA PLANT BASED ON COAL GASIFICATION

PROJECT: INTEGRATED ROM BASED FERTILISER COMPLEX AT TALCHER, ANGUL DISTRICT, ODISHA (INDIA)

TABLE OF CONTENTS

1.0 SCOPE

1.1 General

This Philosophy states that contractor's scope of work shall include basic & detailed engineering, procurement, supply, manufacturing, fabrication, transportation, loading, unloading, insurance during transit, storage, construction, erection/ installation of all **Mechanical Rotating Equipment** with allied electrical & instrumentation excluding civil works, obtaining all necessary statutory approvals from concerned government authorities as applicable, testing, mechanical completion, pre-commissioning, commissioning, performance guarantee test runs including total project management and handing over of UREA HANDLING & BAGGING PACKAGE of prescribed capacity for **M/s Talcher Fertiliser Ltd. (TFL).**

In addition, all statutory rules & regulations shall also be complied with.

2.0 DESIGN PHILOSOPHY FOR MACHINERY

2.1 Codes and Standards

Latest Edition of National / international codes and standards shall be followed for design and manufacturing of different machinery items. Generally the manufacturer will comply with these codes and standards with minor deviations that are normally adopted by manufacturer and are reasonably accepted as per good engineering practice by owner.

A list of such deviations, if any, shall be furnished by the LSTK Contractor / Packager / Packager/ Packager along with offer.

Code	Description
API 610	Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industry
ANSI/ ASME B 73.1 M	Horizontal, End Suction centrifugal Pumps for Chemical Process
International Standard	Horizontal Centrifugal Pumps for Clear Cold Water
API 611	General-Purpose Steam Turbines for Refinery Service.
API 612	Petroleum, Petrochemical and Natural Gas Industries Steam Turbine - Special Purpose application
API 613	Special Purpose Gear Units for Petroleum, Chemical and Gas Industry Services

API 614	Lubrication, Shaft-Sealing, and Control Oil System for Petroleum, Chemical and Gas Industry Services
API 616	Gas Turbine for Petroleum, Chemical and Gas Industry Services
API 617	Axial, Centrifugal Compressors and Expander Compressor for Petroleum, Chemical and Gas Industry Services
API 618	Reciprocating Compressors for Petroleum, Chemical and Gas Industry Services
API 619	Rotary Type Positive Displacement Compressors for General Refinery Services.
API 670	Vibration, Axial-Position, and Bearing- Temperature Monitoring Systems.
API 671	Special Purpose Coupling for Refinery Services, Petrochemical and Gas Industry .
API 673	Special Purpose Centrifugal Fans for General Refinery Services.
API 674	Positive Displacement Pumps-Reciprocating
API 675	Positive Displacement Pumps-Controlled Volume
API 676	Positive Displacement Pumps-Rotary.
API 678	Accelerometer and Vibration Systems.
API 682	Shaft sealing Systems for Centrifugal and Rotary Pumps.
API 685	Sealless Pump (Magnetic & Canned)
ISO / DIN	Centrifugal Pumps for smaller size & Non Critical Services.
International Standard, ASHRAE / ISHRAE	HVAC
Performance Testing (ASME Codes)	
PTC 8.2	Centrifugal Pump
PTC 6	Steam Turbines
PTC 9	Displacement Compressors
PTC 10	Centrifugal Compressors
PTC 11	Centrifugal Fans
PTC 22	Gas Turbines
AGMA Standard	
420	Practise for Enclosed Reducers or Increasers using Spur, Helical, Herringbone and Spiral Bevel Gears.

421	Practise for High Speed Helical Gear Units.
NEMA Standards	
SM 23	Steam Turbine for Mechanical Drive Service.

2.2 Design Life

All equipment shall be designed for a minimum service life of 25 years and at least 2 years of uninterrupted operation under normal operating conditions. This requirement excludes specialised components requiring periodic maintenance and replacement.

2.3 Essential Project Reference Documents

The following documents shall be observed, and relevant aspects incorporated into specifications and datasheets:

- Process Description, Specifications and Data Sheets.
- Hazardous Area Classification
- Electrical and Instrumentation Design Criteria

2.4 Regulations

Besides codes & standards, LSTK Contractor / Packager shall follow National Laws and Regulations together with Local by Laws for the state including statutory requirements as applicable.

2.5 Site Conditions

Site conditions shall be as defined elsewhere.

2.6 Material of Construction

Generally Materials of construction shall be as per the process part of NIT.

Use of equivalent & superior material may be selected & shall be furnished with the offer along with chemical composition.

2.7 Quality Assurance & Control

2.7.1 The quality assurance shall be as per the approved procedures, test methods & facilities to be developed by the LSTK Contractor / Packager to ensure that the supplied equipment shall be of highest quality. The quality control shall mean that all the tests , measurements, checks & calibration which are to be carried out may be compared with the actual specified characteristics of the equipments/unit /system.

2.7.2 Quality Assurance (QA) shall mean the organizational set up, procedures as well as test methods and facilities developed by LSTK Contractor / Packager in order to assure that the machines & associated auxiliaries leaving LSTK Contractor's shop are of the highest possible quality i.e. either equal to or better than the requirement specified.

2.7.3 Quality Control (QC), shall mean all the tests, measurement, checks and calibration which are to be carried out in LSTK Contractor's shop in order to compare the actual characteristics of the equipment/unit/system with the specified ones, along with furnishing of the relevant documentation (certificates/records) containing the data or result of these activities.

2.7.4 LSTK Contractor/ Packager shall submit a comprehensive description (manual) of QA/QC measures contemplated by him for implementation with regard to this specification. It is contractual obligation of the LSTK Contractor / Packager / Packager to develop and implement adequate QA/QC systems.

2.7.5 QA/QC system shall cover all products and services required for the complete machine unit as per scope of work including job sub contracted by the LSTK Contractor.

2.8 Order of precedence:

In case of any ambiguity found w.r.t details of Rotating equipments, following order of precedence (in order of priority) shall be followed:

1. Process Datasheet of rotating equipment
2. Applicable Codes & Standards referred in this Design philosophy
3. This Design philosophy document.

3.0 DESIGN REQUIREMENTS

3.1 General

- All machines shall be directly coupled to their prime movers. V-Belt driven system is not preferred. If not, specifically mentioned, the drivers shall have rated output at least 10% greater than the power requirement at design operating condition of the driven equipment.
- Copper (Cu) or Cu-alloy shall not be used for any components.
- All type of pumps/Agitator/Rotating equipments shall have Mechanical Seals.. Seal manufacturer recommendation may be asked as per applicability. Gland packing is not acceptable.
- Special tools and wrenches required for installation and maintenance shall be provided.

- Noise level for all rotating equipment shall be limited to 85 dBA measured at 1 meter distance from the equipment.
- Packager/Contractor have to submit the reference list for similar equipment's models (minimum 2 nos.) supplied in past for similar duty conditions. Reference list must contain at least the following: Fluid handled Capacity, Suction Pressure, Discharge Pressure, Model No., Power consumption, Client Name, Address, and Year of supply & commissioning.
- All running equipment shall have a stand-by unit installed.
- Rotary equipment base frame is to be grouted by epoxy grout.
- Pump alignment to be done by Laser and alignment machine to be handed over to client after completion of project

3.2 Centrifugal compressors

- The centrifugal compressors shall conform to API 617, latest edition. In addition, following points shall be applicable:
- All machines shall have stable operating characteristics. The head generated shall rise continuously from choke point to surge point.
- The manufacturer's criteria for suction and discharge piping shall be incorporated into the piping design and layout.
- Torsional and lateral critical speed analysis shall be carried out and it shall be ensured that no critical speed (Torsional or lateral) shall be within 15% of any operating speed.
- Casings shall be preferably centre line supported.
- Vertical split (Barrel type) compressors shall have the inner casing designed for easy withdrawal from the outer shell and easy reassembly for inspection or replacement of parts.
- Impellers shall be welded or electrochemically eroded. Tip speed of the impeller shall not exceed 310 m/s.
- Diaphragm type coupling of proven make like Bendix shall be used. The couplings shall be designed as per API-671.
- Dry Gas seals shall be provided for centrifugal compressors except for Process Air & CO2 compressor.
- Combined lubrication and seal oil system (as applicable) shall be provided as per API 614 (latest edition) for each compressor and drive turbine. All the lube oil piping shall be made of SS.
- Twin oil cooler and twin oil filter shall be provided.
- For machines with oil seals, two seal oil traps shall be provided with each casing - one for each seal. These traps shall be sized and interconnected so that each trap

is capable of accepting the flow from both the seals while one trap is removed for maintenance.

- Complete Anti-Surge control system with computerised calculations with compressor characteristics shall be provided for each machine.
- Shaft vibration monitoring instruments (both radial and axial) shall be provided to trip the machine in case of high radial vibration or axial movement.
- All the trip interlock shall be two out of three voting logic.
- All the transmitters shall be smart type and suitable for communication with DCS.

3.3 Reciprocating Compressors

- The reciprocating compressors shall conform to API-618, latest edition. In addition to the above, the following shall be applicable:
- Lateral and torsional critical speed analysis shall be carried out to ensure the elimination of any lateral and torsional vibration that may hinder the operating speed range.
- Machine shall be balanced to minimise lateral loads.
- The piston speed for lubricated cylinder shall not exceed 4 m/s and for non-lubricated cylinders it shall be limited to 3 m/s.
- Distance piece of non-lubricated compressor shall of sufficient length to ensure that no oil is in contact with gland packing.
- The design of compressor valve shall be such that the valve assembly cannot be inadvertently reversed e.g. Suction valve cannot be fitted into the discharge port.
- Valve plates and springs shall be made of stainless steel. PEEK may be used for valve plates in case the vendor has experience of using it for similar service and duty conditions.
- Cylinders shall be water cooled.
- The maximum piston rod loading shall be calculated considering safety valve set pressure.
- Non-lubricated compressors shall be provided with piston rings, packing made of carbon filled PTFE or equivalent.
- The packing boxes shall be provided with atmospheric vents to minimize gas leakage.
- Pulsation dampeners shall be provided for meeting the residual pulsation requirements as per API.
- For API compressors the requirements for acoustic study shall be in accordance with the API recommendation.

- To minimise the need for heavy overhead pipe structures, suction and discharge piping to and from the knockout drums should run close to grade, supported on sleepers.
- Frame lubrication system shall be provided with auxiliary pump driven by electric motor for initial lubrication.
- Cylinder lubrication, if required, shall be provided by a separate forced feed mechanical lubricator complete with necessary tubing/piping, check valve and sight flow indicator.
- Bidder to follow the Vendor list attached with the ITB for the selection of Vendors.
- Full flow twin oil filter shall be provided.

3.4 Screw Compressor (If applicable)

The Compressor shall be designed as per API 619 latest edition.

3.5 CENTRIFUGAL PUMPS

3.5.1 Requirement

- The pumps shall be designed as per API 610, latest edition. The pumps shall be of robust design to ensure long service life and minimum maintenance requirement. The pumps shall be designed for easy access for inspection and maintenance. All continuously running pumps shall have a spare pump.
- All pumps shall have continuously rising head curve from any specified operating point to shut off point. Pumps running in parallel shall have equal head rise to shut off point.
- All pumps shall be designed for 20% overload.
- The pump shall be designed to develop the specified differential head at rated capacity, suction pressure and specific gravity while running at the rated speed. Rated speed of pump shall be full load speed of the drive motor. In case the driver is not in pump vendor's scope, full load speed of the driver shall be furnished to the pump vendor along with other details after order. The pump characteristics shall be guaranteed / tested with reference to the full load speed of motor.
- The pumps should have stable operating characteristics. The pump head at shut off shall be approximately 110% of head at rated capacity and not exceeding 120%.
- Best efficiency point shall be as close as possible to normal operating point.
- Guarantee point shall refer to the differential head, rated capacity, specific gravity, and full load speed of the driver.
- The pump and accessories shall be suitable for outdoor, unsheltered installation and continuous duty unless otherwise specified in the respective specification sheets.

- The pumps shall be supplied complete with all the accessories as specified in the respective specification sheets inclusive of necessary appurtenances, auxiliary piping, companion flanges at all terminals points, special tools, spares etc.
- Accessories required / recommended by pump vendor other than those specified in the pump specification sheet for safe and efficient operation of the pump unit shall be included in the pump vendor's scope of supply and the same shall be identified in the bid separately with adequate justification.
- Pumps shall have SI dimensions; comply with applicable ISO standards except for piping connections which shall be as per ANSI/ASME standard.
- Reference list of pumps which are in operation for similar service conditions shall be furnished with the offer indicating broad specifications, purchase order number, date and name & address of user.
- The maximum calculated axial load shall not in any operating condition exceed 50% of bearing manufacturer's load rating.
- Metastream type of coupling shall be provided. Coupling guard shall be non-sparking for pumps located in hazardous area.
- Mechanical seal of John crane / Flowserve sanmar / Eagle-Burgmann make only shall be provided. No other manufacturer shall be acceptable. Only balanced mechanical seal shall be used.
- All continuously running pumps shall have a stand-by pump.

3.5.2 Basic Design

- It should be possible to increase the head minimum by 5% by installing higher size impeller.
- In addition to static balancing, impellers shall be dynamically balanced as per G6.3 of ISO-21940.
- Pump inlet, outlet and auxiliary connections shall be flanged. All connections shall be provided with slip-on type companion flanges, nuts, bolts and gaskets.
- Connections of 11/4, 21/2, 31/2, 5, 7 nominal pipe sizes shall not be used.
- When specified, pump shall be provided with drip tray under the stuffing box and leak-off line with flange, companion flange, nuts, bolts and gaskets. Material composition shall be same as that of pump casing. Leak - off piping shall be arranged upto the edge of the base plate and shall be suitably terminated by bidder to hook-up point.
- Pump inlet, outlet and auxiliary flanged connections shall confirm to the facing and drilling requirements of ANSI / ASME B 16.1 or ANSI / ASME B16.5.
- All equipment shall be designed to permit rapid and economical maintenance. Major parts such as casing components and bearing housings shall be designed (shouldered or doweled) to ensure accurate alignment on reassembly.

- Impeller shall be keyed to the pump shaft. Impeller nut shall be used to secure the impeller and a positive mechanical locking method shall be adopted.
- The pump shaft shall be one piece for horizontal pumps. For vertical pumps number of shafts shall be minimum.
- Shafts for horizontal pumps shall be fitted with deflectors. Deflectors shall be made of non-sparking material (corrosion resistant material for corrosive service).
- Renewable wear ring surfaces shall be furnished on impeller and casing Mating wear surfaces of hardenable materials shall have a difference in Brinell hardness number of at least 50.
- Radial and thrust bearings shall be rolling element type. These shall be designed for minimum 24,000 hours bearing life.
- For between bearing pumps arrangement, bearing housing shall be cast integral with the lower half of the pump casing or bolted to it. Bearing housing should be provided with stiffening brackets and be sufficiently rigid to resist the dynamic loads during operation.
- Castings shall be sound and free from shrink holes, blow holes, cracks, scale, blisters and other similar injurious defects. When weld repairs to castings are authorized by ASTM specification for the material, repair welding shall be carried out in accordance with that specification. Unless otherwise specified, weld repairs shall be inspected according to the same quality standards used to inspect the casting.
- Material of construction of pump parts shall be as per pump specification attached with process specification. If the vendor considers other materials better, same shall be offered as an alternative only. Materials not specified in the specification sheet shall be selected by the vendor in accordance with the service conditions and based on relevant codes & standards. Chemical composition and physical properties of the materials (MOC), wherever used by bidder, must be proven ones and furnished along with the offer
- A name plate of 18 Cr - 8 Ni Stainless Steel or Monel, securely attached by stainless steel pins at an easily accessible point on the pump body shall be furnished. The name plate shall be stamped with following information:
  - Purchaser's item number
  - Pump serial number
  - Capacity in m^3/h
  - Differential head in meters
  - Revolution per minute
  - Casing hydrostatic test pressure in kg / cm^2g
  - Absorbed power in kW
- Motor shall have power ratings including service factor at least equal to following percentage of pump rated absorbed power. :

Pump	Motor rating percentage of absorbed power
< 22	125
22 - 55	115
> 55	110

- Vendor shall indicate for vertical pumps, minimum liquid level for pump operation / startup in the offer.
- For vertical pumps, a hole shall be provided in the column pipe above the maximum liquid level to relieve pressure on stuffing box.
- For vertical pumps, the specified head shall be measured at the discharge flange, at pump mounting level. Pumps shall be suitable to develop specified discharge head in addition to column losses and vertical distance, between minimum level in the sump tank and center line of the discharge flange. Pump vendor shall indicate total head to be developed by the pump in the offer.
- Vertical pumps taking suction from sump / vessel shall be furnished with corrosion resistant suction strainer. Perforation / mesh size shall be suitable for proper operation of pump. Sufficient free flow area of the strainer shall be provided.
- Pumps shall be provided with shaft sleeve under mechanical seal.
- Shaft sleeves shall be hard chrome oxide coated under flexible member of mechanical seal.
- Gland Packed pumps shall not be offered.
- When pumps are specified with mechanical seals: Make of mechanical seal shall be Flowserve, Eagle Burgmann, John Crane make.
- Mechanical seal shall be inside mounted, balanced type with Carbon versus Tungsten Carbide faces or Carbon versus Silicon Carbide faces. Suitable flushing plan shall be provided.
- Coupling make shall be as follows:

Driver rating up to 25 kW	:	Lovejoy (RRL), Pinbush type Unique, Flender
Driver rating more than 25 kW	:	Pinbush type/All metallic ype Rathi-Discoflex type M, Euroflex,Triveni-Flexibox

3.6 Reciprocating Pump / Metering pumps/ Screw pump

- Reciprocating pump shall be designed as per API 674 latest edition and metering pump shall be designed as per API 675 latest edition. Screw pumps shall

be designed as per API 676 latest edition along with API 682 compliance mechanical seal.

- The metering pumps shall be suitable for continuous capacity variation from 0 to 100%. The capacity variation should be possible while the pumps are working.

3.6 CENTRIFUGAL FANS / LOBE BLOWERS

- Centrifugal fans/ blower shall be designed as per AMCA standard or equivalent relevant national/ international codes, latest edition.
- Forced and induced draught fans shall be coupled to drivers through shim pack dry flexible coupling, and the complete assembly shall be mounted on a substantial bedplate.
- First critical speed of the rotor shall be higher than 120% of rated speed. Rotor assembly shall be dynamically balanced.
- Capacity control shall be achieved by means of dampers (Preferably on suction side) especially for constant speed fans, as applicable.
- The fan casing shall be suitably split such that impeller assembly can be removed for maintenance without disturbing inlet and outlet ducting.
- SS bolts and nuts shall be provided for the split casing joints of fans for corrosive service.
- The drive motors of the fans/ blower should be designed with additional capacity to take care of surge loading. However Motor rating shall be minimum 125 % of shaft power for shaft power up to 22 KW, 115 % of shaft power for shaft power between 22 – 55 KW and 110 % of shaft power for shaft power above 55 KW.
- Bearing shall be preferably oil lubricated.

3.7 AGITATOR

Agitators shall be manufacturer as per relevant national / international codes & standards. Assembly shall be such as to enable replacement of bearings, shaft sealing devices, gear unit and driver without dismantling other major parts of unit and without emptying or depressurising the vessel.

First critical speed of the rotor shall not be less than 140% of rated speed.

Adequate space shall be provided for packing replacement without removing or dismantling of any part other than the gland and the seal cage.

Motor rating shall be minimum 125% of shaft power.

Flexible coupling shall be provided between the power drives and agitator shaft or gear, and shall have minimum service factor of 2.

Spacer type coupling shall be provided for units provided with Mechanical Seals. The spacer shall be of sufficient length to permit replacement of the seal assembly without removing the driver / gear.

Gear unit shall be provided in accordance with AGMA standard. Gear box rating shall be selected based on minimum service factor of 1.5.

Agitators including drivers and transmissions shall be suitable for outdoor installation with no shelter.

3.6 HVAC System

Complete design of air-conditioning system (heat load calculations for all three seasons, i.e. summer, monsoon & winter with psychometric plots specifying the design TR capacity, dehumidified air quantity and monsoon/winter heating capacity)

Air conditioning system & air flow ventilation rate should be sufficient to satisfy not only air removal specification, but also to maintain over pressure and temperature specification.

It should be also capable to avoid wind penetration in order to meet the requirements of a conditioned space, simultaneous control of temperature, humidity, cleanliness, contamination and air distribution should be considered in design & selection of HVAC equipment.

Environment friendly refrigerant to be used in HVAC equipment.

All civil buildings / facility, Control room, substation, labs etc to be equipped with suitable HVAC system with 100 % redundancy for central air-conditioning system.

For Stand by philosophy, it shall be noted that 1 no. stand by AC unit/system shall be considered for up to 3 nos. working Package AC units. However 2 nos stand by AC system/units shall be considered between for 4 to 6 working AC units/systems.

Site related temperature, humidity shall be considered for adequate design & selection of HVAC system along with compliance to National / international codes and standards viz. ISHRAE/ ASHRAE.

One full charge of refrigerant for each air condition system to be provided as a spare.

4.0 INSPECTION & TESTING

Machines shall be inspected by Third Party Inspection Agency (Lloyds/BV/TUV/PDIL). The Inspection and testing shall be in accordance with the all relevant codes, standards, specifications, including the minimum guide line given.

4.1 All testing accessories, measuring instruments including NDT testing equipment, etc. shall be arranged by LSTK Contractor / Packager. DM water shall be used for hydro testing of the equipment.

4.2 In general, following tests shall be conducted for all rotating equipments:

- Material test
- Non-destructive test
- Hydrostatic test for all the pressure containing parts (1.5 times of MAWP)
- Dynamic balancing of rotor
- Helium leak test
- Mechanical running test for 4 hrs
- NPSHR test for pumps (in case difference of NPSHr & NPSHa is less than 1 m)
- Performance Test
- Disassembly Test
- Strip test

5.0 PAINTING

All exterior non-stainless steel surfaces subject to atmospheric corrosion with the exception of machined surfaces shall be epoxy painted. All exterior machined surfaces shall be coated with suitable rust preventives.

SECTION – 3.1.3

DESIGN PHILOSOPHY-STATIC EQUIPMENT

FOR

[UREA (NEEM OIL COATED) HANDLING SYSTEM, BULK SILO AND BAGGING SYSTEM INCLUDING FILLED BAGS STACKING/ LOADING TO WAGON & TRUCK]

PLANT: AMMONIA-UREA PLANT BASED ON COAL GASIFICATION

PROJECT: INTEGRATED ROM BASED FERTILISER COMPLEX AT TALCHER, ANGUL DISTRICT, ODISHA (INDIA)

0	26.07.21	26.07.21	Issued for Tender	BS	BS	RRK
P	19.10.20	19.10.20	Draft Issue for client comments	BS	BS	RRK
REV	**REV DATE**	**EFF DATE**	**PURPOSE**	**PREPD**	**REVWD**	**APPD**

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1. 0 Design Criteria

1.1 This specification covers the requirements for the complete design (Mechanical), procurement, fabrication, construction/erection, insulation, painting ,Pickling & Passivation (for SS equipments), inspection and testing of static equipment for urea handling & bagging package of M/s Talcher Fertiliser Ltd. (TFL) in accordance with this specification, standards specification, codes and other attachment etc. listed in bid document.

1.2 The equipment shall be designed & constructed as per the latest edition of the following codes and standards:

Code	Description
ASME Section VIII Div 1	Rules for construction of Unfired Pressure Vessels
API 650	Welded Steel Tanks for Oil Storage
ASME Section II A & B/ ASTM	Materials Specifications
ASME Section II PART C	Specification for welding rod, electrode & filler metal
ASME SEC II PART D	Properties
ASME Section V	Non-destructive Examination
ASME Section IX	Welding Qualification
ASME B 16.5	For Flanges
ASME B 16.47	For large diameter flanges
ASME B 16.20	For Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral Wound, and Jacketed
ANSI	Pipes, Flanges, Fittings and Valves
IS: 875 / SITE DATA	For wind load consideration
IS: 1893 (Part 4) & IS: 1893 (Part 1) / SITE DATA	For seismic design consideration

1.3 Complete mechanical design of Equipment as per latest code /standard of construction shall be the responsibility of the LSTK Contractor. Strict compliance with the requirement of codes/equipment specification & any other referred document shall be ensured. In addition, all statutory rules & regulations shall also be complied with.

1.4 Design conditions for all equipment shall be as per technical Specification and Material specification. Minimum required thickness is calculated based on design parameters considering different types of loadings including effect of static head of liquid column. Equipment shall also be designed for hydrostatic condition. Final thickness is decided giving due consideration for corrosion allowance.

1.5 Design pressure shall be at the top of vertical vessel or at the highest point of horizontal vessel. The design pressure at any lower point shall be determined by adding the maximum operating liquid head and any pressure gradient within the vessel.

1.6 Wind analysis shall be performed as per IS-875 (Latest Edition).Wind forces shall be increased by 20% (over & above design code requirement) to cater the effect of piping system, platforms and ladders etc.

1.7 Seismic analysis shall be performed by Response spectrum method (RSM) considering seismic zone-IV as per IS-1893 part-1 & IS-1893 Part 4 (Latest edition).

1.8 All carbon steel (CS) & low alloy steel (LAS) pressure parts shall have 3 mm corrosion allowance unless specified otherwise.

1.9 All internals CS/ LAS parts including low temperature materials shall have at least 1.5 mm corrosion allowance on either side unless otherwise specified.

1.10 Design of supports and anchor bolts shall be performed for compressive and tensile loading. In no case shall diameter of anchor bolts be less than M24 for skirt support and M16 for other type of support.

1.11 Each Lifting lug shall be designed with shock factor 2.

1.12 Hydro testing of equipment shall be as per UG-99b of ASME Sec VIII Div-1. In order to safeguard against the risk of brittle fracture during hydrostatic test metal temperature during hydrostatic test be maintained at least 30°F (17°C) above the minimum design metal temperature, but need not exceed 120°F (48°C). Design pressure for each nozzle shall be sum of maximum allowable working pressure and static head of corresponding nozzles.

1.13 Maximum Allowable Working Pressure (MAWP) is the maximum gauge pressure at the top of a completed vessel, which is obtained from the calculations for every element of the vessel based on the actual thickness in the corroded condition. Supplier shall calculate the MAWP of each vessel, and the calculation shall be included in design calculations. MAWP shall not be assumed to be the same as the design pressure except for cases where MAWP cannot be determined by calculation to the applicable code. Accordingly calculate hydro test pressure as per UG-99b

1.14 Bolt of size M 48 and above shall be designed and spaced so as to permit tightening with a hydraulic stud-tensioner. The bolts shall have an extra threaded length at one end of approximately 1 bolt diameter, and shall be provided with threaded protection caps. Hex nuts shall have suitable holes for manual tightening. The requisite no. of hydraulic stud-tensioner device with necessary adopters/insertions based on varying sizes of studs shall be supplied by bidder as per mechanical design of the equipment.

1.15 Orientation of longitudinal seams and position of circumferential seams shall be clearly marked in the fabrication drawing. Nozzles, support and other attachments shall be located clear of welded joints.

1.16 All process equipments shall be supplied with Nitrogen filled. In case of equipment assembled and welded at site, it shall be filled with N2 after testing at site. Dry Nitrogen shall be filled at a pressure of 0.5 Kg/cm2g and equipment shall be fitted with a pressure gauge and valve.

1.17 Bidder shall guarantee the equipment & their components against faulty design with regard to their mechanical adequacy, improper material of construction & poor workmanship for the period specified in contract.

1.18 Bidder shall stand Performance Guarantee of equipment as per respective technical specifications/Process Data sheets.

1.19 Design conditions for all equipment shall be in accordance with the process data Sheets/specification .However, in any case design pressure shall not be lower than 10% over the maximum anticipated operating pressure and design temperature should be 25°C higher than the maximum anticipated operating temperature for all equipment unless otherwise specified.

1.20 Basic allowable stresses for shell, heads and other components etc.of vessels and shell, roof, etc. of tanks shall be the values specified in the design code.
Maximum allowable “tensile stress” and “compressive stress” shall be as per UG-23 of ASME Sec VIII Div -1. These stresses may be increased by 20% for earthquake & wind combination case in line with UG-23 (d).

1.21 All blind flanges and man way covers weighing 35 kgs or more shall be fitted with handling Facilities such as davits.

1.22 As a General rule all nozzle attachment to shell/head shall be set in type.

1.23 In case of conflict between this specification and other specification, codes and data sheets. It shall be referred to PDIL/ Owner for clarification and the decision of PDIL/Owner shall be final & binding on contractor without any cost & delivery implications. However, it shall be resolved considering the most stringent in the following order

- Statutory requirement
- Requirement specified in this specification
- Process data sheet/ P&ID
- Applicable codes & standards

1.22 REGULATIONS

Besides codes & standards, LSTK Contractor shall follow National Laws and Regulations such as Indian Boiler Regulation and Department of Explosives, Nagpur, India together with Local by Laws for the state including statutory requirements as applicable. Static and Mobile Pressure Vessel (SMPV) rules as applicable shall also be complied with.

PUBLICATIONS:

WRC Bulletin # 107	Local Stresses in Spherical & Cylindrical Shells due to External Loadings.
WRC Bulletin # 297	Local Stresses in Cylindrical Shells due to External Loadings on Nozzles

1.23 **DESIGN DOCUMENTATION**

1.23.1 Detailed design calculations considering different loadings shall be made as per code/standards and the additional requirements as mentioned below:-

1.23.2 Design of equipment inside the offsite plant complex shall be in accordance with the process licensor’s data sheets and specifications.

1.23.3 LSTK Contractor shall consider the interfaces with other engineering disciplines w.r.t.

- Piping Layout/Location Drawings
- Civil / Structural Drawings
- P & ID's
- Materials
- 3D PDS Model for Piping and Equipment Layout
- Hazardous Area Classification

1.23.4 Design philosophy of other disciplines shall be observed and shall be relevant to the extent applicable.

- Civil/Structural Design Criteria
- Piping Design Criteria
- Process Design Criteria
- Electrical and Instrumentation Design Criteria

1.24 CONSTRUCTION & ERECTION

1.24.1 LSTK Contractor shall follow standard established procedures for handling storage, construction & erection. LSTK Contractor shall strictly follow Manufacturer's/Principal's instructions, approved drawings and procedures for construction & erection and satisfy Principal in all respects of storage, handling, construction & erection of Package. All erection work shall conform to the working/erection drawings (to be prepared by LSTK Contractor) and shall be in conformity with codes & standards as applicable. The LSTK Contractor shall supply & arrange all necessary construction & erection tools and tackles, machinery, scaffolding etc.

1.24.2 LSTK Contractor shall perform the following:

i) Before installing the equipment, the foundations shall be checked and wherever Necessary, chipping shall be done by the LSTK Contractor. All grouting materials,packing plates/wedges required for the levelling and alignment of equipment, structures & pipelines etc shall be provided.

ii) Top of the foundations shall be thoroughly cleaned to the satisfaction of Principal / LSTK Contractor before placing base plates.

iii) All equipment & structure etc. shall be checked and inspected for its proper levelling and granting (grouting) shall be done with suitable grouting material as required.

iv) After tightening the foundation bolts, the final level / alignment shall be rechecked and redone, if required.

v) Installation of all supports and hangers, including concreting or welding as necessary.

vi) To check correctness of the piping, instruments and other connecting points in the equipment and piping installed.

vii) The welding joints shall be stress relieved wherever necessary as per applicable codes, Standards & specification.

1.24.3 The following shall be arranged and supplied by LSTK Contractor for completion of job. Any other item whatsoever required shall also be included by LSTK Contractor in their scope.

i) All construction & erection materials, equipment & machinery, scaffolding, consumable, and test equipment etc.
ii) Cranes/Hydra, temporary lifting beams and spreaders etc.
iii) Procedures for site assembly, construction & erection including lifting methodology for Owner/Third party approval

.

1.24.4 As a minimum contractor shall comply the requirements indicated below:

i) Fabricate, erect and align the equipment & internals as per applicable codes, standards & specifications. All internals shall be inspected before and after installation.

ii) Carry out all NDT's required. The Personnel performing NDT's should have a minimum qualification as "NDT LEVEL-II" in the relevant Technique, certified by American Society for Non-destructive Testing.

iii) Perform non-operating field pressure tests and leak tests on field fabricated equipment in accordance with the applicable codes, standards and specifications, ensuring disposal of test media in accordance with instruction/recommendations

.

iv) Notify Owner / Third party of the test schedules for witness the tests by concerned inspector.

1.25 QUALITY ASSURANCE & CONTROL

1.25 1 The quality assurance shall be as per the approved procedures, test methods & facilities to be developed by the LSTK Contractor to ensure that the supplied equipment shall be of highest quality. The quality control shall mean that all the tests , measurements, checks & calibration which are to be carried out may be compared with the actual specified characteristics of the equipments/unit /system.

1.25.2 Quality Assurance (QA) shall mean the organizational set up, procedures as well as test methods and facilities developed by LSTK Contractor in order to assure that Equipment leaving LSTK Contractor's shop are of the highest possible quality i.e. either equal to or better than the requirement specified.

1.25.3 Quality Control (QC), shall mean all the tests, measurement, checks and calibration which are to be carried out in LSTK Contractor's shop in order to compare the actual characteristics of the equipment/unit/system with the specified ones, along with furnishing of the relevant documentation (certificates/records) containing the data or result of these activities.

1.25.4 LSTK Contractor shall submit a comprehensive description (manual) of QA/QC measures contemplated by him for implementation with regard to this specification. It is contractual obligation of the LSTK Contractor to develop and implement adequate QA/QC systems. QA/QC System shall cover all products and services required for the equipment as per scope of work including job sub contracted by the LSTK Contractor.

2.0 Material of Construction

2.1 Material of construction for various equipment shall be as selected as follows for general Condition/service unless specified otherwise in respective process data sheet.

a) **Pressure Vessel (KCS/CS)**

Shell /Head plates	: SA 516 Gr. 60/70 (Epoxy /rubber Line as applicable)
Nozzle Flange	: SA 105 (Epoxy /rubber Line as applicable)
Nozzle Neck (Pipe/Plate)	: SA 106 Gr. B (Nozzle size < 10"); SA 516 Gr. 60/70 ((Epoxy /rubber Lined as applicable) (Nozzle size > 10")
Non standard forging	SA 266 Gr 2 (Epoxy /rubber Line as applicable)

b) Pressure Vessel (SS)

Shell /Head plates	: SA240 Gr*
Nozzle Flange	: SA 182 Gr*
Nozzle Neck (Pipe/Plate)	: SA 312 Gr* (Nozzle size < 10"); SA 240 Gr * (Nozzle size > 10")
*SS grade as specified in datasheet	

b**)** CS Tanks

Shell/ Roof /Bottom Plates	: IS2062 GR B/SA36 with Epoxy /rubber lining as applicable)
Nozzle Flange	: SA 105 (Epoxy /rubber Lined as applicable))
Nozzle Neck (Pipe/Plate)	: SA 106 Gr. B (Nozzle size < 10"); IS 2062 GR B/SA36 (Epoxy /rubber Lined as applicable) (Nozzle size > 10")
Stud/ bolts and nuts for nozzles fitted with blind flange	SA193 Gr B7/ SA 194 Gr. 2H
b) **SS Tanks/ Non- Coded Vessel**	
Shell/ Roof /Bottom Plates	: SA240 Gr *
Nozzle Flange	: SA 182 Gr*
Nozzle Neck (Pipe/Plate)	: SA 312 Gr* (Nozzle size < 10"); SA 240 Gr * (Nozzle size > 10")
Non standard forging	: SA336 Gr *
*SS grade as specified in datasheet	

2.2 The Additional material requirements as indicated below shall be considered by Bidder.

2.2.1 All raw materials including bought -out items, whatsoever required, to complete the supplies shall be procured and supplied with due identifiable mill material test certificates & inspection reports duly certified by third party inspection agency.

2.2.2 For coarse grained and high tensile materials in carbon steel (UTS > 45 Kg/mm2) and low alloy steel, guaranteed impact strength shall be ensured at a temperature 15 degree C below envisaged hydraulic test temperature as a precaution against brittle fracture during hydraulic test.

2.2.3 Carbon steel plates shall be procured in fully killed condition. CS plates shall be fully killed & normalized. All plates above 50mm thickness shall be vacuum-degassed and examined by Ultrasonic Testing (UT) as per applicable material specification code/standard.

2.2.4 All Stainless Steel (SS) plates shall be hot rolled & solution annealed and pickled as per SA-480.

2.2.5 All forgings except for flanges as per ANSI shall be UT tested as per ASTM A 388 for the thickness greater than 50 mm and shall be procured in normalized / annealed condition acceptance standards shall be as per AM 203.2 of ASME Section VIII Div. 2. In case any defect is found, no repair by welding shall be allowed.

2.2.6 All forgings including nozzle flanges shall be examined for surface defects by MP/PT testing after machining as per applicable material specification code & standard.

2.2.7 All external / internal attachments, pads/cleats for support directly welded to the equipment shall be of same materials (grade) as that of equipment, unless specified otherwise.

2.2.8 All nozzles up to DN 10" size shall be made of seamless pipe. For sizes above DN 10" nozzle connection shall be rolled from plates with full radiography of plates.

2.2.9 Unless otherwise specified girth flanges shall be of forged quality and ultrasonically tested.

2.2.10 Unless more restrictive prescription given by material specification the max. Content for carbon steel used for fabrication as shown by ladle analysis shall be 0.23% for plates, pipes & tubes 0.25% for forging.

2.2.11 Top portion of skirt (min. 500 mm height) welded to the bottom dished head shall be of same material as that of shell /head for LAS & SS materials.

2.2.12 Heat treatment of formed parts shall be carried out as per following:

For Carbon Steel:

Cold formed dished ends or knuckles up to 16 mm nominal thickness shall be stress relieved.

b. Cold formed dished ends or knuckles above 16 mm nominal thickness shall be normalised.

c. For Low alloy Steel: - Cold Formed Dish ends or Knuckles shall be stress relieved.

d. Hot formed dished ends or similar parts, which have not been uniformly heated in the normalising range in the final stages of manufacture shall be normalised.

e. When the completed vessel involves post weld heat treatment, heat treatment recommended in (a) above shall not be applicable.

f. Vessels in caustic service, Amine or Sour gas service shall be stress relieved.

g. All internal and external attachments, clips, insulation studs, name plate bracket, and the like shall be welded to the vessel before post weld heat treatment

2.2.13 Pressure part plates having thickness 16 mm to 50 mm (both inclusive) shall be ultrasonically Tested (UST) as per ASTM A-435. Pressure part plates having thickness above 50 mm and all Plates to be used shall be UST as per ASTM A-578 Level B. No laminations or inclusions shall be permitted.

2.2.14 The minimum thickness of weld overlay material (undiluted) shall be 1/8 inch (3 mm) except clad or weld Overlay tube sheets and gasket surfaces.

2.2.15 Unless otherwise specified Copper & Copper alloys shall not be used. Copper content up to 0.4% are acceptable in carbon steel & 0.6% in stainless steel.

2.2.16 PWHT of complete vessel shall be carried out in one go in a furnace. Local stress relieving of Weld joint in piece meal shall be avoided as far as possible.

2.2.17 For SS 316 & 316L, SS316L Mod (Urea Grade) materials and for other specialized urea grade Materials, the requirements of ferrite content and Inter granular corrosion test shall have to be complied with in conformity with Process Licensors standard. The inter granular corrosion test shall be carried on SS316 L mod (Urea Grade) materials for other specialized urea grade materials, materials , weld & HAZ as per ASTM A 262 practice C & While for SS316L material ASTM A 262 practice E shall be applicable. The corrosion rate shall be as per the recommendations of Process Licensor.

2.2.18 For SS 316 & 316L material Ferrite content for plate, pipe and forging shall be max. 2%. However for SS 316L Urea grade and for other specialised urea grade materials, ferrite content shall be max. 0.6%.

2.2.19 In case of equipment fabricated of materials of SS316L for urea service, low ferrite filler material Shall be so selected that ferrite content in two subsequent pass in contact with process fuel shall be max. 2% and for equipment fabricated of material SS316L urea grade, the limitation of ferrite content shall be 1%. The welding not in contact with process fluid may have ferrite content limited to 6%.

2.2.20 When post weld heat treatment is required for pressure vessels, all material for pressure holding Components shall be simulation tested with minimum additional two (2) heat treatment cycles. Additional two heat treatments are; one for PWHT after shop repairing and the other for future PWHT at site.

3.0 Technical Requirements

3.1 Storage Tanks

3.1.1 The following design codes shall be adopted for tank design as applicable:

i) API 650 Welded Steel Storage Tanks for Oil Storage
ii) PDIL standard PDS: SR 005 Storage Tanks with Flat Cover (CS/SS) wherever Applicable

3.1.1.1 For fixing the nominal capacity of the cone roof tank, allowance for free board (minimum 500 mm), vapour space and dead liquid space at the bottom shall be taken in to account. Tank diameter and height shall be firmed up based on nominal capacity (Cylinder volume)

3.1.2 For Carbon Steel storage tanks the minimum thickness shall be based on stability considerations.

3.1.2.1 Minimum thickness for roof & shell shall be 5 mm, and bottom plate 6 mm, excluding corrosion allowance

.

3.1.3 Storage tanks up to 4 meter in diameter shall be shop fabricated items. Tanks with diameters greater than 4 meter shall be field erected.

3.1.4 Tanks constructed of stainless steel shall comply with API 650, Appendix S.

3.1.5 Shell seams shall be located to clear openings to the maximum extent possible in accordance with API 650.

3.1.6 Bottom plates may be lap-welded with the lap toward the direction of drainage. Butt welded bottom plates shall be furnished when specified on the tank drawings or data sheets or when tanks are specified to have rubber lining.

3.1.7 For each surface in contact with product/vapour, the specified corrosion allowance shall be added to the required thickness of all load-carrying components including shell, roof, bottom and roof supports. & One-half the specified corrosion allowance shall be added to each surface of no-load-carrying internal components.

3.1.8 All walkways, stairways, and platforms shall be furnished with handrails on open or exposed sides.

3.1.9 Anchor bolts shall be provided based on design considering wind/seismic loads, uplift due to internal pressure etc. However, tanks having diameter ≤10 meter shall be provided with anchor Bolts and shall be spaced at approximately 1.8M of circumference.

3.1.10 Maximum height of unstiffened shell shall be calculated based on the corroded thickness of shell courses. Section modulus of wind girders shall also based on corroded thickness of shell courses.

3.1.11 All storage tanks shall be designed considering liquid height up to top curb angle of shell Using one foot method for tanks less than and equal to 60 meter. However for seismic design, operating liquid level may be considered. All design calculation shall be carried out in corroded condition.

3.1.12 Unless otherwise specified bottom plate slope shall be 1:100 from the centre of the tank towards shell.

3.1.13 Butt welded annular ring below shell (minimum 8 mm thick excluding corrosion allowance) shall be provided for all tanks of diameter 12 m and above.

3.1.14 Fabrication tolerance on shell, bottom, and foundation e.t.c. shall be as per applicable code.

3.1.15 Anchor bolt shall be provided if required by calculation for uplift or stability for wind and Seismic load. Minimum anchor bolt size shall be M24 excluding any corrosion allowance on bolt diameter. Tanks with diameter ≤10 m shall be provided with anchor bolt at spacing of maximum 1.8 m, however minimum 4 nos of M24 shall be provided for all tanks with diameter ≤10 m.

3.1.16 All tanks shall be provided with under tank leak detection and sub grade protection system as per appendix-I of API-650 for applicable foundation Type.

3.1.17 Thickness of tank bottom shall be determined as per API-650 Appendix –I for tank bottom Supported by piers/grillage. Maximum deflection of Corroded bottom plate shall not be more than half of the thickness.

3.1.18 The roof plates shall be self supported of supported by structure. Column supported roof shall not be acceptable. The roof and its supporting structure shall be designed to carry the dead Load, internal and external pressure as specified in process data sheet and live load as per design code.

3.1.19 Inside/outside painting of tanks shall be carried out based on product stored and as per Process data sheet enclosed elsewhere in bid package.

3.1.20 For the Rubber Lined Equipments, Equipment corners shall be grounded & corners on rubber lined surface shall be grounded to 6mm radius & all interior welds surfaces shall be grounded flush, the internal surface finishes to be suitable for rubber lining with no curves dents or surface imperfections for air entrapment.

3.1.21 Maximum allowable nozzle load shall be mentioned in tank Drawing calculated as per API-650 Appendix P and provide backup calculation.

3.1.22 The extent of radiographic examination shall be spot examination, as minimum.

3.3 Vessel

3.3.1 Design, materials, fabrication and inspection of welded pressure vessels shall comply with ASME Code Section VIII, Division 1 (latest edition) and Technical Specifications.

3.3.2 For vessels the minimum thickness of shell & heads, including corrosion allowance shall be as indicated below:

Sr. No	**Shell Diameter(mm)**	**Thickness (Min.) mm**	
		CS / LAS	**HAS**
1.	ID < 500	5	3
2.	501 < ID < 1200	5	4
3.	1201 < ID <2000	6	5
4.	2001 < ID < 2600	8	6
5.	ID > 2600	10	8
CS = Carbon Steel, LAS = Low-Alloy Steel, HAS = High-Alloy Steel			

3.3.3. All nozzles above 24” NB shall comply with ASME B16.47 Series B (API 605).

3.3.4. Minimum branch nozzle thicknesses shall be Schedule Extra Strong above 2” NPS, and Schedule 160 for 2” NPS and below.

3.3.5 Stress calculations due to Local loads on vessel for external structural attachments, such as platform clips, pipe support clips and lifting lugs shall be performed.

3.3.6 Design of vessel skirt shall be based on seismic/wind/thermal considerations and fire proofing/insulation requirements.

3.3.7 Vessel skirts for carbon steel vessels shall be designed from the same material(Grade) as the shell or the head. Vessel skirts for other than carbon steel vessels shall be the same material (Grade) as the shell or the head for the top 500 mm.

3.3.8 Vessels with skirt support having eight or more anchor bolts shall be required to be supplied with an anchor bolt template. The template shall be an annulus 10 mm (minimum) thickness and 150 mm (minimum) wide, with bolt holes equal to bolt diameter plus 3 mm, stacked drilled with skirt base plate.

3.3.9 Maximum permissible deflection for vessel when subjected to design wind loadings shall not exceed 0.005 x Vessel height.

3.3.10 Minimum man way size shall be equal to 24" nominal pipe size.

3.3.11 Manhole/hand hole/blind holes covers shall be equipped with davits or hinges to facilitate handling.

3.3.12 Horizontal vessels of large size and thin wall shell on saddle supports shall be investigated for buckling, local circumferential bending and shear stress. The method of L. P. Zick (Supplement to Welding Research, 1971) may be used for this investigation.

3.3.13 Use of structural steel shall be limited to non-pressure parts only.

3.3.14 Local vessel stress calculations for external structural attachments, such as platform clips, pipe support clips and lifting lugs shall be performed.

3.3.15 Dimensional tolerances shall be in accordance with the design codes or standards, whichever is more stringent.

3.3.16 For vessel with diameter less than 900 mm and having removal internals, shell flange shall be provided.

3.3.17 The extent of radiographic examination of the shell and head seams shall be spot examination, as minimum.

3.4 Safety

3.4.1 Safety standards and features which are inherent in the specific mechanical equipment design codes, standards and regulations are applicable.

3.4.2 Safety features to be incorporated into the design include, but are not limited to, the following features for equipment:

i) Ladder cages
ii) Safety chain across platform access
iii) Step-off platforms where necessary
iv) Platform grating

v) Toe plates

4.0 Fabrication

4.1 The Bidder shall comply in all respects with the provision of the applicable codes, standards and specification during fabrication with respect to tolerances, welding, fabrication, forming of heads, radiography, heat treatment, inspection, testing and quality control etc. unless & otherwise specified.

4.2 Plates of different thicknesses shall be made flush with the inner surfaces of equipment unless otherwise stated.

4.3 Larger heads which cannot be formed in one piece shall be fabricated as follows with prior approval from Principle.

a) In two pieces, with the welding seam included in the middle third and preferably on the centre line

b) In petal construction, with meridianal seams and a central cap of diameter not larger than 0.75 times the vessel outside diameter

4.4 Due provisions must be kept for venting out entrapped gases during welding of pads, flanges and liner plates etc.

4.5 All welding shall be carried out by qualified welders using approved procedures in compliance with the requirements of codes, standards & specifications and shall be duly certified by the concerned inspecting authority. All welding procedures must be got approved from authorised inspecting authority before starting any fabrication job. Welding of all parts must be completed before heat treatment.

4.6 All welds shall be full penetration welds with back chipping and re-welding from the second side. For those joints which are inaccessible for back chipping the root run shall be carried out with TIG process. Single side welding with backing strips shall are not permitted.

4.7 All parts shall be fabricated in accordance with good shop practice and in uniformity so that all corresponding parts will be inter-changeable.

4.8 All sharp corners shall be rounded off with smooth radius. Inside edge of manhole and hand hole at the internal surface shall be rounded to minimum radius 5 mm.

4.9 All flange bolts & skirt-bolts shall straddle centre line unless otherwise stated.

4.10 In case of nozzle with butt-end construction, extra length shall be provided to facilitate hydraulic testing and subsequently cutting and edge preparation to suit piping welding at site.

4.11 All nozzles less than or equal to NB 65 mm shall be stiffened with three equispaced plate ribs of the same material as that of shell.

4.12 Flange facing and thread connection shall be protected against oxidation during HT.

4.13 Longitudinal and circumferential welded seams shall not interfere with nozzle openings, reinforcement plates, saddle pads, and other attachments as far as possible.

4.14 Welding wherever specified, is to be done by qualified and approved welders using the suitable fillers and fluxes recommended for the materials in the fabrication drawings.

5.0 Inspection & Testing

5..1 Equipment shall be inspected and tested in accordance with the relevant codes, standards and specifications by TPIA (owner approved) . All equipment shall be inspected during various stages of manufacturing starting from identification of raw materials to final completion as per agreed Quality Assurance Plan (QAP) which shall be prepared by Successful Bidder after award of contract. In case of site fabricated/assembled equipment same inspection agency shall be responsible for inspection and testing at site. However all the bought-out items must be supplied with test certificate and inspection reports.

5.2.2 The equipment shall be inspected by Third party inspection agency (TPIA) (owner approved) as defined elsewhere as inspection agency. It shall be the responsibility of the Bidder to make available to the inspector all the drawings, calculations and other documents. However the Principal shall have free access for inspection at vendor's/sub-vendor's shop and at site during project execution.

5.2.3 The equipment shall be considered acceptable for despatch only after final certification for acceptance is issued by concerned inspector.

5.2.4 All parent material (Primary & Secondary Components), welds and HAZ shall be impact tested at Minimum Design Metal Temperature (i.e. minimum service temperature or the temperature to be computed as per applicable codes, standards & specifications) by Bidder and shall have impact energy values as per the applicable codes, standards & specifications.

5.2.5 Production control coupons, when required as per codes & standards shall be subjected to impact test, corrosion test etc. in addition to mechanical tests as required. In case of heat treated equipment test coupons shall be given similar heat treatment as for the equipment.

5.2.6 Formed heads when fabricated in pieces shall be normalised and weld seams fully radio graphed after forming.

5.2.7 Vessel containing lethal, toxic and highly inflammable substance shall be fully radio graphed and stress relieved.

5.2.9 All nozzle reinforcing pads shall be tested pneumatically at 0.5 Kg/cm2g pressure with soap solution on attachment welds. Vent holes shall be plugged with non hardening mastic to prevent ingress of water.

5.2.10 All completed equipment shall be tested hydraulically as per the requirements of codes, standards & specifications in presence of the inspecting authority. Pneumatic test of completed equipment shall be carried out only when specially mentioned in the specification sheets. Chloride content in water used for testing shall not exceed 30 ppm for SS equipment and 40 ppm for CS and low alloy steel equipment. Duration of test shall be as per applicable codes & standards. Hydrostatic test shall be done prior to painting at weld and/or coating on weld.

5.2.11 The temperature of test water shall comply with requirement of Fabrication code.

5.2.12 Unless otherwise stated gaskets used during testing shall be same as specified for operating conditions. However all joint gaskets shall be replaced by new gasket after Hydro testing.

5.3 The following NDT requirements are mandatory in addition to codes, standards & specification requirements:

A) UT examination

i) All butt - welds in thickness greater than 50mm as supplement to radiographed.
ii) FPW of nozzle attachments of thickness above 50mm as supplement to radiography
iii) Clad Plates and formed heads from clad plates in all thicknesses
iv) All forgings

B) MP / PT examination

i) All edges of plates and opening in shell of CS having thickness equal to & above 40mm and LAS / SS having thickness more than 25mm
ii) Root and final layer of all butt welds
iii) Fillet welds of SS
iv) All weld surfaces after PWHT
v) Each layer of weld deposit in SS overlay
vi) Knuckle surfaces of dished ends, expansion bellows and pipe bends
vii) All forgings after machining
viii) Skirt to head joint
XI) All welds of SS and non ferrous materials and welds for vessels with design temp. (-)45 degree C and below after hydro testing.
x) All welds of SS over ¾ inch thk. after hydro testing.

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C) Radiography:

i) All weld seams of formed head, if made in more than one segment shall be full radio graphed after forming
ii) When spot radiography is specified, all T – Joints & minimum 5% of total weld length excluding T joints shall be radiographed
iii) All nozzles fabricated from plates shall be 100% radio graphed
iv) Radiography of welds in C - 1/2 Mo & Cr - Mo - Steel preferably be carried out after

Note : If a vessel is not 100% radio graphed and/or UT tested, then a minimum examination of butt, corner & T-joints shall be made.

6.0 Pickling and Passivation

6.1 All SS material shall be Pickled & Passivated as per following procedures:

6.1.1 Pickling

Aqueous pickling solution shall be as follows:

Nitric acid (Tech. grade) 10 to 25% plus Hydrofluoric acid 1 to 8% (to be used only for stabilised SS grades). Temperature 50 to 60° C for 10% Nitric acid and 20° C for 25% Nitric acid. When

size and shape of product permit, total immersion in the pickling solution is preferred. Where immersion is impractical, pickling may be accomplished by wetting the surface by

i) Swabbing or spraying
ii) Partial filling the item with pickling solution and rotating or rocking so that all the surface receives the required chemical treatment.

The maximum period for which the pickling solution shall be allowed to remain on the surface is 30 minute. During pickling removal of oxides may be hastened by brushing with a hard fibre or SS wire brush. Over pickling shall be avoided.
The pickling agent shall be washed off with plenty of water so as to leave no trace behind.

6.1.2 **Passivation**

After pickling and water rinsing, an aqueous caustic permanganate solution containing NaOH 10 weight % and KMnO4 4 weight % shall be used for neutralising pickling solution. This shall be followed by thorough water rinsing.
Water used for pickling and washing shall not have chloride contents exceeding 30 ppm.

7.0 Painting

7.1 All CS external surfaces of shop fabricated equipment shall be primer and final painted as defined elsewhere Listed in bid document.

8.0 Insulation

8.1 The equipment shall be insulated as defined elsewhere Listed in bid document.

9.0 Spares (Erection & commissioning, 2 years operation & Special Spares etc.)

9.1 **COMMISSIONING SPARES**

9.1.1 All commissioning spares shall be included by LSTK Contractor in their scope of supply and shall be part of the main equipment.

9.2 **SPARES FOR 2 YEARS OPERATION**

9.2.1 2 years operation spares shall be supplied by the contractor as per Section-6 of Bid

10.0 Documentation

Documents shall be submitted as per “Documentation schedule” in Section-5 of Bid..

11.0 Vendor List

All equipment shall be procured/fabricated as per approved vendor list (Section-11). Any equipment for which vendor list is not enclosed, the LSTK Contractor may furnish a list of their proposed vendors along with their references for supply of similar type of equipment along with bid. However all the additional proposed vendors shall have well proven track record and shall be subjected to consultant/owner's approval

SCOPE OF WORK

(MECHANICAL STATIC EQUIPMENT)

FOR

[UREA (NEEM OIL COATED) HANDLING SYSTEM, BULK SILO AND BAGGING SYSTEM INCLUDING FILLED BAGS STACKING/ LOADING TO WAGON & TRUCK]

PLANT: AMMONIA-UREA PLANT BASED ON COAL GASIFICATION

PROJECT: INTEGRATED ROM BASED FERTILISER COMPLEX AT TALCHER, ANGUL DISTRICT, ODISHA (INDIA)

1.0 Scope

This specification covers the requirements for the complete design (Mechanical), procurement, fabrication, construction/erection, insulation, painting ,Pickling & Passivation (for SS equipments), inspection and testing of static equipment for urea handling & bagging package of M/s Talcher Fertiliser Ltd. (TFL) in accordance with this specification, standards specification, codes and other attachment etc. listed in bid document..

Bidder scope of Work (For Static Equipment) shall include but shall not be limited to following :

a) Complete mechanical design
b) Detailed engineering of equipment including all mountings, accessories & bought-out items.
c) Procurement of all materials & bought out items.
d) Shop/site fabrication (as applicable) & assembly
e) Route survey, if required
f) Inspection, testing (including hydro testing)
g) Surface preparation, painting , insulation, pickling and Passivation (for SS equipments), internal and/or external coating, epoxy coating, rubber lining e.t.c
h) Packing (seaworthy when sea transportation) forwarding, transportation to site etc.
i) N2 filling of equipment as applicable
j) Storage and preservation at site
k) Statutory approvals
l) Stage wise and final inspection by appointed TPIA/Owner
m) Fire proofing as per requirement of the bid package
n) Any other requirement for safe and smooth operation
o) Submission of engineering drawing & document for Owner/PDIL review. All drawing submitted to owner/PDIL shall be thoroughly checked by contractor before submission.
p) Supply of “As Built documentation and QC dossiers”.

The above mentioned activities shall be carried out in accordance with applicable code and all technical requirements covered in the bid package.

1.1 Scope of supply (For Static Equipment)

Bidder scope of supply shall include but shall not be limited to following:

- Supply of static equipment (Vessels, heat exchanger , Tanks, PHE e.t.c) including their accessories
- Supply of all fabricated and proprietary internals for all equipment as applicable.
- Supply of mandatory (spare parts for two year operation) and commissioning spares attached elsewhere in bid package.
- Insulating material, primer paints, fire proofing material e.t.c.

- Supply of material & equipment required for blast cleaning, chemical cleaning, pickling Passivation, surface preparation & polishing & coating of internal surface, epoxy coating, rubber lining, and FRP lining e.t.c. for equipment as applicable.
- Supply of all equipments , tool & tackles including torque wrench, bolt tensioner e.t.c. as per specification and all material required for inspection and testing (i.e. NDT, Hydro testing, performance testing e.t.c) erection & Hydro testing including all site re-hydro tested equipment.
- Supply of all tools and tackles, template for foundation for heavy lift equipment and for the erection for all equipment.
- Eye bolts, jack screws, dowel pins and lifting lugs etc. as required
- Lifting lugs / erection lugs
- Cleats for earthing connections
- Name plate with bracket
- Cover flanges for manholes, hand holes, inspection openings etc. with bolting and gaskets.
- Supply of all other materials whether specifically mentioned or not but required for completion of the job in all respect as per bid package.

SECTION – VI 3.1.4

DESIGN PHILOSOPHY – PIPING
UREA HANDLING & BAGGING PACKAGE

PLANT: AMMONIA-UREA PLANT BASED ON COAL GASIFICATION

PROJECT: INTEGRATED COAL BASED FERTILIZER COMPLEX AT TALCHER, ANGUL, DISTRICT- ODISHA, INDIA

CONTENTS

LIST OF ATTACHMENTS

DOCUMENT/ANNEXURE NUMBER	DESCRIPTION
1	Table Of Basic Span
2	Accessibility For Valves & Instruments
3	Vertical And Horizontal Guides Spacing
4	Clearances
5	Design Philosophy For Stress Analysis
PNMP-TS-6000	Engineering Specification–Piping (For Package Units)
PC-150-PDS-600	PIPING MATERIAL SPECIFICATION

1.0 SCOPE

The scope of this document is pertaining to the design philosophy, norms .and specific requirements which shall be adhered to by contractor or his associates and representatives during the course of the project in designing, procurement & construction of piping material.

1.1 APPLICABLE STANDARD & CODES

Standard No.	Title
ASME/ANSI B16.5	Steel Pipe Flanges and Flanged Fittings
ASME/ANSI B16.9	Steel Butt-Welding Fittings
ASME/ANSI B16.10	Face to Face and End to End Dimensions of Valves
ASME/ANSI B16.11	Forged Fittings Socket Welded and Threaded -
ASME/ANSI B16.20	Metallic Gaskets for Pipe Flanges – Ring Joint, Spiral Wound, and Jacketed.
ASME/ANSI B16.21	Non-Metallic Flat Gaskets for Pipe Flanges
ASME/ANSI B16.25	Butt-Welding Ends
ASME/ANSI B16.34	Valves – Flanged, Threaded Welding End.
ASME/ANSI B16.47	Large Diameter Steel Flanges
ASME/ANSI B31.1	Power Piping
ASME/ANSI B31.3	Process Piping.
ASME/ANSI B31.5	Refrigeration Piping
ASME/ANSI B36.10M	Welded and Seamless Wrought Steel Pipe.
ASME/ANSI B36.19M	Stainless Steel Pipe
API 6D	Specification for Pipe Line Valves (Gate, Plug, Ball and Check Valves).
API 6FA	Fire Test for Valves.
API 501	Specifications for Metallic Gaskets for Refinery Piping.
API 594	Check Valves:, Wafer-Lug and double flanged type
API 598	Valve Inspections and Testing.
API 599	Steel Plug Valves Flanged and Butt-weld ends
API 600	Steel Gate Valves Flanged and Butt-welding ends, Bolted Bonnets
	API 602 Gate, Globe, and Check Valves for Sizes DN 100 (NPS 4) and Smaller for the Petroleum and Natural Gas Industries
API 603	Class 150 – Corrosion Resistant Flanged End gate valves.
API 604	Ductile Iron gate valves – flanged ends.
API 606	Compact C.S. Gate Valve extended body.
API 607	Fire Test for soft seated Ball Valve.
API-608	Metal Ball Valves, Flanged, Threaded & BW Ends.
API 609	Butterfly Valves, Lug type & Wafer type.
API 623	Steel Globe Valves—Flanged and Butt-welding Ends, Bolted Bonnets
IBR	Indian Boiler Regulations
AWWA C207-D	Large Dia. Steel Flanges (Ring Type).
EJMA	Expansion Joints Manufacture Association.

MSS SP 6	Standard Finishes for Contact Faces of Pipe Flanges and Connecting End Flanges of Valves and Fittings.
MSS SP 25	Standard Marking System for Valves, Fittings, Flanges & Unions
MSS SP 43	Wrought Stainless Steel Butt-weld Fitting
MSS SP 45	By-pass and Drain Connection.
NACE MR0175-94	Sulphide Stress Cracking resistant Metallic Material
NFPA	National Fire Protection Association.
EN 10204	Metallic Products - Types of Inspection documents
ASTM D3035	Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
ASTM D3261	Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

2.0 DESIGN PHILOSOPHY

2.1 Piping systems shall be in accordance with Clause 1.1, which permits the use of the following specifications:

ASME B31.1 Power Piping
ASME B31.3 Process Piping
Materials, design, construction, testing and inspection shall be fully in accordance with the selected specification.

2.2 The dimensions, manufacturing tolerances and marking of ferrous and non ferrous piping components shall conform to the applicable standards .The design shall comply with all applicable codes, laws and statutory regulations. The Contractor shall optimize the layout with the approval of the owner and taking into consideration the following :

i) General site layout taking into account the topographical geo-technical aspect of the site.
ii) Access for maintenance and fire appliances.
iii) The interdependency of units and buildings with each other within the complex.
iv) Safety escape routes for personnel based on emergency or disaster management plans in the event of environmental upset or fire.
v) Suitable drainage system of Project site.

2.3 Material of construction shall be suitable for specified process duty (both normal and abnormal operations) and have a projected life and corrosion/ erosion allowance in excess of minimum life of the project. Piping materials specified in piping materials specification shall be used for selection of material of construction of major services.
All materials under steam service shall be supplied with proper certificates in prescribed forms.

3.0 CODES, STANDARDS AND SUPPLEMENTARY SPECIFICATIONS:

3.1 The latest edition of codes shall be applicable for piping system design, materials, fabrication, manufacture, erection, construction and inspection etc. For any item not covered in the list of codes and standards / International Standards / proven design may be finalized based on discussion with OWNER/Consultant.

3.2 Where conflict occurs, the order of precedence shall be:

a) Statutory Regulations

b) National, International and Industry Standards and Codes of Practice.

c) Technical Specifications

3.3 Standards, Codes and Supplementary Specifications for piping design shall be applied as follows:

i) Process and utility piping to ASME B31.3 Process Piping

ii) Power Plant piping to ASME B 31.1

Fire protection system shall be designed and installed in accordance with applicable NFPA (National Fire Protections Associations) Codes.

4.0 GENERAL DESIGN

4.1 Flanges for process and utility piping shall be in accordance with ANSI B16.5 and ANSI B16.47.

4.2 Wherever possible all purchased equipment shall be supplied with flanges that comply with ANSI B16.5/B16.47.

4.3 The minimum size of piping to be used in pipe-racks shall be 2" NB.

4.4 With the exception of equipment connections the minimum size of piping shall be ½" NPS.

4.5 Pipe sizes 1 ¼", 2 ½", 3 ½" 5" and 22" NPS shall not be used except as connections to purchased equipment.

4.6 Threaded pipe nipples between headers and vent, drain and instrument isolation valves shall be Schedule 160 for CS and Schedule 80S for SS in the size range ½" to 2" NPS.

4.7 Piping 2" NPS and above shall be butt-welded. All weld joints in piping 1½" NPS and below shall be socket welded using socket weld fittings.

4.8 In Class 600 and higher pressure rating double block valves shall be used for systems open to atmosphere, such as vents and drains. Piping in hazardous service shall have vents, drains and bleeds routed to a safe location. Category 'M' substances shall be vented to the flare system.

4.9 When a line of one material specification is connected to a line of higher material specification, the connecting line shall be constructed of the higher material specification or pressure rating up to & including the first block valve.

4.10 As a minimum, piping systems shall have isolation facilities as follows:

ASME B31.3 Category 'M' service and Normal service (Class 900 and above) shall have double block isolation valves with a downstream drop-out spool.

ASME B31.3 Normal service (Class 150 and 600) shall have a valve and downstream spectacle blind.

ASME B31.3 Category 'D' service shall have a valve and downstream spectacle blind.

Generally, equipment shall have provision for isolation of piping to each equipment connection by means of valving and /or blinds as determined by service conditions.

5.0 DESIGN PHILOSOPHY / GENERAL CRITERIA

5.1 Equipment Layout

5.1.1 Basis of Equipment Layout

Equipment Layout shall be finalised based on the following data:

a) Overall Plot Plan
b) P&I Ds
c) Equipment Data Sheets
d) Wind Direction
e) Safety Distance and Specific Distance mentioned in Piping Design Basis and as per statutory requirements.

5.1.2 Development of Equipment Layout

The following aspects shall be considered during development of equipment layout.

a) Process Requirement -Proper interconnection between equipment as per P&I Ds to achieve the intended process parameters.

b) Economy of piping material- Minimize the quantity of costly piping.

c) Erection & Construction requirements:

Erection scheme and schedule of all equipment must be considered during equipment layout to have smooth erection mainly in case of tall columns, heavy equipments like thick walled reactors, space for laying tall columns, approach roads for cranes / derricks for lifting the column or reactors and requirement of special foundation / pile etc.

d) Operation and Maintenance Requirement

- Overhead and side clearances for exchangers and pumps
- Horizontal & overhead clearances for easy movement of working personnel.
- Crane approaches for air coolers/fired heaters.
- Provision of monorail for pumps and exchangers

e) Similar equipment grouping - All columns, exchangers, pumps etc. should be grouped together for convenience of maintenance and safety wherever feasible.

f) The technological structures should be interconnected for easy movement of operational personnel.

g) U/G piping corridors for main headers should be marked in equipment layout for all under ground piping.

5.1.3 Plant Layout & Design guidelines

5.1.3.1 General

The plant layout shall be based on ensuring adequate access, to allow construction, inspection, maintenance and operation to be performed in a safe and efficient manner. The

alignment of equipment and pipe shall offer an organised appearance. The layout shall be in accordance with, but not limited to the design practices described in this criteria.

Where dynamic loading, limited pressure drop or other severe service condition applies, particular care shall be taken in routing pipe lines.

Flushing connections shall be provided on all lines containing flammable or toxic material, slurries, and materials which solidify- when the line is dead. Sufficient Nitrogen purging points shall also be provided. Supply piping of fuel gas shall be arranged for equal flow distribution.

Trolley beams, pipe davits, shall be provided with appropriate removable hoists mechanism for charging and discharging catalysts, chemicals, packing rings etc.

Piping and all other services shall be arranged so as to permit ready access of Cranes for removal of Equipment for inspection and servicing.

All utility and process piping shall be located above ground, and major lines shall be located in overhead pipe ways.

Lines that must be run below grade, and must be periodically inspected or replaced, shall be identified on the P & ID's; these lines must be placed in covered concrete trenches. Sleeper-ways shall not be used in process areas where they may block access for personnel and equipment.

Drip legs and dead ends shall be avoided, especially for piping where solids or fluids may congeal from corrosive condensate.

Where sleeper ways are used the elevations shall be staggered to permit ease of crossing or change of direction at intersections. Flat turns may be used when entire sleeper ways change direction. Flat turns must not be used within pipe racks.

Spacing and routing of piping shall be such that expanding/contracting lines (including insulation) will not clash with adjacent lines, structures, instruments and electrical equipment during warm up and cool down.

Piping to be sloped shall be indicated on the P&I D's.

5.1.3.2 Pipe-Rack/T-Post/Small Portals

In general, equipment layout shall be prepared considering straight pipe rack, however other shapes like L / T / U / H / Z etc can also be considered based on area available.
The width of the rack shall be 4M, 6M, 8M, 10M or 12M for single bay having four (4) tiers maximum. In general, the spacing between pipe rack portals (span) shall be taken as 8 M for main rack. However it can be decreased to 6 M depending on the size/number of the pumps to be housed below pipe rack. Intermediate Beams between two portals shall be provided to support smaller pipes <= 2". 20% extra space shall be provided on the pipe rack and portals on each tier for future expansion/modifications.

-Clearance beneath pipe rack shall be 3.8 M minimum.
-Height between two pipe rack tiers shall be 2.0M minimum.
-Road clearance shall be 9 M minimum wherever heavy duty crane movement is required during construction and future maintenance.
-Road clearance shall be 7.5 M minimum for main roads.

-Road clearance shall be 5 M minimum for secondary roads.
-T-Portal's width shall not be more than 2.5 M and height shall not be less than.3.0 M

5.1.3.3 **Pumps**

Wherever practicable pumps shall be arranged in rows with the centre line of the discharge on a common line. In general, pumps shall be kept inside the pipe rack. However in case of smaller racks, pumps shall be kept on one side or outside the pipe rack to provide clear access under the rack as per clause applicable.

Pump foundation height shall be 300 mm above H.P.P.

Gap between each pump foundation / and foundation of technical structure should be sufficient for easy removal of equipment after piping. Clearance between two adjacent pumps shall be such that clear 900 mm aisle is available.

All pumps not open to sky with motor rating >= 45 KW shall be provided with monorail. No monorail should normally be provided for pumps outside rack and sufficient space below rack shall be available for pump maintenance.

5.1.3.4 **Clearance and Accessibility**

5.1.3.4.1 **Access to Pumps**

Clear access of 3.8M vertically and 4.5M horizontally shall be provided centrally under main pipe rack for small mobile equipment to service pumps, wherever these are put under pipe ways with prior specific approval. Pumps outside rack shall be approachable by small cranes etc. from under the pipe rack.

5.1.3.4.2 **Access to lower items to grade (Lowering Area)**

Clear access shall be provided at grade on the access side for lowering external and internal fittings from tall elevated equipment by providing pipe davits.

5.1.3.4.3 **Layout & Access Requirements for Platforms ladders and Stairs**

For providing platform ladder & staircase following guidelines shall be followed.

- Two means of access (i.e. two ladders or one ladder and one stair case) shall be provided at any elevated platform which serves three or more vessels & for B/L valves operating platform.
- Platforms, ladders and stairways shall be the minimum, consistent with access and safety requirements.
- Stairway for tanks to be provided on upstream of predominant wind direction.

i) Platform at elevated structure

a) Dual access (i.e. one staircase and one ladder) shall be provided at large elevated structure if any part of platform has more than 22.65M (75 ft) of travel.

ii) Platforms with stair access shall be provided for:

a) Location at which normal monitoring (once a day or more) is required or where samples are taken.

b) Locations where vessels or equipment items need operator attention "such as compressors, heaters, boilers etc.

iii) Platforms with ladder access shall be provided for:

a) Points which require occasional operating access including valves, spectacle blind and motor operated valves, heater stack sampling points.

b) Man ways above grade on equipment.

iv) Ladder location

a) Wherever practicable, ladder shall be so arranged that users face equipment or platform rather than facing open space.

b) Landings shall be staggered. No ladder shall be more than 6 M in one flight.

5.1.3.5 **Clearances**

Minimum clearances shall be as indicated in Annexure.

5.2 **Unit Piping**

5.2.1 **Basis of Unit Piping**

- Piping & Instrument Diagram
- Equipment layout
- Equipment Data sheet & Setting plan
- Line list
- Instrument Data sheet
- Structural & building drawings
- Topography of the plant
- Piping material specification
- Overall plot plan
- Tie in point drawing.

The following objective shall be ascertained during piping layout.

- Proper access to all operating points including valves, and for all orifice tapping points and instruments in particular.
- Proper access to interrelated operating points for specific purpose and for maintenance.

5.2.2 **Pipe Ways/Rack piping**

5.2.2.1 Racks shall be designed to give the piping shortest possible run and to provide clear head rooms over main walkways, secondary walkways and platforms.

5.2.2.2 Predominantly process lines are to be kept at lower tier and, utility & hot process lines on upper tier.

5.2.2.3 Generally the top tier is to' be kept for Electrical (if not provided in underground trench as per electrical design basis) and Instrument cable trays. Cable tray laying to take care of necessary clearances for the fire proofing of structure.

5.2.2.4 Generally the hot lines and cold lines shall be kept apart in different groups on a tier. .

5.2.2.5 Generally the bigger size lines shall be kept nearer to the column.

5.2.2.6 Minimum spacing between adjacent lines shall be decided based on O.D of bigger size flange'(minimum rating 300# to be considered), O.D of the smaller pipe, individual insulation thickness and additional 25 mm clearance, preferably. Wherever even if flange is not appearing the minimum spacing shall be based on above basis only. '

5.2.2.7 Actual line spacing, especially at 'L' bend and loop locations, shall take care of thermal expansion / thermal contraction / non expansion of adjacent line. Non expansion / thermal contraction may stop the free expansion of the adjacent line at "L' bend location.

5.2.2.8 Anchors on the racks are to be provided on the anchor bay, if the concept of anchor bay is adopted. Otherwise anchors shall be distributed over two to three consecutive bays.

5.2.2.9 Anchors shall be provided within unit on all hot lines leaving the unit.

5.2.2.10 Process lines crossing units (within units or from unit to main pipe way) are normally provided with a block valve, spectacle blind and drain valve. Block valves are to be grouped and locations of block valves in vertical run of pipe are preferred. If the block valves have to be located in an overhead pipe way, staircase access to platform above the lines shall have to be provided.

5.2.2.11 Provision of block valves, blinds etc. shall be as per Process Design Basis and P & IDs.

5.2.2.12 All small bore piping shall be designed in a way so as to ensure adequate space for maintenance and operation. For small bore piping intermediate support shall be provided in between portals.

5.2.2.13 Stubs on saline water (if applicable) service shall be from top of main header.

Minimum branch size for tapping including for instruments e.g PG/ *PTI* TE etc. shall be of 3" NPD and 150 mm height on internal cement lined pipes.

5.2.2.14 Aboveground lines shall be grouped to run on pipe racks or sleepers in so far as practicable.

5.2.2.15 Hot lines on pipe racks or sleepers shall be grouped and expansion loops shall be nested together. The number of expansion loops shall be kept to a minimum.

5.2.2.16 Piping handling corrosive fluids shall be run under piping handling non corrosive fluids, and shall not, where possible, be run overhead across walkways or normal passages for personnel.

5.2.2.17 All process and utility piping will be located aboveground within the plant battery limit, except water mains.

5.2.2.18 All piping shall be arranged in horizontal banks, where possible, to facilitate supporting.

Banks running north-south shall be at different elevations from banks running east-west. Exceptions are permitted to avoid unnecessary change in elevation at change of direction or where essential to avoid pockets.

5.2.2.19 All piping shall be routed for the shortest possible run and have the minimum number of fittings consistent with provision for expansion and flexibility. All piping shall be arranged in a neat manner, providing free access around all operating equipment.

5.2.2.20 Vertical lines at vessels shall run close to the vessel shell to facilitate supporting. The line shall be arranged and grouped to allow the use of single support.

5.2.2.21 Lines carrying molten solids, slurries or highly viscous liquids shall have a sufficient

slope for each gravity flow.

5.2.2.22 The shortest and most direct layout possible shall be provided for gravity flow lines, especially when the fluid is subject to solidification and when the differential pressure is small.

5.2.2.23 Piping shall be arranged to facilitate handling of equipment for inspection or maintenance.

5.2.2.24 Vapor collecting system shall be routed so that the vapor rises continuously from the vessel being vented to a higher point without pocketing.

5.2.2.25 Pockets shall be avoided in lines, particularly those carrying corrosive chemicals, slurries, vents, blow down lines, etc.

5.2.3 Column / Vessel Piping Control Valves

5.2.3.1 Piping shall be supported from cleats welded on the vessel as far as possible.

5.2.3.2 Proper guides at intervals shall be provided for long vertical lines.

5.2.3.3 Access platforms/ladders shall be provided along the column for valves and instruments.

5.2.3.4 For ease of operation and maintenance, column and vessels which are grouped together, shall have their platforms at the same elevation interconnected by walkways wherever feasible. However each column \ vessel shall have an independent access also. Column vessel platforms should be designed in such a way so that all the nozzles should be approachable from platforms.

5.2.3.5 Unless specifically indicated in P&ID's control valves shall preferably be kept at grade instead of platform.

5.2.3.6 Piping intended for vacuum services shall be routed as short as possible, with minimum bends and flanged joints.

5.2.3.7 Piping support cleats shall be designed for safety valves considering impact loading during popping off.

5.2.4 Pump Piping

5.2.4.1 Pump drives shall have clear access.

5.2.4.2 Pump suction piping shall be as short as possible and shall be arranged with particular care to avoid vapor pockets.

5.2.4.3 Reducers immediately connected to the pump suction shall be eccentric type flat side up to avoid the accumulation of gas pocket. For end suction pumps, elbows shall not be directly connected to the suction flange. A straight piece minimum 3 times the line size shall have to be provided at the suction nozzle.

5.2.4.4 Pump discharge check valve if installed in vertical lines shall be fitted with a drain connection as close as possible downstream of the valve.

When a suction vessel operates under vacuum, the vent connection of the pump has to be permanently connected to vapour space of the suction vessel to allow possible filling of the pump with liquid before it is started.

5.2.4.5 Unless otherwise specified T -type strainers shall be used on pump suction piping for sizes 2" and above.

5.2.4.6 Y-type strainers to be used for all sizes in steam services and for pump suction lines 1½ and below.

5.2.4.7 All small bore piping connected to pump (drain to OWS & CBD, seat and gland leak drain) shall have provision for break up flanges for removal of pumps.

5.2.4.8 Piping shall be so arranged that forces and moments imposed on the pump nozzle do not exceed the allowable values as per API 610.

5.2.4.9 Pump discharge should preferably be routed away from the pump rather than towards the motor side.

5.2.4.10 Pump cooling water connection shall be taken from the top of circulating cooling water header.

5.2.5 **Steam Header & Supply Lines / Steam and Condensate Systems**

5.2.5.1 Steam piping shall be designed to have complete condensate removal. Drip legs shall be provided with steam traps at low points in the system.

5.2.5.2 All steam branch connections shall be taken from the top of the header.

5.2.5.3 Return exhaust steam / condensate lines shall connect to the top of the exhaust steam Condensate header.

5.2.5.4 Where block valves have been installed in the main steam header such that condensate can collect either side of the valve when closed, a safe means of draining the condensate prior to opening the valve shall be provided.

- Steam header shall be located generally on the upper tier and at one end of the rack adjacent to columns.
- Branch lines from horizontal steam header, except condensate collection points, shall be connected to the top of the pipe header.
- Isolation valves (if provided) on the branch line shall preferably be provided on the horizontal run and outside the pipe rack.
- All branch lines shall be drainable.
- Drip legs & steam traps shall be provided at all low points and dead ends of steam header. Drip legs at low points shall be closer to downstream riser and shall be provided to suit bidirectional flows, if applicable.
- All turbines on automatic control for startup shall be provided with a steam trap in the steam inlet line.
- All traps shall be provided with strainers if integral strainers are not provided.
- Steam traps discharging to atmosphere shall be connected to storm water drain/storm sewer, in case of open system. In case of condensate recovery, traps shall discharge into condensate header.
- Expansion loops are to be provided to take care of the expansions within units.

- Wherever condensate is to be drained, proper condensate draining facility shall be provided.

5.2.6. **Water Piping**

5.2.6.1 Water piping shall be designed to minimize the possibility of water hammer.

5.2.6.2 Water main headers may run underground to prevent freezing.

5.2.6.3 Unless local code or regulation prohibits, firewater lines shall be underground to prevent freezing. Firewater piping system shall conform to egulations of the competent governmental authorities.

5.2.7 **Instrument Air Piping**

5.2.7.1 Instrument air lines shall not be connected to process lines, service lines, and other equipment.

5.2.7.2 Instrument air shall not be used as plant air or service air.

5.2.7.3 Branch lines form the instrument air header shall be taken from the top of the header and shall be provided with a block valve close to the header. Also in the upstream of Instrument manifold, Gate valve has to be provided.

5.2.8 **Supports and Anchors**

5.2.8 1 Supports and/or anchors shall be provided close to changes in direction of lines, branch lines and, particularly, close to valves to prevent excessive sagging, vibration and strain.

5.2.8 2 Allowable spans between pipe supports shall be determined to keep the maximum deflection within 16 mm.

5.2.8 3 In cases where periodic maintenance requires removal of equipment, such as pumps and relief valves, and where lines must be dismantled for cleaning, piping shall be supported to minimize the necessity of temporary supports.

5.2.8.4 Spring-loaded hangers may be used on piping subject to thermal expansion or contraction. In cases where the movement is very large, or the limitation of reaction and

stress are very severe, constant support spring hangers shall be used.

5.2.8.5 Suction and discharge lines of rotating equipment shall be supported as close as possible to equipment nozzles, and shall be relieved of excessive strains by using proper pipe supports.

5.2.8.6 Supports shall not be directly welded to pipes. Where welding is unavoidable, supports having the same chemical composition as pipe shall be carefully welded.

5.2.8.7 All piping shall be properly supported to minimize vibration.

5.2.8.8 Outlet piping of safety and relief valves shall be supported so that the inlet piping is capable of withstanding the reaction caused by operation of safety and relief valves. Furthermore, the supports shall be designed to minimize the stresses due to thermal expansion and the stresses in the valve body due to the weight of piping.

5.2.8.9 Expansion joints shall be guided and anchored to the extent necessary for their proper operation and alignment.

5.2.8.10 Anchors shall provide sufficient fixation to substantially transmit all load effects into the foundations.

5.2.8.11 Underground piping shall be given special anchoring consideration for differential settlement.

5.2.9 **Utility Stations**

Requisite number of utility stations shall be provided throughout the unit to cater for the utility requirement. Utility stations shall have four connections one for LP steam (SL), one for Plant Air (AP), one for Service Water (WS) and one for nitrogen each of 1.0" with isolation valves unless otherwise specified in P&ID.
Utility connection with nitrogen shall be provided with NRV along with isolation valve kept at a separate location other than this cluster @ 15 M

Air and water lines shall have quick type hose connection and steam line shall have flanged type hose connection. All connections shall be directed downward. All connections shall have globe valve for isolation purpose. An inter connection with valve shall be provided between steam and service water lines shall be provided. Inert gas hose, when required, shall have built in non return valve in quick connection coupling of piping end.
Number of utility stations shall be such that all equipments shall be approachable from at least one utility station. The approach of utility station shall be considered 15 M all around the station location.

The Utility stations shall generally be located adjacent to pipe-rack column.

The utility stations shall also be provided on elevated structures like - technological structure, operating platforms of vertical equipments etc.

Operating platforms having manholes must have a utility station. Utility station locations shall be limited to a height of 35 M from H.P.P.

5.3 Offsite & Yard Piping

In general, offsite piping (except tank ages area), electrical cable and instrumentation cable shall also be laid either on pipe rack or pipe sleepers.

Wherever piping is laid on pipe sleepers, it shall have hard surfacing below it keeping a gap of 300 mm from the bottom of the pipes. Hard surfacing should be completed before start of pipe laying. Width of hard surfacing shall be about 1.0 meter more than the piping corridor. This extra hard surfacing shall be for movement of operating personnel along the piping corridor.

Pipes at road crossing shall be under culverts in general. Overhead pipe bridges may be used for areas where pipe racks are provided. Where culverts are not provided, pipe sleeves shall be used for underground road crossing. Culverts / overhead pipe bridges shall be adequately designed to take care of future requirements. Minimum 20% extra width shall be provided in all such structures.

Clearances between lines shall be minimum "C" as given below:

$C=(Do+D_f)/2$ + 25 mm + Insulation thickness(es) where,

Do - outside diameter of smaller pipe (mm)

D_f - outside diameter of flange of bigger pipe (mm)

However this 'C' spacing between the offsite piping on the rack/sleeper can be suitably increased so that the lines should not touch each other after insulation / lateral thermal expansion.

Adequate clearance shall be provided for every long & high temperature lines to avoid clashing at the bends. See 5.2.2 also for line spacing at 'L' bends and loops.

Expansion loops for all lines shall generally be kept at the same location.

Vents shall be provided on all high points & drains shall be provided at all low points. Drain valves at sleeper piping shall be kept outside the sleeper way if the same is not accessible and valves shall be put in horizontal only.

Places where piping is extended to make drain valves accessible - 2 nos. of stiffeners, irrespective of pipe rating, shall be provided as per 5.13.1. Spacing of guides on each line on a pipe bay shall not exceed the value given in clause 5.13.1

5.4 Flare Piping

Flare header shall be sloped towards flare knock-out drum. Only horizontal loop shall be provided as per requirement to accommodate thermal expansion. The desired slope shall be ensured throughout including flat loop. Flare header shall be supported on shoe of height ranging from 100mm to 300mm.

Proper thermal analysis temperature shall be established including the possibility of temperature gradient along the line before providing expansion loops. Efforts shall be made to minimize the number of loops. Flare line between knock out drum and water seal drum shall be designed for pressure fluctuations and adequately supported to avoid vibrations.

5.5 Underground Piping

5.5.1 Underground steel piping shall be protected from electric corrosion.

5.5.2 Underground piping passing under loaded areas, such as main roads in the plant, shall be protected from heavy traffic by casing pipes or covers extending at least 1 m on either side of the area or having the wall thickness sufficient to bear earth pressure.

5.5.3 Underground piping shall be sloped to all drain points with a downward slope of not less than 1 m in 150 m.

5.5.4 Expansion elbows or joints of underground piping for hot fluids, such as steam or heated heavy oil, shall be enclosed in a conduit from which they are separated to allow free longitudinal expansion.

5.5.5 Where it is impossible to run pipe aboveground or underground, trenches may be used.

5.5.6 Trenches for piping close to process equipment should be avoided, whenever possible.

5.5.7 All underground pipe work shall be provided with following protection:

a) At location where Underground Piping becomes above ground, INSULATING GASKET with material Glass Filled Teflon or equivalent shall be provided.

b) CATHODIC PROTECTION (CP) shall be provided to all underground piping. Specification shall be submitted by the CONTRACTOR & shall be approved by the OWNER.

c) Underground piping shall be wrapped & coated by “PYP KOTE” or equivalent tapes / sheets, 4.00 mm thick & shall be “HOLIDAY TESTED” before Hydro Test.

d) All underground pipes shall have Sand Bed, at least 150 MM all around the pipe.

e) All road crossings by Underground piping shall be through Hume Pipe Sleeves.

5.5.8 **Buried Pipes**

The following points to be considered in designing of buried pipes

i) All underground metallic piping shall be coated and wrapped and provided with cathodic protection system. If sacrificial metal is used, permanent testing arrangement shall be provided.

ii) All cooling water distribution headers 18" and higher shall be laid underground.

iii) All Sewage lines (oily and chemical) from catch basin to mains and manholes shall be laid underground.

iv) Underground pipe crossing roads, access ways and rails shall have casing pipe (R.C.C or C.S).

v) Valve chamber wherever required shall be made of brick or concrete. Valve chamber should be spacious to attend valves during operation/Maintenance.

vi) All U.G. headers shall clear equipment foundations as far as possible. Under special cases, the C.W. header may be laid over the footing of foundations.

vii) Provide break flange at + 500 MM from floor level connection with cathodic protection to isolate underground pipe from above ground piping with insulating gasket KIT.

viii) Pipes shall be laid below electrical cables if any.

ix) Top of underground piping shall be below grade level at least 1 meter deep in case of open areas and 1.5 meter deep for roads.

5.5.9 Piping in Trenches

The following points to be considered in designing of trench pipes

i) Piping located below grade, requiring inspection, servicing or provided with protective heating.

ii) Fire water lines/Process lines.

iii) Drain lines requiring gravity flow trenches.

iv) Sump for valves and trenches shall be provided.

v) Suitable draining scheme for trenches shall be provided.

5.6 **Air Systems**

5.6.1 Branch connections shall be taken from the top of the header.

5.6.2 Low points shall be fitted with drains.

5.7 **In-Line Instruments**

5.7.1 Liquid level controllers and level glasses shall be located so as to be accessible from grade, platform or permanent ladder. The level glass shall be readable from grade wherever possible.

5.7.2 Relief valves shall be accessible. Relief valves with a centre line elevation over 4.5 M above grade (expect in pipe racks) shall be accessible from a platform or permanent ladder.

5.7.3 Relief valves that discharge to a closed system shall be installed higher than the collection header, with no pockets in the discharge line.

5.7.4 Relief valves that discharge to atmosphere shall have tail-pipes extended to a minimum of 3.0 M above the nearest operating platform that is within a radius of 8 M.

5.7.5 Provide steam traps at pocketed low points and at dead ends of steam headers. Provide steam traps on excessively long runs of steam piping to ensure dry quality steam at destination. Steam traps located more than 4.5 M above grade, except in pipe racks, shall be accessible from a platform.

5.7.6 Control valves shall be accessible from grade or platforms. In general, the instruments or indicators showing the process variables shall be visible from the control valve.

5.7.7 Orifice runs shall be located in the horizontal. Orifice flanges with a centre line elevation over 4.5m above grade, except in pipe racks, shall be accessible from a platform or permanent ladder.

5.7.8 Orifice taps shall be located as follows:

i) Air, Gas and steam
Top vertical centreline (preferred)
45 degrees above horizontal centreline (alternate)

ii) Liquid
Horizontal centreline (preferred)
45 degrees below horizontal centreline (alternate)

iii) Tap orientation shall be shown on piping isometrics.

5.8 **Sample Connections**

Sample connections shall be accessible from grade or platforms. In general, where liquid samples are taken in a bottle, locate the sample outlet above a drain funnel to permit free running of the liquid before sampling.

5.9 **Vents and Drains**

5.9.1 The minimum size of vent and drain connections shall be as follows:

For process & utilities lines :

4” & Below	NPS ¾”
6” & 10”	NPS 1”
12” & above	NPS 11/2”

Vent & Drain shall be provided with the valve & blind flange. For all vents / drains of process lines / utilities lines, double valves shall be required for 600 # & more rating.

Process vents and drains shall be indicated on the P&ID's

5.9.2 Vent, drain and sampling valves on process lines, not connected to a piping system, shall be provided with appropriate end closures.

5.9.3 Vents shall be located at high points of pipelines when necessary.

5.9.4 Drains shall be located at low points to empty pipelines or equipment after testing or during maintenance (i.e for every loop).

5.9.5 All drains and vents shall be provided with valve, except that vents for test purpose for flare liens (header), may be plugged. Exposed threads shall generally be seal welded.

Low-point hydrostatic drains and high-point hydrostatic vents shall be added as required; locations to be determined during the design review.

5.9.6 Vent valves shall be the globe or gate type and drain valves the gate type.

5.9.7 Valved bleeds shall be provided at control valve stations, level switches, level controllers, and gauge glasses.

5.10 Line Strainers

5.10.1 Provide temporary conical type strainers in 2" NB and above butt weld pump suction lines for use during start-up. Arrange piping to facilitate removal.

5.10.2 Provide permanent Y-type strainers for pump suction piping below 2" NB Thd or SW.

5.10.3 Provide temporary basket type strainers located at the suction pulsation device inlet for start-up of reciprocating compressors. Arrange piping to facilitate removal of the filter.

5.10.4 Provide temporary basket type strainers and locate them as close as possible to the compressor inlet flange for start-up of centrifugal compressors. Arrange piping to facilitate removal of the filter.

5.10.5 Allowable pressure drop when specified shall be certified by vendor along with the offer. If asked specifically, vendor shall furnish pressure drop calculations

5.10.6 All 2" & higher sized Y type strainers shall be provided with 3/4" threaded, tap and solid threaded plug as drain connection. For less than 2", this shall be ½ " size.

5.10.7 Bottom flange of Y-type strainer shall not have tapped hole. Full length standard size studs shall be used for joining blind flange.

5.10.8 For fabricated strainers, all BW joints shall be fully radiographed and fillet welds shall be 100% DP/MP checked.

5.10.9 All the strainers shall be hydrostatically tested at twice the design pressure.

5.11 Spectacle Blinds

5.11.1 Spectacle blinds shall be provided to isolate equipment. In hazardous service flanged drop-out spools shall be provided for safety purposes. Both shall be shown on the P&ID's.

5.11.2 Spectacle blinds shall be accessible from grade or platforms. Blinds located in a pipe-rack are considered to be accessible. Blinds that weigh over 40kg shall be accessible by mobile equipment. Where this is not possible davits or hitching points shall be provided.

5.12 Flexibility Analysis and Supporting

5.12.1 Pipe Supporting Criteria & General Guidelines.

Piping system shall be properly supported taking into account the following points:

1. Load of bare pipe + fluid + insulation (if any).
2. Load of bare pipe + water fill.
3. Load of valves and online equipment and instrument.
4. Thermal loads during operation.
5. Steam-out condition, if applicable.
6. Wind loads for piping at higher elevation, e.g. transfer lines, column over head lines, flare headers, etc.
7. Forced vibration due to pulsating flow.
8. Vibration due to two phase flow.
9. Loads due to internal pressure.
10. Any external loads/concentrated loads and cold load of springs.

Pipe supporting shall preferably follow the minimum basic span as given in Annexure-1 except for flare line in off site on trestles in which case the maximum basic span shall be restricted to 18.0 meters, irrespective of line size.

For sizes not covered in Annexure-1, basic span shall be established based on project requirement. For piping on rack or sleeper, as a minimum, providing resting support on every grid of pipe rack / sleeper is mandatory. Depending on the pipe size, as a rule, guides shall be provided on straight run of pipes at intervals as specified in Annexure-3 unless specifically becomes non-viable due to flexibility problems.

Additional supports, guides, anchors, special supports like spring supports and sway braces shall be provided after detailed analysis of piping system to restrict the forces experienced on nozzles of critical items like pumps, compressors, turbines, exchangers, air fin coolers etc.

For lines which do not need any support otherwise but become unsupported by opening of flange, etc, during maintenance and thereby may transfer the total load on a small branch off, a permanent support shall be suitably provided which may be a spring support also. Bare pipes of size 14" and above on elevated structures shall be supported with pad or shoe. While bare pipes of size 6" and' above, on sleepers, corrosion pads shall be provided.

Pads shall be provided for insulated pipes before welding the shoes for sizes 8" & above.

Adequate stiffening shall be provided for the following:

a) Lines in above 600#,

b) Lines having two phase flow,

c) Lines having Pulsating flow such as discharge of reciprocating compressors & reciprocating pumps,

For pulsating flow lines detailed thermal and vibration analysis by analog study shall be done to decide location of anchor supports and guides etc. Pulsating flow lines shall be as identified by licensor/owner.

Wherever two phase flow in piping is expected, piping design shall be checked by dynamic analysis to prevent vibrations.

Pipe support design shall be such that deflection in piping systems due to sustained loads shall not exceed 15mm, in any case, between two adjacent supports.

As far as possible long trunnion types of supports (more than 0.5 metre) are to be avoided. In case long trunnion support is unavoidable in straight length of pipe, trunnion height to be restricted to 0.5 M and balance height to be made up by providing extended structure.

In the heaters where steam air decoking provision is there, the main lines and decoking lines should be supported in a way so that either of the lines should not be in the hanging position while connected to other one. Same philosophy shall be adopted for similar type of switch over arrangement.

Piping passing through the technology structure or passing near the concrete column etc. should have adequate annular space to avoid restriction of line movement during thermal expansion. The gap should take care the thermal expansion along with insulation thickness.

High density PUF blocks shall be considered for cold piping supports. Use of wood blocks shall be avoided.

All pipes supports shall be so designed that there is no undue tension on equipment flanges. Flange joints should not move away from each other in case of unbolting of the joint.

5.12.2 **Flexibility Analysis Criteria & General Guidelines**

5.12.2.1 Formal flexibility analysis by computer program of piping system shall be performed on latest version of CAESAR-II software as per Annexure 5, 5A & 5B.

5.12.2.2 The directions of forces and moments shall be in accordance with Welding Research Council Bulletin 107 (WRC 107), with the exception that the radial force (P) shall be away from the vessel. All forces and moments shall be assumed to act simultaneously and apply at the nozzle/vessel interface.

5.12.2.3 Air coolers to API 661 shall be specified with Fx forces and Mz moments increased to 1.2 times the value shown in Figure 8 of API 661 for nozzle sizes 6”NPS and larger to simplify piping flexibility analysis and facilitate piping layout.

5.12.2.4 Piping stress analysis and equipment nozzle loading analysis shall be in accordance with ASME B31.3 and the relevant API, ANSI/ISO and NEMA Codes.

5.12.2.5 API 610 Pumps

The allowable nozzle loads on centrifugal pumps shall meet the load criteria of API 610. Heavy duty base plate shall be specified where the pump design temperature is in excess of 150°C.

ASME or Manufacturer’s Standard Pumps

The allowable nozzle loads on horizontal centrifugal pumps design to ASME B73.1 shall be specified by the manufacturer. For preliminary layout and analysis NEMA SM 23 criteria shall be used for individual nozzles.

Other Horizontal Centrifugal Pumps

The allowable nozzle loads shall meet the load criteria specified by the manufacturer.

Vertical Turbine, Can-Types Pumps

The combined bending and tensional thermal stress in the piping attached to the nozzle shall be limited to 25 percent of the allowable stress range shown in ASME B31.3. The combined stress due to dead load and other sustained loads shall be limited to 25 percent of the allowable hot stress.

5.12.2.6 For piping design purposes, differential settlement between items of major equipment on separate foundations shall be taken as 10 mm.

5.12.2.7 Cold springing in piping shall not be permitted without written permission from the Owner. Cold springing of piping directly connected to rotating equipment is not permitted under any circumstances.

Piping shall be analyzed for expansion, contraction, differential settlement, relief, valve reaction and effects mentioned at CI. 5.12.1.

The design of piping systems shall take into account the different conditions expected during operation, start-up, shut-down, cold branch in case of standby pump, tracing, etc. Hydrocarbon lines shall be designed for steam-out conditions, if specified in line schedule. The use of expansion joints shall be considered only when space oar pressure drop

limitation does not permit pipe bends. Expansion joint of axial type shall be avoided.

Forces and moments due to weight, thermal loads and other imposed loads on the equipment nozzle must not exceed the allowed loads for the equipment.

Minimum analysis temperature shall be the design temperature of the line as per line list.

5.12.3 **Method of Analysis**

Formal computer analysis shall be performed on piping systems as per design philosophy for stress analysis

The package used shall be latest version of CEASER / AUTO PIPE / SIMPLEX / CAEPIPE. Only one of these packages shall be used for the project & not a combination of the above packages.

All lines shall be analyzed at design / analysis temperature. In the absence of analysis temperature lines shall be analyzed at design temperature.

However in case of wide difference in design and operating temperature, temperature for analysis shall be established in process documents. (e.g. flare line)

All non-critical lines may be analyzed using other methods.

Special analysis methods shall be followed for lines involving pulsating flow such as those connected to reciprocating pumps & compressors which require acoustical plus analog study by approved agencies and shall require entire system analysis along with piping / equipments.

Seismic analysis shall be done for line sizes 12” and above.

5.13 Personnel Protection

5.13.1 Eyewash and emergency safety showers shall be provided in areas where operating personnel are subject to hazardous sprays, emissions or spills.

5.13.2 Personnel protection shall be provided on un-insulated lines and equipment operating above 70 deg C when they constitute a hazard to the operators during normal operation of the facility.

5.13.3 Leakage indicating tape and spray impingement shrouds shall be provided at flanged joints in hazardous service.

5.14 Mechanical Handling

5.14.1 Handling facilities such as davits and monorails shall be provided on vessels over 10m in height where the weight of removable internal and/or external equipment is greater than 35 Kg.

6.0 MATERIALS

6.1 General

6.1.1 Basic material selection of particular line depending on its service, temperature and corrosivity shall be spelt out in process package. Material specification shall follow the requirements as per process parameters & attached PMS / VMS.

6.1.2 Only piping materials listed in ASME B31.3 shall be used for Category ‘M’ and Normal Service piping. Unless otherwise specified in PMS, For Category ‘D’ utility piping, where scaling and impurities are to be avoided (such as instrument air, potable water and deluge water) hot dipped galvanised and threaded fittings may be used in sizes up to and including 4” NB. Galvanised piping shall not be used in environments containing acids or other corrosive commodities. In corrosive environments stainless steel piping material shall be used for such utility systems.

6.1.2 All items/parts of Austenitic Stainless Steel shall be supplied in solution annealed condition.

For all Austenitic Stainless steels, Inter granular Corrosion' (IGC) Test shall be conducted.

6.1.3 In absence of specific requirement, Natural Rubber shall be used for lining in rubber lined piping items, wherever applicable. The Vendor shall confirm the suitability of Rubber Material for specified service. Unless otherwise specified, rubber lining shall be in accordance with IS4682 Part-I.

6.1.4 Unless otherwise specified, HDPE pipes & fittings shall be in accordance to ASTM D3035/ ASTM D3261/ASTM D3350 or equivalent.

6.1.5 Specification for FRP material

6.1.5.1 Anticorrosion Barrier of Polymer veil having minimum thickness 2.5 mm shall be provided for chemical resistance. Mechanical resistance to be sustained by FRP.

6.1.5.2 The selected nominal pipe wall thickness will include manufacturers full under tolerance, and

the specified corrosion and/or erosion allowance. The pipe thickness will be adequate to resist all external loads from thermal, mechanical and other sources in addition to the process pressure-temperature requirements. However the pipe thickness will be according to vendor's norms and standard calculations but not be lower than indicated in DIN 16965 Part 4. External FRP layer shall be protected against ultra-violet light.

6.1.6 Cast Iron shall not be used as Material of Construction for any piping items like Pipes, fittings, flanges, valves, fasteners, gaskets, etc.

6.2 Pipe

6.2.1 Calculation of pipe thickness and branch reinforcement shall be based on requirements of ASME B31.3. Proper corrosion allowance and mill tolerance shall be considered to achieve the selected thickness.

6.2.2 Unless specifically exempted, welded pipes shall be acceptable only with longitudinal weld made employing automatic welding. 100% radiography for all welds except for pipes for category D service.

6.2.3 Double seam 180˚ apart is allowed for sizes 36" and larger only.

6.2.4 Galvanized Pipes shall be only Hot Dip galv. to ASTM A53.

6.2.5 Hydrostatic tests shall be applied to each length of pipe and be in accordance with the requirements of ASTM A530/A530M, unless otherwise specified.

6.2.6 Check analysis shall be carried out as per ASTM-A-530 for pipes as per ASTM-A-312 and pipe size > 8" and thickness > Sch.120, Check analysis shall also be carried out as per supplementary requirement S1 of ASTM-A-312.

6.3 **Fittings**

6.3.1 Type of fittings shall be equivalent to pipe type. All fittings shall be seamless similar to pipe specification in construction unless otherwise specified.

6.3.2 Thickness of fittings at ends to match pipe thickness for BW fittings. For reducing BW fittings having different wall thicknesses at each end, the greater one shall be employed and the ends shall be matched to suit respective thickness.

6.3.3 Unless and otherwise specified in the requisition all socket weld and screwed fittings shall be in accordance with ANSI B16.11 to the extent covered in the specification except for unions which shall be in accordance with MSS-SP-83.

6.3.4 Special fittings like Weldolet, Sockolet, Sweepolet etc. which are not covered in ANSI , MSS-SP shall be as per Manufacturer's Std. Contours of these fittings shall meet the requirements of ANSI 31.3. Manufacturer shall submit drawings/catalogues of these items along with the offer & also shall be submitted for approval before manufacturing.

6.3.5 All pipes employed for manufacturing of fittings shall be required to have undergone Hydro test to ASTM A530 to the extent so as to produce wall stress of 75% of SMYS of the material.

6.3.6 All welded fittings shall be 100% Radio-graphed by X-Ray on all welds.

6.4 **Flanges**

6.4.1 All flanges shall be of forged one piece material (seamless), and plate may not be substituted without written approval from the Purchaser.

6.4.2 All flange joints on piping system including flanges on the equipment, manholes, etc shall be tightened using Torque wrench / hydraulic bolt tensioner depending upon service criticality.

6.5 Gaskets

Gaskets shall be as per piping material specification/ applicable standard.

6.6 Stud, Bolts, Nuts and Jack Screws

6.6.1 All bolting shall be as per ASME/ANSI 818.2.1 for Studs, M/C Bolts and Jack screws, and ASME/ANSI B18.2.2 for nuts. Machine Bolts shall not be used in piping flange joint, except for Butterfly Valves, which shall be lug type, having UNC Threads in lugs facilitating opening of flanges from both sides.

6.6.2 Screw threads of bolting shall be unified coarse threads in accordance with ANSI / ASME B1.1 having Class 2A for bolts and Class2B for nuts. Screw threads in sizel-1/8 and larger shall be 8 threads per inch.

6.7 Valves

6.7.1 General

All flanged valves (except forged) shall have flanges integral with the valve body.
Valve Castings/Forgings purchased shall be from Local approved foundries/forging shop.
Yoke material shall be at least equal to body material.
Forgings are acceptable in place of Castings but not vice-versa.
No cast iron material valves to be used in any service.
Valves in saline water (if applicable) service shall be with non ferrous trims and all wetted parts other than trims shall be epoxy coated.
Generic material of valves body, required as per process/service conditions but not specifically mentioned, shall not be lower in chemical composition than the connecting pipe material.

6.7.2 Ball/Plug/Butterfly Valves

Use of soft seated ball/plug/butterfly valves shall be suitably selected based on temperatures handled.

Butterfly valves shall be suitable for throttling application.

As a rule, they shall be limited to water services only. Lug type Butterfly valves shall be with threaded lugs only. Each butterfly valve shall be provided with the Bolts to be installed from both sides separately.

PN equivalent rating for Class150# valves shall be minimum PN16.

Ball valves may be used in place of gate or plug valves with the following limitations:

i) Operating conditions are within the permissible pressure - temperature range of seat materials.

ii) Fire safe type to be used for hydrocarbon services.

6.7.3 **Valve Dimensions**

Face-to-Face/End-to-End dimension shall be as per ANSI B16.10. In case the same is not covered under B16.10, the dimension shall be as per BS 2080/manufacturer standard.

Hand wheel diameter shall not exceed 750mm and lever length shall not exceed 500 mm on each side. Effort to operate shall not exceed 35 kgf at hand wheel periphery. However, failing to meet the above requirement, vendor shall offer gear operation.

Quarter-turn valves shall have "open" position indicators with limit stops.

6.7.4 **Non Destructive Testing of Valves**

6.7.4.1 Radiography procedure, areas of casting to be radiographed, and the acceptance criteria shall be as per ASME/ANSI B16.34.

All valve castings shall be of radiographic quality.

The minimum requirement of radiography shall be as under:

Class	Size	Qty
150	Up to 24”	5%
150	26” & above	100%
300	Up to 16”	10%
300	18” & above	100%
600 & above	All	100%

6.7.4.2 The welds of body-to-bonnet and body-to-end flange shall be subjected to 100% NDT; both radiographic and magnetic or liquid penetrant examinations.

6.7.4.3 Beveled ends on each butt welding end valve shall be subjected 100% magnetic particle or liquid penetrant examination.

6.7.4.4 Each valve shall be pressure tested in accordance with API 598.

6.7.5 **Criteria for Isolation Valves**

Installation	Process Isolation	Drain/ Vent	Pressure Taping	Level Taping	Flow Element	Safety Valve	Control Valve
150 / 300#	Single	Single	Single	Single	Single	Single	Single
600 #	Single	Double	Double	Single	Double	Single	Single
Above 600#	Double	Double	Double	Double	Double	Double	Single

Note: For S/D & at battery limit, it will be as per process requirements.

6.8 **Traps**

Vendor shall also furnish the performance curve indicating the capacity in mass/hour at various differential pressures across the trap.

Parts subject to wear and tear shall be suitably hardened. Traps shall have integral strainers.

All traps shall be hydrostatically tested to twice the design pressure.

6.9 **Hoses**

Manufacturer shall guarantee suitability of hoses for the service and working conditions specified in the requisition, if the material is not specified in the Material Requisition for any particular service.

All hoses shall be marked with service and working pressure at minimum two ends clearly.

Hoses shall be resistant to ageing, abrasion and suitable for outdoor installations.

Complete Hose assembly shall be tested at two times the design pressure

Steam hoses shall be subject to steam resistance test.

6.10 **Expansion Joints(Metallic)**

The applicable codes are ASME B31.3 and EJMA (Expansion Joint Manufacturer's Association).

Bellows shall be formed from solution annealed sheet conforming to the latest ASTM Spec. Any longitudinal weld shall be 100% radiographed. The finished longitudinal weld must be of the same thickness and same surface finish as the parent material.

Circumferential welds are not permitted. Bellows are to be hydraulically or expansion (punched) formed. Rolled formed bellows are not acceptable. Noticeable punch or die marks resulting from expansion operation are not acceptable.

No repairs of any kind are allowed on the bellows after forming. Deep scratches and dents are not acceptable.

The out of roundness shall be limited to ± 3mm. This is the max deviation between the max & min diameter.

The actual circumference of the welding end shall be maintained to ± 3mm of the theoretical circumference.

Apart from the usual requirements, the vendor shall also furnish

a) Design calculations to justify stiffness and fatigue life.

b) Axial, lateral stiffness, angular stiffness, effective pressure thrust area.

c) Installation/maintenance manual.

6.11 **Supports & Spring Assemblies**

The Material, Design, Manufacture and Fabrication shall be generally as per MSS-SP-58/ MSS-SP-89 and/or BS 3974.

Testing of springs shall be as per BS1726.

6.12 **Non Destructive Examination**

10% radiography of butt welds and 10%DP/ MP test of fillet welds shall be done for pipe Classes in 150# & 300#.

100% radiography on butt weld joints and 100% DP/MP for fillet welds test shall be done for Pipe Classes in 600# & above.

7.0 **PAINTING**

Painting shall be as per attachment provided elsewhere in NIT.

8.0 **WELDING**

Welding shall be as per ASME BPV- Sec. IX

ANNEXURE – 1

TABLE OF BASIC SPAN

Pipe Size In.	SCH/Thk (in)	PIPE- VAPOR INSULATION			PIPE- LIQUID INSULATION			BARE PIPE EMPTY		BARE PIPE WATER FILLED		Pipe size in.
		BASIC SPAN (L)M			BASIC SPAN (L)M							
		UPTO 175^0 C	176^0 C TO 315^0C	316^0C TO 400^0C	UPTO 175^0 C	176^0 C TO 315^0C	316^0C TO 400^0C	SPAN(L) M	WEIGHT KG/M	SPAN(L) M	WEIGHT KG/M	
3/4"	SCH 40	3.5	3.5	2.5	3.5	3.0	2.0	4.5	1.68	4.0	2.04	*3/4"*
1"	SCH 40	4.5	4.0	3.0	4.5	3.5	3.0	5.0	2.52	4.5	'3.07	1"
1-1/2"	SCH 40	5.0	5.0	4.5	5.0	4.5	3.5	6.0	4.08	5.0	.5.4	*1-1/2"*
2"	SCH 40	5.5	5.0	4.5	5.0	4.5	3.5	8.5	5.47	5.5	7.65	2"
2-112"	SCH 40	6.5	6.0	5.0	6.0	5.5	4.5	7.5	8.7	6.5	11.79	*2-112"*
3"	SCH 40	7.5	6.5	5.5	6.5	6.0	5.0	8.0	11.35	6.5	16.15	3"
4"	SCH 40	8.0	7.5	6.5	7.5	7.0	6.0	9.0	16.2	7.5	24.45	4"
6"	SCH 40	10.0	9.5	8.5	9.0	8.0	7.5	10.5	28.3	9.0	46.7	6"
8"	SCH 40	12.0	11.0	10.0	10.0	10.0	9.0	12.0	42.84	10.0	75.22	8"
10"	SCH 40	13.5	13.0	12.0	11.5	10.5	10.5	14.0	60.74	11.5	111.9	10"
12"	*3/8"* w	14.5	13.5	13.0	12.0	11.5	11.0	15.0	74.40	12.0	147.5	12"
14"	*318"*w	15.0-	14.5	13.5	12.0	12.0	11.5	16.0	82.5	12.5	172.05	14"
16"	*318"*w	16.0	15.5	14.5	13.0	12.5	12.0	17.0	94.5	13.0	213.15	16"
18"	*3/8"* w	17.0	16.5	15.0	13..5	13.0	12.0	18.0	106.5	13.5	258.3	18"
20"	*318"* w	18.0	17.5	16.0	14.0	13.5	12.5	19.0	118.5	14.0	307.5	20"
24"	*3/8"*w	20.0	19.0	17.5	14.5	14.5	13.0	21.0	1425	15.0	418.2	24"
3/4"	SCH 80	3.5	3.5	2.5	3.5	3.0	2.0	4..5	2.20	4.0	2.49	*3/4"*
1"	SCH 80	4.5	4.0	3.0	4.5	3.5	3.0	5.0	3.25	4.5	3.72	1"
1-112"	SCH 80	5.0	5.0	4.5	5.0	4.5	4.0	6.0	5.45	5.0	6.60	*1-112"*
2"	SCH 80	6.0	5.0	4.5	5.5	5.0	4.0	6.5	7.53	6.0	9.45	2"
2-112"	SCH 80	6.5	6.0	5.5	6.0	6.0	5.0	7.5	11.49	6.5	14.25	*2-1/2"*
3"	SCH 80	7.5	6.5	6.0	6.5	6.5	6.0	8.0	15.37	7.0	19.66	3"
4"	SCH 80	8.0	8.0	7.0	7.5	7.5	6.5	9.0	22.47	8.0	29.94	4"
6"	SCH 80	10.5	10.0	9.0	9.5	9.0	8.5	10.5	42.90	9.5	59.85	6"

Pipe Size In.	SCH/Thk (in)	PIPE- VAPOR INSULATION			PIPE- LIQUID INSULATION			BARE PIPE EMPTY		BARE PIPE WATER FILLED		Pipe size in.
		BASIC SPAN (L)M			BASIC SPAN (L)M							
		UPTO 175^0 C	176^0 C TO 315^0C	316^0C TO 400^0C	UPTO 175^0 C	176^0 C TO 315^0C	316^0C TO 400^0C	SPAN(L) M	WEIGHT KG/M	SPAN(L) M	WEIGHT KG/M	
8"	**½" w**	12.0	11.5	10.5	10.5	10.0	10.0	12.0	65.10	11.0	94.8	8"
10"	**½" w**	13.5	13.0	12.0	11.5	11.5	10.5	14.0	82.20	12.0	130.69	10"
12"	**½" w**	14.5	13.5	./, 3.0	12.5	12.0	11.5	15.0	98.13	13.0	168.64	12"
14"	**½" w**	15.0	14.5	13.5	13.0	12.5	12.0	16.0	108.15	13.5	194.4	14"
16"	**½" w**	16.0	15.5	15.0	13.5	13.0	13.0	17.0	124.2	14.0	240.0	16"
18"	**½" w**	17.5	17.0	.16.0	14.5	14.0	13.5	18.0	140.25	14.5	286.64	18"
20"	**½" w**	18.0	17.5	..:.17. 0.	15.0	14.5	14.0	19.0.	157.5	15.0	341.8	20"
24"	**½" w**	20.0	19.0	. 18.5	16.0	15.0	15.0	21.0	188.25	16.0	458.44	24"
1"	10S	4.0	3.5	3.0	4.0	3.0	2.5	4.5	2.08	4.0	2.7	1"
1-112"	10S	5.0	4.5	3.5	4.5	4.0	3.0	5.5	3.12	5.0	4.57	*1-112"*
2"	10S	5.0	4.5	3.5	4.5	4.0	3.0	6.0	3.94	5.5	6.33	2"
2-112"	10S	6.5	5.5	4.5	5.5	5.0	4.5	7.0	5.26	6.0	8.85	*2-1/2"*
3"	10S	7.0	6.0	5.0	6.0	5.5	5.0	7.5	6.45	6.0	11.91	3"
4"	10S	7.5	7.0	6.0	*6.p*	6.0	6.0	8.0	8.34	7.0	17.87	4"
6"	10S	9.5	9.0	8.0	8.0	7.5	7.5	10.0	13.82	8.5	34.54	6"
8"	10S	11.0	10.5	10.0	9.5	9.5	8.5	11.5	19.94	10.0	55.5	8"
10"	10S	12.5	12.0	11.0	10.5	10.0	9.5	13.0	27.S3	11.0	83.4	10"
12"	10S	14.0	13.0	12.0	11.0	11.0	10.0	14.5	36.00	11.5	114.6	12"
14"	105	14.5	14.0	13.0	11.5	11.0	11.0	15.5	41.18	11.5	132.6	14"
16"	10S	16.5	14.5	14.0	12.0	11.5	11.5	16.5	47.33	12.5	172.2	16"
IS"	10 S	16.5	15.5	14.5	12.5	12.5	11.5	17.5	53.18	13.0	212.1	18"
20"	10 S	17.5	16.5	15.5	13.0	13.0	12.0	18.5	68.50	13.0	264.5	20"
24"	10 S	19.0	18.0	17.0	14.0	13.5	12.5	20.5	94.37	14.0	376.8	24"

ANNEXURE – 2

ACCESSIBILITY FOR VALVES AND INSTRUMENTS

VALVES, INSTRUMENTS, EQUIPMENT TO BE OPERATED	CENTRELINE OF ITEM TO BE OPERATED, LOCATED LESS THAN 3.6m ABOVE GRADE, 2.75 m ABOVE FLOOR OR PLATFORM OR 1.8m ABOVE WING PLATFORM	CENTRELINE OF ITEM TO BE OPERATED, LOCATED MORE THAN 3.6m ABOVE GRADE, 2.75m ABOVE FLOOR OR PLATFORM OR 1.8m ABOVE WING PLATFORM
EXCHANGER HEADS	NIL	PLATFORM
OPER.VALVES 2" & SMALLER	FIXED LADDER	FIXED LADDER
OPER. VALVES 3" & ABOVE	PLATFORM	PLATFORM
MOTOR OPERATED VALVES	PLATFORM	PLATFORM
CONTROL VALVES	PLATFORM	PLATFORM
RELIEF VALVES 2" & SMALLER	FIXED LADDER	FIXED LADDER
RELIEF VALVES 3" & ABOVE	PLATFORM	PLATFORM
BLOCK VALVES 2" & SMALLER	PORTABLE LADDER	PLATFORM
BLOCK VALVES 3" & ABOVE	PLATFORM (NOTE-1)	PLATFORM (NOTE-1)
BATTERY LIMIT VALVES	PLATFORM	PLATFORM
PRESSURE INSTRUMENT	FIXED LADDER IF ABOVE 2.2m HEIGHT	FIXED LADDER
TEMPERATURE INSTRUMENT	FIXED LADDER IF ABOVE 2.2 M Ht	FIXED LADDER
SAMPLE POINTS	PLATFORM	PLATFORM
GAUGE GLASSES	FIXED LADDER	FIXED LADDER
LEVEL CONTROLLERS	PLATFORM	PLATFORM
PROCESS BLINDS AND SPACERS 2" & SMALLER	PORTABLE LADDER / PLATFORM	PLATFORM
PROCESS BLINDS AND SPACERS 3" & ABOVE	PLATFORM	PLATFORM
MANWAYS/MANHOLES	PLATFORM	PLATFORM
HANDHOLES/INSPECTION HOLES	PLATFORM	PLATFORM
NOZZLES (process}	PLATFORM	PLATFORM
VESSEL VENTS	PORTABLE LADDER	FIXED LADDER

LINE DRAINS & VENTS	PORTABLE LADDER	PORTABLE LADDER
ORIFICE FLANGES	PLATFORM (NOTE-1)	PLATFORM (NOTE-1)

NOTE -1:-BLOCK VALVES / ORIFICE FLANGES, IF LOCATED, WITH CENTRE LINES GREATER THAN 2 METER FROM THE OPERATING FLOOR / OPERATING PLATFORM, SHALL BE PROVIDED WITH PORTABLE PLATFORM OR CHAIN FOR OPERATION.

NOTE -2 : PLATFORM SHALL BE PROVIDED FOR THE ORIFICE FLANGES ON PIPE RACK.

ANNEXURE-3

MAXIMUM SPACING OF GUIDES FOR VERTICAL & HORIZONTAL PIPES

NOM PIPE SIZE IN INCHES	VERTICALSPACING METRES	HORIZONTAL SPACING METRES
1	6.0	6.0
1 ½	6.0	6.0
2	6.0	6.0
3	8.0	12.0
4	8.0	12.0
6	8.0	12.0
8	8.0	12.0
10	12.0	18.0
12	12.0	18.0
14	12.0	18.0
16	12.0	18.0
18	12.0	18.0
20	16.0	18.0
24	16.0	18.0
26 & ABOVE	16.0	18.0

NOTES:-

1. These spacings may be varied to suit column spacing of rack. The above spacing is for straight runs of pipe & does not include guides which are used for control of thermal movements, as decided by stress group.

2. The guide spacings given in the above table are indicative only.

ANNEXURE – 4

CLEARANCES

Minimum clearances for piping, equipment, structures, platforms, and supports shall be in accordance with the following table:

Item	Description	
Roads	Headroom for primary access roads wherever heavy duty crane movement is required.	9 M
	Headroom for primary access roads	7.5 M
	Width of primary access roads excluding shoulders.	Refer Civil
	Headroom for secondary roads	5 M
	Width of secondary roads excluding shoulders.	Refer Civil
	Clearance from edge of road shoulders to platforms, equipment, pipe associated with equipment, or similar features.	1.5 M**
Maintenance Aisles at Grade	Horizontal clearances for equipment maintenance by hydraulic crane (12t capacity)	3 M
	Vertical clearance for equipment maintenance by hydraulic crane (12t capacity)	3.6 M
	Horizontal clearance for fork lift and similar equipment (2500 kgs capacity)	2.4 M
	Vertical clearance for fork lift and similar equipment (2500 kgs capacity)	2.4 M
	Horizontal clearances for equipment maintenance by portable manual equipment (A-frames, hand trucks, dollies or similar equipment)	1 M
	Vertical clearances for equipment maintenance by portable manual equipment (A-frames, hand trucks, dollies or similar equipment)	2.4 M
Walkways	Horizontal clearance (not necessarily in a straight line)	750 mm
	Headroom (except for hand wheels)	2.2 M
Platforms	Minimum width	1200mm

Item	Description	
Platforms	Headroom from stairwell treads.	2.2 M
	Minimum clearance around any obstruction on the platform.	500 mm
	Headroom	2.2 M
	Maximum vertical distance between platforms	6 M
	Minimum toe clearance behind a ladder.	210 mm
	Minimum handrail clearance.	100 mm
Equipment	Minimum maintenance space required between flanges of exchangers or other equipment arranged in pairs.	500 mm
	Minimum maintenance space required for structural members or pipe.	300 mm
	Clearance from edge of road shoulder (the extreme projection)	1.5 M
Fired Equipment	Horizontal clearance from hydrocarbon equipment (shell to shell)	15 M
	Exception: Reactors or equipment in alloy systems shall be located for the most economical piping arrangement.	
	Clearance from edge of road to heater shell.	3 M
Valve Hand wheels	Clearance between the outside of the hand wheel and any obstruction.	25 mm*
Pipe (aboveground)	Clearance between the outside diameter of the flange and the outside diameter of pipe insulation.	25 mm*
	Clearance between the outside diameter of the pipe, flange or insulation and a structural member.	50 mm*
	Clearance between the outside diameter of the flange and the outside diameter of bare pipe.	25 mm*
	Minimum distance from underside of pipe to grade or platform.	300 mm
Control Valve Arrangement	Centreline of control valve above grade or platform.	450 mm
	Minimum centreline of control valve from face of column or	600 mm

Item	Description	
	wall.	
	Where process conditions require steam or hydrocarbon vapours to be discharged to atmosphere at a safe location, the tail pipe shall terminate as below:	
	Distance above nearest operating platform.	3 M
	Within radius of nearest operating platform.	7.5 M
** Verify conformance with local regulations. * With full consideration of thermal movements		

ANNEXURE – 5

DESIGN PHILOSOPHY FOR STRESS ANALYSIS

1.0 PURPOSE

This design basis deals with the subject of Identification of Stress Critical pipelines and preparation of Critical line list. This procedure also defines the minimum requirements for performing stress analysis, design and location of spring, support and level of system

Analysis with the extent of documentation required for flexibility analysis.

Purpose of piping stress analysis is to ensure:

Safety of piping and piping components

Safety of connected equipment and supporting structure

Piping deflections are within the limits

2.0 SCOPE

This specification covers the supply of engineering services to perform a complete piping and pipe support analysis for piping systems.

3.0 DEFINITIONS

3.1 Critical Lines / Critical Line List

Critical lines or Critical Line List as referred to in this procedure relates to Piping Stress Critical Lines and does not include or refer to process critical lines.

3.2 Stress Analysis Temperature

Stress Analysis Temperature refers to either “Maximum Operating Temperature” or “Steam-out temperature / hot nitrogen purging temperature” of the lines under review whichever is higher. In absence of the above values, it refers to the Design Temperature of the line under review. The Line List should be strictly followed in obtaining the above temperature values.

3.3 Design Pressure

Design Pressure refers to the “Design Pressure” of the line under review as indicated on the Line List. Design Pressure is as defined in clause 301.2 of ASME B 31.3.

3.4 Temperature For Flexibility Analysis

The temperature to be used for the flexibility analysis shall be taken as the maximum / minimum temperature which the pipe will see under any combination of different normal / abnormal operating conditions, as defined in clause 301.3 of ASME B 31.3. Where piping is exposed to direct sunlight, solar radiation temperature of 70 ^{0}C is considered in establishing the maximum temperature of piping. Even, for non-critical piping exposed to direct sunlight on pipe rack or elsewhere, expansion loops, wherever essential, are provided to take care of pipe movements resulting from piping skin temperature due to solar radiation.

In general, unless there is a difference of more than 50 ^{0}C between working Temperature and the design temperature, the design temperature should be taken as Flexibility temperature. Ambient Temperature shall be considered as 21ºC the assumed piping installation temperature. The displacement stress range from this installation temperature to the minimum recorded ambient temperature of 0^0 C being less than the same from installation temperature

to the maximum operating temperature of hot piping in most cases, the later governs as per clause 319.2.3 of ASME B 31.3

The temperature under fire condition is normally not considered for flexibility analysis.

1.0 SELECTION

A line is selected and listed as a Critical Line provided it falls under any one of the categories defined below and is intended to include the special requirements of Piping Stress Engineer. It is hence defined as any line for which a flexibility review is required or where pipe supporting is deemed to be critical and needs review by a Stress Engineer. Line DN 50 and smaller is inherently flexible and is not normally considered critical unless built from non-metallic or non-ferrous materials. In case of more than one applicable line size, larger line size governs. Lines are classified as Level I, Level II & Level III according to the criteria listed below.

4.1 Level I [Extensive Analysis]

Piping systems or lines that meet Annexure 5A criteria are deemed to be extremely critical. These lines are categorized as Level I and require careful study to ensure that the code compliance is met and the accurate determination of nozzle and support loads have been made. The routing of these lines is very important. They must be analyzed in the early stages of the project during routing studies so that the impact on the location of less critical lines is minimized. Normally, these systems require computer analysis. The general intent of the Level I analysis criteria is to study lines size DN 80 & larger that are affected by thermal expansion and / or a dynamic response, and that can't be evaluated by a weight-only analysis (as per the general intent of Level II analysis). Consideration has to be given to other special situations that augment the Level I general intent guidelines such as for lines that are excessively large and stiff.

4.2 Level II [Normal Analysis]

Piping systems or lines that meet Annexure 5B criteria are moderately critical lines and often do not require such rigorous study to ensure code compliance or accurate determination of nozzle and support loads. These lines are smaller in size and operate at lower temperatures (in general) than the lines to be analyzed using Level I Criteria. Normally, only manual calculations, by use of appropriate monographs are required for analysis of these systems.

4.3 Level III [Minimum Analysis]

All lines that are outside the purview of Level I or Level II criteria will be classified as level III and shall be reviewed by the Piping Engineer during the squad check of the piping drawings and or fabrication Iso's. If more detailed analysis is required, the Piping Engineer may change the level of analysis during the squad check as applicable. Normally, only visual analysis is required for these systems.

4.4 Lines Deemed To Be Support Critical

Lines subjected to two-phase flow.

Cross country pipelines.

Lines with pipe thickness Sch 160 or greater.

Lines DN 400 and above with pipe thickness less than 8 mm.

Lines DN 250 and above with corrosion allowance 3 mm and above.

Lines with high concentrated loads such as heavy valves or fittings etc.

Lines downstream of Relief Valve / letdown Control Valves / bursting (rupture) discs.

Connecting to vent or flare systems or discharging to atmosphere

Liquid Blow down Lines.

Lined pipes

Non-metallic pipes

4.5 Lines Needing Dynamic Analysis

There are instances where in the frequency of the applied load is comparable to the natural frequency of the piping system. Such systems tend to store the energy and release it according to certain scientific laws. Such a system is dynamic in nature and the study of the response of such a system is referred to as “Dynamic Analysis”. Examples of such kind of systems are Relief Valve discharge lines, water hammer and surge in pipe lines, two phase flow in pipelines, reciprocating pumps and compressor piping, submarine piping etc.

4.6 Special Piping

Special piping forming part of reformer tubes, heater internal piping, etc. are treated as proprietary piping and nozzle loading at the Interface connections are to be co-ordinate with vendor.

5.0 RELATED DOCUMENTATION

5.1 Critical Line List Format.

The critical line list shall be prepared from the project line list document by inserting following relevant fields such as Stress level, stress package no., stress analysis temperature, support critical nature of the line, dynamic loadings, steam out / purge temperature etc.

The list shall reflect analysis status of line that includes its input received date from design & output handover date to design and specific remark if any.

5.2 Lines Affecting the Flexibility of Critical Lines

Non-critical Lines found to affect the flexibility of critical lines which have not been included during the initial review are subsequently added to the Critical Line List.

Non-critical Lines on which advice may be sought by the Lead Piping Engineer are not normally entered into the Critical Line List but covered verbally, or by a memorandum if a record is required.

6.0 PIPE STRESS ANALYSIS AND SUPPORTING

6.1 Piping system shall be properly supported taking in to account of the following points:

Piping stress analysis shall follow ASME B 31.3 and shall be complete to prevent overstressing of the pipe during operating conditions with wind and seismic loadings. During sustained, occasional (wind and seismic) & thermal expansion loading on piping,

The material allowable stresses shall be as per ASME B 31.3 for ASTM materials. For DIN material specifications the allowable stress values shall be calculated as per ASME

B 31.3 clause 302.3.2(d), wherein yield strength and ultimate strength values at temperature shall be taken from DIN material standards. For DIN material specifications, the other material properties viz. elastic modulus, density, coefficient of thermal expansion shall be taken from the respective DIN material standards.

6.2 Analysis shall include, but not be limited to the following; thermal, dead weight, internal pressure, wind and seismic, and a combination of these based on ASME B 31.3.

6.3 Piping shall be designed in accordance with the Indian Standard criteria for earthquake resistance design for structures IS: 1893 for seismic zone-IV (refer project design basis). As a minimum, two (2) orthogonal horizontal components and a vertical component of ground motion will be considered in the seismic analysis. For American standard, loading applied to piping would be in accordance with uniform building code (UBC).

The equivalent horizontal static force method shall apply in general .The contractor shall also carry out special designs and provisions as necessary for piping which is considered to be dynamically sensitive to earthquake.

Seismic analysis to be performed for lines equal to and above 12".Seismic load case shall ALGEBRIC combination with operating cases.

Heavy rigid masses like valves shall be restrained in their vicinity to avoid large seismic movements. Guides or snubbers as the case may be used for this purpose.

Horizontal seismic coefficient (Ah) to be considered as 0.26 and Vertical (Av) to be considered as 0.173.

6.4 Wind loads shall be calculated in accordance with IS-875 code of practice for structural safety of building – Loading Standards for Indian code requirement using basic wind speed as mentioned in project design basis. For American standard, wind load in accordance to ASCE 07 shall be calculated. Reduction in velocity pressure due to apparent shielding afforded by buildings and structure or terrain shall not be permitted.

Wind loading shall only be considered for lines larger than 20" OD at elevation higher than 10m above grade. Displacements due to wind and earthquake should be limited to 50 mm.

Both the horizontal directions shall be analyzed independently in two cases

+X, -X, +Z, -Z

Wind and seismic loading will not occur simultaneously.

6.5 Analysis of all nozzles loading on vessels within the piping boundaries is covered in this specification. Nozzle analysis shall follow the guidelines of ASME Section VIII, Division 1, and WRC 297 & 107 (latest editions). Nozzle stresses shall fall within the allowable per ASME.

6.6 Piping system shall have sufficient flexibility to avoid leakage at joints. Flanged joints imposed by external moments may be analyzed and the stresses evaluated by using the methods of equivalent pressure given in the ASME boiler and pressure code section III. Flange leakage shall be assessed as per "Pressure Equivalent Method". In case of Failure in Pressure Equivalent Method, the Flanges shall be checked for leakage using Caesar Flange leakage

Module. Flange leakage shall be assessed for all PSV flanges, Control valve flanges, High Pressure lines, and all steam lines. Also for equipment flanges where loads are high.

6.7 All forces on connections to equipment shall not exceed maximum allowable as specified by equipment vendor.

6.8 Pipe supports loads shall be based on the maximum loads determined by the piping analysis. Adjustments shall be made to the piping system and model such that the pipe supports loads are within a reasonable uniformity throughout the piping system.

6.9 Various Load cases built in Caesar II to check stress in piping system are listed below.

1	WW+HP	HYD	
2	W+T1+P1	OPE	
3	W+T2+P1	OPE	
4	W+T1+P1+U1	OPE	
5	W+T1+P1+U2	OPE	
6	W+T1+P1+U3	OPE	
7	W+T1+P1-U1	OPE	
8	W+T1+P1-U2	OPE	
9	W+T1+P1-U3	OPE	
10	W+T1+P1+WIN1	OPE	
11	W+T1+P1+WIN2	OPE	
12	W+P1	SUS	
13	W+P2	SUS	
14	L2-L12	EXP	
15	L3-L12	EXP	
16	L4-L2	OCC	
17	L5-L2	OCC	
18	L6-L2	OCC	
19	L7-L2	OCC	
20	L8-L2	OCC	
21	L9-L2	OCC	
22	L10-L2	OCC	
23	L11-L2	OCC	
24	L12+L16	OCC	
25	L12+L17	OCC	
26	L12+L18	OCC	
27	L12+L19	OCC	
28	L12+L20	OCC	
29	L12+21	OCC	
30	L12+L22	OCC	
31	L12+L23	OCC	

P1- Maximum Operating Pressure W- Dead Weight

T1- Maximum Operating Temperature WW- Water Weight

P2- Design Pressure WIN- Wind Load

T2- Design Temperature U- Uniform Load

HP- Hydro test Pressure L2- Load case

SUS, EXP, OCC, HYD, OPE- Various load types, viz., sustained, occasional, hydro test, operating etc.

7.0 CODES AND STANDARDS

The following codes and standards shall apply in the design and analysis of the piping systems covered under this specification:

Allowable Stress ASME B 31.3

Piping ASME B 31.3

Nozzle Loadings PMC's Standard, WRC297/107(Welding Research Council) /

Allowable Vendor

Wind Analysis ASCE 7 – 98

8.0 SOFTWARE USED

The package used shall be latest version of CEASER-II 5.2. Only one of these packages shall be used for the project & not a combination of the above packages.

9.0 DOCUMENT REQUIREMENT

9.1 A written report shall be submitted on the piping and equipment analysis. The report shall include all pertinent information that shall include but not be limited to the following.

Location and type of pipe supports with loads and movements.

Location of expansion joints and movements.

Vertical and horizontal loads including moments at all support points.

Vertical and horizontal loads including moments on all equipment and

Vessel connections.

Caesar II analysis report, which shall include as a minimum, restraint forces, movements and stresses for all load cases. For flange connection, loaded with high bending moments and/or tensile forces in piping or at equipment connections, Caesar II flange leakage report will be provided. For piping analyzed, if subjected to hydro test, hydro test load case will be made in Caesar II to check for loading under hydro test & the requirement of any additional temporary supports for hydro test.

Detailed nodal model used for the stress analysis

All assumptions and limitations applied to the analysis

9.2 All dimensions and analysis shall be performed using metric and SI units.

9.3 The final report / stress package folder shall be submitted as follows:

1. Front sheet with Approval status
2. Isometrics with following information
   - Node numbers
   - Type of supports selected by stress engineer

- Springs / Bellows data required for procurement like spring rate, loads, tide/untied information and SM (special material) identification.
- Maximum Expansion and sustain stress values with node number
- Nozzle/Anchors initial movements and piping imposed forces and moments on the same
- Support loads (anchors, guides or rest) only they are above limit (The limit is defined in the beginning of the project in consultation with civil)
- Design and maximum operating conditions
- Coordinate axis system considered for inputs
- Dimensional details for piping designer to locate supports in piping model/layout.

3. Checklist as per Work instructions.
4. Following outputs
   - Load Cases
   - Restraint summary
   - Spring hanger report, if any
5. Stress critical line list extract for the lines analysed
6. Piping material specifications
7. Equipment drawings with allowable loads, if available
8. PID

ANNEXURE-5A

CRITERIA FOR IDENTIFING EXTREMELY CRITICAL LINES (LEVEL I)

Temperature T, Degree C	Pipe Diameter DN (mm)	Piping Material	Service and Description
All	All	All	Piping which will undergo hydraulic shock, auto-ignition or is in service.
All	DN≥80	All	Category M (Lethal) fluid service per ASME B31.3 (No cyclic service).
All	DN≥80	All	Piping which is openly exposed to winds> 75 mph.
T<-29	DN≥80	Carbon Steel	All Services.
T<-45	DN≥80	All	All Services
T≥65	DN≥80	Non-Metallic	All Services
T≥65	DN≥80	All	Lines with pressure≥900 psig.
T≥150	DN≥80	All	All Services
ALL	DN≥400	All	All Services.
T≥260	ALL	ALL	ALL Services.
-29≥T≥65 OR -7≥T≥50	DN≥80 DN≥100	All	Piping connected to nozzle load sensitive equipment, air-cooled exchangers and rotating equipment (see note 1).
ALL	ALL	All	Lines requiring expansion joints or flexible connectors.
DELTA T≥27 (NOTE 2)	DN≥80	All	Jacketed piping.
-29≥T≥65	DN≥100	All	Internally lined pipe (except glass).
All	ALL	All	Glass lined piping.
All	DN≥80	All	Differential Tank Settlement (Upto 3 supports from nozzle).
-40≥T≥80 -29≥T≥70	DN≥100 DN≥200	Metallic Metallic	Underground Piping

NOTES:

1) Load sensitive equipment include fired heaters, reformers, lined vessels with lining of brittle material, non-ferrous equipments, graphite heat exchangers, plate & frame heat exchangers, etc.
2) This criterion is not to be applied to auxiliary piping such as seal flush; bearing cooling, etc. delta T refers to the differential temperature between the process piping and jacket.

ANNEXURE-5B

CRITERIA FOR IDENTIFING MODERATELY CRITICAL LINES (LEVEL II)

Temperature T, Degree C	Pipe Diameter DN (mm)	Piping Material	Service and Description
All	DN<80	All	Lethal fluid service.
T<-29	DN<80	Carbon Steel	All Services.
T<-46	DN<80	All	All Services
95<T<150	80<DN<200	All	All Services
T≥65	DN<80	Non-Metallic	All Services
T≥65	DN<80	All	All Services
T≥65	DN<80	All	Lines with pressure≥900 psig.
T≥150	DN<80	All	All Services
ALL	200<DN<400	All	All Services.
T≥260	ALL	ALL	ALL Services.
ALL	ALL	ALL	Piping connected to nozzle load sensitive equipment, air-cooled exchangers and rotating equipment (see note 1 of Table-1).
DELTA≥27(NOTE 2 of Table-1)	DN<80	All	Jacketed piping.
All	ALL	All	Internally lined pipe (except glass).
All	DN<80	All	Differential Tank Settlement (Upto 3 supports from nozzle).
All	ALL	All	Underground Piping
All	ALL	All	Piping connected to pressure relief
All	ALL	All	Close coupled interconnecting piping between equipment with differential movement greater than 6.0mm.

ENGINEERING SPECIFICATION–PIPING
(FOR PACKAGE UNITS)

CONTENTS

1.0 GENERAL PIPING SCOPE OF WORK

1.1 The detail scope of work includes such as but not limited to complete management, Design, Detailed Engineering, 3D modelling, Stress Analysis, to provide all the necessary data, drawings, documents required as per the project requirements, Procurement, Supply, Transportation of materials, shop & site Fabrication, Erection, Installation, Supporting, Non-Destructive Testing (NDT) & required Inspection , pre-heating, dye-penetrant test, Magnetic Particle Test, post weld heat treatment, radiography, Ultrasonic test , Testing, Flushing, Air drying, blowing , cardboard-blasting , seal/leak-testing, Pre-Commissioning, Trial run, Commissioning and Guarantee of all the associated works pertaining to complete piping system and related facilities for Urea handling & Bagging package at TFL, TALCHER.

1.2 Design, material, fabrication and erection shall be in accordance with latest edition of ASME B31.3 chemical plant and petroleum refinery piping code. The dimensions, manufacturing tolerances shall conform to applicable standards.

1.3 All works described in this package shall be performed in accordance with the design-basis, specifications, drawings, and other requirements of NIT and shall be subject to Owner's review and approval.

1.4 MATERIAL OF CONSTRUCTION

Materials as per internationally acceptable code shall be used for piping based on service requirement. All materials for piping Components shall conform to ASTM or API Specifications as per enclosed piping specifications. All piping materials and valves shall be procured from the reputed approved suppliers/vendors.

1.5 Cost of piping job shall also include the cost of supervision, Labour, overheads / profits, materials, consumables, scaffolding and all other associated arrangements required to execute the related activities of this package.

1.6 PIPING INTER - CONNECTION

Piping lines as per P&ID, shall be provided at battery limit which shall be indicated later by Owner. Bidder shall provide valve at battery limit for respective piping system of the package unit.

1.7 SPARES

Two years operation spares shall be quoted as recommended by bidder for this package unit.

1.8 After completion of erection jobs, all piping system will be suitably hydraulically tested as per the test pressure indicated in the line list / relevant document approved by owner.

2.0 DESIGN AND DETAILED ENGINEERING BY BIDDER

2.1 Collection of all data/ information furnished in the NIT and additionally collected/ generated by Bidder.

- Finalization of design data/ basis for carrying out design, detailed Engineering for complete scope of work as per project specifications, contained in the NIT.

2.1.1 Performing design and detailed engineering of the following:

a) Complete piping system for the package unit.

b) Carry Out all necessary calculations in accordance with approved design basis, drawings / documents and requirements of the NIT.

c) Finalization of layouts for the unit and preparation of construction drawing, preparation of piping drawings, equipment layouts, piping general layout drawings (GAD's) , pipe supports, piping isometrics. Typical indicative sketches/drawings included in NIT

document shall be taken as broad basis for developing the layouts. Since the availability of free space is limited, Bidder shall plan his piping layouts in such a way so as to minimize the area requirement while giving due importance to ease of access, operation and maintenance of the facilities installed by the Bidder. The fabrication/erection & all other piping jobs shall be carried out as per drawings/documents approved by Owner.

d) Carrying out Material Take Off for the entire piping system for the package unit.

e) The detail design shall take into consideration of local Statutory Regulation, if any, for the package unit.

3.0 PROCUREMENT & SUPPLY BY BIDDER

3.1 Bidder shall procure and supply all materials whatsoever required for temporary/permanent installation of piping system in sequence and at appropriate time. All equipments, materials, components etc shall be suitable for the service and the design life of the system.

3.2 Bidder shall procure all materials, components, equipments, consumables etc required for successful completion of the piping system. Bidder shall also procure spares required for pre-commissioning and commissioning/start-up the as recommended for all the items supplied by him as per specifications provided in the NIT. Where no specifications are available in the contract, the same shall be prepared by the Bidder, and shall be subject to Owner's approval.

3.3 Material take-off with complete description of size, rating, material, thickness and specifications.

3.4 Preparation and finalization of data sheets for all piping materials e.g. all valves etc. All data-sheets shall be subject to review and approval by Owner.

3.5 Preparation of Material requisitions, Request for Quotation & its evaluation and recommend Bidders for Owner's approval. Preparation of purchase requisitions, review of Bidder's drawings and calculations, approval of manufacturing procedures wherever necessary, and the party inspection at manufacturer's works of the materials by reputed agencies as required. Quality control and expediting of all procured items at Bidder's shop or at fabrication yard.

3.6 Bidder shall procure materials as per specifications and list of approved Vendors/Suppliers (for major Items) included in the bid document.

3.7 Carry out proper documentation of inspection and quality assurance programs for all equipment and bulk materials duly approved by Owner. Bidder shall maintain an accurate and traceable listing of procurement records for the location, quality and character of all permanent materials in the Project.

3.8 Bidder shall immediately report to the Owner of all changes which will affect material quality, and take necessary corrective actions. Purchase requisitions including Purchase Orders of all major items shall be approved by Owner. For balance items, records shall be furnished for information only.

3.9 Compliance with Bidders and supplier's instructions and recommendations for transportation, handling, installation and commissioning.

4.0 INSPECTION

4.1 Inspection authority means the Third Party Inspection Agencies (TPIA) approved by the Owner to carryout inspection of materials.

4.2 The inspecting authority shall have the right to select random samples for check test and reject materials, if samples furnished as above and tested as per the specifications fail to meet the requirement specified.

4.3 All the items shall be inspected and tested in the presence of one or more representatives of the purchaser during various stages of manufacturing. Material shall be considered acceptable for dispatch only after final certificate of acceptance is issued by the Inspector.

4.4 Testing performed in the presence of the purchaser's representatives shall not relieve the supplier of their own responsibilities and guarantees and any other contractual obligations.

4.5 Quality Assurance plan (QAP) / Inspection Test Plan (ITP) shall be submitted by bidder for approval by Third Party Inspection Agency (TPIA).

4.6 Scope of Inspection by TPIA:

Review of MTC (all batches).

Visual check for surfaces, external appearance (10% random witness).

Dimensional check (10% random witness).

Positive Material Identification (PMI) for alloy steels (10% random witness).

Hydrostatic test (10% random witness).

Packing: Report review.

Documentation (MTC, Inspection Release Note): 100% Review

5.0 PAINTING

Painting shall be as per specification attached elsewhere in NIT.

6.0 CONSTRUCTION

All construction works be carried out as per "Approved for Construction" drawings, procedures, specifications and applicable codes and standards. Any changes at site shall also need prior approval from the Owner and revision of drawings.

Bidder shall procure and supply all materials whatsoever required for temporary/permanent installations of piping system in required and at appropriate time. All equipment, materials, components etc. shall be suitable for the intended service and the design life of the system. Wherever no specification is available in the contract, the same shall be prepared by the Bidder and shall be subject to Owner approval.

7.0 BIDDER'S RESPONSIBILITY

All works shall be carried out by Bidder in accordance with the drawings / documents / specifications indicated in the subsequent paragraphs.

7.1 Specifications

7.2 Standards

7.3 Piping Support Standards

7.4 Drawings

7.5 Design Review

7.6 Bidder shall submit all proposal designs, analysis, drawings, installation and testing procedure for review & approval by Owner as mentioned in the scope work. Bidder shall as a minimum, provide above deliverables for Owner's information / records & review / approval.

7.7 Typical Plot Plan drawing of package unit is attached in the NIT. This drawing is INDICATIVE only and is furnished for Bidder's information. Issued for construction (IFC) drawings shall be prepared by Bidder after detailed engineering being done by him and shall be subject to approval by the Owner.

7.8 The Bidder shall submit separately, the material take off for piping, valves, fittings and all other accessories as per requirements.

7.9 Bidder shall obtain statutory approval from various authorities having jurisdiction over the area, as necessary, for construction of the unit package.

8.0 DRAWINGS/ DOCUMENTATION SCHEDULE

Bidder shall furnish all the drawings/ documents to Owner for comments/ approval. He shall incorporate all comments/ modification suggested by Owner. The drawings/documents should be properly organised, supplied & submitted as per documentation schedule of NIT.

9.0 PACKAGING

9.1 Items shall be thoroughly dried, cleaned and shall be free from moisture, dirt & loose foreign materials, with ends protected from mechanical damage during transportation, shipment & storage.

9.2 For transportation overseas, protection and packing shall be adequate to prevent damage from sea atmosphere.

10.0 DOCUMENTATION WITH BID

Following drawings/documents must be submitted along with the bid.

i) Proposed equipment layout drawing.

ii) Proposed piping Layout drg.

iii) Quality control procedure & plan for piping system.

iv) Completion schedule of piping job in Bar-chart format.

v) List of all construction equipments, tool-tackles & man power resources proposed to be used.

vi) Clause wise list of deviations / exclusions, if any, to bid requirements shall be furnished. Bidder is cautioned that exclusions and deviations listed elsewhere in bidder's offer shall not be considered for evaluation.

PIPING MATERIAL SPECIFICATION

AMMONIA UREA COAL BASED FERTILIZER PROJECT.

TALCHER FERTILIZER LTD., ODISHA.

3	03.02.2021	03.02.2021	ISSUED FOR COMMENT	VINEETA	NS/RK	GL/HOD
2	28.12.2020	28.12.2020	ISSUED FOR COMMENT	VINEETA	NS/RK	GL/HOD
1	25.15.2020	28.12.2017	ISSUED	VINEETA	NS/RK	GL/HOD
0	09.03.2020	09.03.2020	ISSUED	VINEETA	NS/RK	GL/HOD
REV	REV DATE	EFF DATE	PURPOSE	PREPD	REVWD	APPD

CONTENTS

PDIL	Service Index (SI) of Piping Material Classes		TFL-PDS-600		3
			DOCUMENT NO.		REV. NO.
SL.NO.	**PMC**	**SERVICE**	**RATING, FACE ,D.TEMP.**	**BASIC MATERIAL**	**CORROSION ALLOW. (MIN.)**	**REV. NO.**
1	**B20**	CW (UG)	CLASS 150, RF, 70^{0}C Max	CS	1.5MM	1
2	**B22G**	DW	CLASS 150, RF, 70^{0}C Max	CS (GALV)	1.5MM	0
3	**B22IS**	CONST.WATER,FW	CLASS 150, FF, 80^{0}C Max	CS	1.5 MM	1
4	**B22ISG**	FW	CLASS 150, FF, 80^{0}C Max	CS	1.5 MM	1
5	**B24**	PW,WW,BD,SC,TC,SW,PA,CWS,CWR,NI,CW,ES,FG,FN,NI,PG, PV,SA,PN,IAW	CLASS 150, RF, 200 ^{0}C Max	CS	1.5 MM	1
6	**B24D**	WASTE EFFLUENT	CLASS 150, FF, 50^{0}C Max	HDPE	0.0 MM	0
7	**B24S**	SL,SC (IBR)	CLASS 150, RF, 240^{0}C Max	CS	1.5 MM	0
8	**B24FL**	EFFLUENT,ACIDIC H2O ETC.	CLASS 150, FF, 80^{0}C Max	CS FRP LINED	1.5 MM	0
9	**B24P**	ETP	CLASS 150, FF, 80^{0}C Max	CPVC	0.0 MM	0
10	**B24RL**	EFFLUENT, WASTE H2O, CHLORINATED H2O	CLASS 150, FF, 80^{0}C Max	CSRL	1.5 MM	0
11	**B50**	AF, AW, CD, DW, HZ, IA, MDA, PC, PH, VS	CLASS 150, RF,150^{0}C Max	304 SS	0.0 MM	0
12	**B52**	UL	CLASS 150, RF,150^{0}C Max	316L SS	0.0 MM	1
13	**D14**	AG,AL,FG	CLASS 150, RF,50^{0}C Max, -35^{0}C Min.	LTCS	1.5 MM	0
14	**D24**	AG,AL,AW,FG,FN,HG,IAH,IAW, PA	CLASS 300, RF,280^{0}C Max	CS	1.5 MM	0
15	**D50**	AW,PH,PC	CLASS 300, RF,200^{0}C Max	304 SS	0.0 MM	0
16	**D52**	UL	CLASS 150, RF,150^{0}C Max	316L SS	0.0 MM	0
17	**F24**	AW,HG,PA,PC,PN,SG	CLASS 600, RF,425^{0}C Max	CS	1.5 MM	0
18	**F24S**	BB,BF,SC,SM	CLASS 600, RF,425^{0}C Max	CS(IBR)	1.5 MM	0
19	**H24S**	BB,BF,SC,SH	CLASS 1500, RJ,340^{0}C Max	CS(IBR)	1.5MM	0
20	**J36S**	SC,SH	CLASS 2500, RJ,540^{0}C Max	AS(IBR)	1.5 MM	0

Abbrev.	**Service**
AF	Antifoam solution
AG	Ammonia Gaseous
AL/LA	Ammonia Liquid
AW	Ammonia water
BB	Boiler BlowDown
BD	Blow Down
BF	Boiler feed water
CD	CO2/Steam mixture
CW	Cooling water
CWS	Cooling water supply
CWR	Cooling water return
DM	DM water
DW	Drinking Water
ES	Exhaust steam
FG	Fuel gas
FN	Fuel Naphtha
FW	Fire Water
HC	Mixed Hydrocarbons
HG	Hydrogen Gas
HZ	Hydrazine
IA	Instrument air
IAH	Instrument air(High pressure)
IAW	Instrument air(Wet)
IG	Inert gas
NG	Natural gas
NI	Nitrogen
PA	Process Air
PC	Process condensate
PG	Process Gas

Abbrev.	**Service**
PH	Phosphate Solution
PN	Process Nephtha
PV	Vent gas
PW	Process Water
SA	service air
SC	Steam condensate
SG	Synthesis Gas
SH/HPS/HP	High Pressure Steam
SL/LP/LPS	LP Steam
SM/MPS	Medium Pressure Steam
SW	Service water
TC	Turbine Condensate
UL	Urea solutions handling
WW	Waste Water

PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER,ODISHA

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:1

Class: B20

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)				
CW(UG)	Ref.SI	Ref.SI			
RATING ASME	CORROSION ALLOWANCE	MATERIAL			
150# RF	1.5 MM(MIN.)	CS			

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		2 - 6	SCH 40	BE	SMLS,API 5L GR.B,C&W,ASME B36.10,	PPX111300	
PIPE		40 - 42	10.00 MM	BE	LSAW,IS 3589 GR.FE410 C&W,ASME B36.10,	PPQW11300	
PIPE		44 - 46	10.00 MM	BE	LSAW,IS 3589 GR.FE410 C&W,ASME B36.10,	PPQW11300	
PIPE		48 - 48	10.00 MM	BE	LSAW,IS 3589 GR.FE410 C&W,ASME B36.10,	PPQW11300	
PIPE		8 - 10	SCH 10	BE	ERW,API 5L GR.B,C&W,ASME B36.10,	PPX411300	
PIPE		12 - 14	SCH 10	BE	ERW,API 5L GR.B,C&W,ASME B36.10,	PPX411300	
PIPE		16 - 18	SCH 10	BE	LSAW,API 5L GR.B,C&W,ASME B36.10,	PP1A11300	
PIPE		20 - 24	SCH 10	BE	LSAW,API 5L GR.B,C&W,ASME B36.10,	PP1A11300	
PIPE		1/2 - 3/4	SCH 80	PE	SMLS,API 5L GR.B,C&W,ASME B36.10,	PPX121300	
PIPE		1 - 11/4	SCH 80	PE	SMLS,API 5L GR.B,C&W,ASME B36.10,	PPX121300	
PIPE		11/2 - 11/2	SCH 80	PE	SMLS,API 5L GR.B,C&W,ASME B36.10,	PPX121300	
PIPE		26 - 28	08.00 MM	BE	LSAW,IS 3589 GR.FE410 C&W,ASME B36.10,	PPQW11300	
PIPE		30 - 32	08.00 MM	BE	LSAW,IS 3589 GR.FE410 C&W,ASME B36.10,	PPQW11300	
PIPE		34 - 36	08.00 MM	BE	LSAW,IS 3589 GR.FE410 C&W,ASME B36.10,	PPQW11300	
PIPE		38 - 38	08.00 MM	BE	LSAW,IS 3589 GR.FE410 C&W,ASME B36.10,	PPQW11300	
PIPE		52 - 54	12.00 MM	BE	LSAW,IS 3589 GR.FE410 C&W,ASME B36.10,	PPQW11300	
PIPE		56 - 58	12.00 MM	BE	LSAW,IS 3589 GR.FE410 C&W,ASME B36.10,	PPQW11300	
PIPE		60 - 62	12.00 MM	BE	LSAW,IS 3589 GR.FE410 C&W,ASME B36.10,	PPQW11300	
PIPE		64 - 66	12.00 MM	BE	LSAW,IS 3589 GR.FE410 C&W,ASME B36.10,	PPQW11300	
PIPE		68 - 70	14.00 MM	BE	LSAW,IS 3589 GR.FE410 C&W,ASME B36.10,	PPQW11300	
PIPE		72 - 72	14.00 MM	BE	LSAW,IS 3589 GR.FE410 C&W,ASME B36.10,	PPQW11300	
FLANGE							
FLANGE		1/2 - 24	150#	SO-RF 125 AARH	CS ASTM A105,ASME B16.5,SLIP ON	FL0260801	
FLANGE		26 - 72	150#	SO-FF	IS2062 GR.B,AWWA C207-D,RING TYPE,SLIP ON	FLA452701	
SPACER AND BLIND		14 - 24	150#	RF 125 AARH	CS ASTM A105,ASME B16.48,	RS022PO01	
SPECL BLIND		1/2 - 12	150#	RF 125 AARH	CS ASTM A105,ASME B16.48,	SP022PO01	
BLIND FLANGE							
BLIND FLANGE		1/2 - 24	150#	RF 125 AARH	CS ASTM A105,ASME B16.5,	BF0220801	
BLIND FLANGE		26 - 72	150#	FF	IS2062 GR.B,AWWA C207-D,	BFA412701	
GASKET							
GASKET		1/2 - 24	150#	SPRL-WND RF	TP304 SS WDG;GPH FLR;TP304 SS INR RNG;CS OTR RNG,ASME B16.20,	GSQN30301	
GASKET		26 - 72	150#	3.0 MM THK FF	GSKT FLAT RNG,GARLOCK 3000(SYN FBR W/NBR BDR),ASME B16.21/AWWA C207-D,RING TYPE	GSTO8QS01	
STUD & NUTS							
STUD & 2NUTS HVY HEX		-			ASTM A193 GR.B7/ASTM A194 GR.2H,,	SNDE00000	
FITTING (BW)							
BRANCH WELD		2 - 48		BW	CARBON STEEL,ASME B31.3,	RWOJ11200	
BRANCH WELD WITH RP		2 - 48		BW	CARBON STEEL,ASME B31.3,	WBOJ11200	
CAP		2 - 24		BW	ASTM A234 WPB-SMLS,ASME B16.9,	CP7310900	
ELBOW		8 - 24		BW	ASTM A234 WPB-WLDD,ASME B16.9,	ELOY10900	
ELBOW		2 - 6		BW	ASTM A234 WPB-SMLS,ASME B16.9,	EL7310900	
ELBOW		26 - 48		BW	IS2062 GR.B,ASME B16.9,	ELA410900	
REDUCER CONC.		2 - 6		BW	ASTM A234 WPB-SMLS,ASME B16.9,	RC7310900	
REDUCER CONC.		8 - 24		BW	ASTM A234 WPB-WLDD,ASME B16.9,	RCOY10900	
REDUCER CONC.		26 - 48		BW	IS2062 GR.B,ASME B16.9,	RCA410900	
REDUCER ECC.		2 - 6		BW	ASTM A234 WPB-SMLS,ASME B16.9,	RE7310900	
REDUCER ECC.		8 - 24		BW	ASTM A234 WPB-WLDD,ASME B16.9,	REOY10900	
REDUCER ECC.		26 - 48		BW	IS2062 GR.B,ASME B16.9,	REA410900	

PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER,ODISHA

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:1

Class: B20

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)				
CW(UG)	Ref.SI	Ref.SI			
RATING ASME	CORROSION ALLOWANCE	MATERIAL			
150# RF	1.5 MM(MIN.)	CS			

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
TEE		2 - 6		BW	ASTM A234 WPB-SMLS,ASME B16.9,	TE7310900	
TEE		8 - 24		BW	ASTM A234 WPB-WLDD,ASME B16.9,	TEOY10900	
TEE		26 - 48		BW	IS2062 GR.B,ASME B16.9,	TEA410900	
WELDOLET		2 - 48		BW	CS ASTM A105,MSS SP 97,	WL0213300	
FITTING (SW)							
CAP		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	CP0230207	W
COUPLING		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	CN0230207	
ELBOW		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	EL0230207	
SOCKOLET		1/2 - 48	3000#	SOCW	CS ASTM A105,MSS SP 97,	SL0233307	
TEE		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	TE0230207	
FITTING (THD)							
CAP		1/2 - 11/2	3000#	THD	CS ASTM A105,ASME B16.11,	CP0240207	T
PLUG		1/2 - 11/2		THD	CS ASTM A105,ASME B16.11,ROUND HEAD	PG0240200	
THREDOLET		1/2 - 48	3000#	THD	CS ASTM A105,MSS SP 97,	TL0243307	
NIPPLE							
NIPPLE		1/2 - 11/2	SCH160	PLN-PLN	SMLS,API 5L GR.B,ASME B36.10,	NPA151312	1
NIPPLE		1/2 - 11/2	SCH160	PLN-THD	SMLS,API 5L GR.B,ASME B36.10,NPT	NPA161312	2
NIPPLE		1/2 - 11/2	SCH160	THD	SMLS,API 5L GR.B,ASME B36.10,NPT	NPA141312	3
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 11/2		PE	ASTM A234 WPB-SMLS,MSS SP 95,	NC73J4500	
SWAGE (ECC)		1/2 - 11/2		PE	ASTM A234 WPB-SMLS,MSS SP 95,	NE73J4500	
VALVES							
GATE VALVE		1/2 - 11/2	800#	SOCW	CS BODY ASTM A105,GAV201,	GAV201	
GATE VALVE		2 - 48	150#	FLG	CS BODY ASTM A216 GR WCB,GAV210,	GAV210	
GLOBE VALVE		1/2 - 11/2	800#	SOCW	CS BODY ASTM A105,GLV201,	GLV201	
GLOBE VALVE		2 - 10	150#	FLG	CS BODY ASTM A216 GR WCB,GLV210,	GLV210	
BUTTERFLY VALVE		2 - 24	150#	RF	CS BODY ASTM A216 GR WCB,BUV203,LUG TYPE	BUV203	

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PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER ,ODISHA.

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:1.

Class: B22G

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)			INSPECTION CLASS
DW,AIR	Ref.SI	Ref.SI		

RATING ASME	CORROSION ALLOWANCE	MATERIAL	VALVE TRIM	STRESS RELIEF	
150# THD	1.5 MM(MIN.)	CS(GALVANIZED)			

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		1/2 - 3/4	SCH XS	THD	SMLS,ASTM A106 GR.B,HOT DIP GALV.,ASME B36.10,	PPAC31300	
PIPE		1 - 11/4	SCH XS	THD	SMLS,ASTM A106 GR.B,HOT DIP GALV.,ASME B36.10,	PPAC31300	
PIPE		11/2 - 2	SCH XS	THD	SMLS,ASTM A106 GR.B,HOT DIP GALV.,ASME B36.10,	PPAC31300	
PIPE		21/2 - 3	SCHSTD	THD	SMLS,ASTM A106 GR.B,HOT DIP GALV.,ASME B36.10,	PPAC31300	
PIPE		4 - 4	SCHSTD	THD	SMLS,ASTM A106 GR.B,HOT DIP GALV.,ASME B36.10,	PPAC31300	
FLANGE							
FLANGE		1/2 - 4	150#	THD-RF 125 AARH	ASTM A105 HOT DIP GALV.,ASME B16.5,	FLFDK0801	
SPECL BLIND		1/2 - 4	150#	RF 125 AARH	ASTM A105 HOT DIP GALV.,ASME B16.48,	SPFD2PO01	
BLIND FLANGE							
BLIND FLANGE		1/2 - 4	150#	RF 125 AARH	ASTM A105 HOT DIP GALV.,ASME B16.5,	BFFD20801	
GASKET							
GASKET		1/2 - 4	150#	SPRL-WND RF	TP304 SS WDG;GPH FLR;TP304 SS INR RNG;CS OTR RNG,ASME B16.20,	GSQN30301	
STUD & NUTS							
STUD & 2NUTS HVY HEX		-			ASTM A193GR.B7/A194GR.2H,HOT DIP GALV.,,	SNZC00000	
FITTING (THD)							
CAP		1/2 - 4	3000#	THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	CPFD40207	
COUPLING		1/2 - 4	3000#	THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	CNFD40207	
ELBOW		1/2 - 4	3000#	THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	ELFD40207	
HALF COUPLING		1/2 - 4	3000#	THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	HFFD40207	
PLUG		1/2 - 11/2		THD	ASTM A105 HOT DIP GALV.,ASME B16.11,ROUND HEAD	PGFD40200	
REDUCER CONC.		2 - 4		THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	RCFD40200	
REDUCER ECC.		2 - 4		THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	REFD40200	
TEE		1/2 - 4	3000#	THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	TEFD40207	
THREDOLET		1/2 - 11/2	3000#	THD	ASTM A105 HOT DIP GALV.,MSS SP 97,	TLFD43307	
NIPPLE							
NIPPLE		1/2 - 11/2		THD	SMLS,ASTM A106 GR.B,HOT DIP GALV.,ASME B36.10,NPT	NPAC41344	
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 11/2		THD	ASTM A105 HOT DIP GALV.,MSS SP 95,	NCFD44500	
SWAGE (ECC)		1/2 - 11/2		THD	ASTM A105 HOT DIP GALV.,MSS SP 95,	NEFD44500	
VALVES							
GATE VALVE		2 - 4	150#	FLG	CS BODY ASTM A216 GR WCB,GAV210,	GAV210	
GATE VALVE		1/2 - 11/2	800#	THRD	CS BODY ASTM A105,GAV207,	GAV207	
CHECK VALVE		1/2 - 11/2	800#	THRD	CS BODY ASTM A105,CHV207,	CHV207	
CHECK VALVE		2 - 4	150#	FLG	CS BODY ASTM A216 GR WCB,CHV210,	CHV210	
BUTTERFLY VALVE		3 - 4	150#	RF	CS BODY ASTM A216 GR WCB,BUV203,LUG TYPE	BUV203	
PLUG VALVE		2 - 4	150#	FLG	CS BODY ASTM A216 GR WCB,PLV202,	PLV202	

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PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER,ODISHA

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:1

Class: B22IS

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)	
CONST.WATER,FW	-22	427

RATING ASME	CORROSION ALLOWANCE	MATERIAL
150# RF	1.5 MM	CARBON STEEL

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		2 - 21/2	04.50 MM	BE	SMLS,IS1239 BLACK,IS 1239 PART I,HVY	PPD512600	
PIPE		3 - 3	4.80 MM	BE	SMLS,IS1239 BLACK,IS 1239 PART I,HVY	PPD512600	
PIPE		4 - 5	05.40 MM	BE	SMLS,IS1239 BLACK,IS 1239 PART I,HVY	PPD512600	
PIPE		6 - 6	05.40 MM	BE	SMLS,IS1239 BLACK,IS 1239 PART I,HVY	PPD512600	
PIPE		1/2 - 3/4	3.20 MM	PE	SMLS,IS1239 BLACK,IS 1239 PART I,HVY	PPD522600	
PIPE		1 - 11/4	04.00 MM	PE	SMLS,IS1239 BLACK,IS 1239 PART I,HVY	PPD522600	
PIPE		11/2 - 11/2	04.00 MM	PE	SMLS,IS1239 BLACK,IS 1239 PART I,HVY	PPD522600	
PIPE		8 - 10	6.30 MM	BE	ERW,IS 3589 GR.FE410,IS 3589,	PP521PK00	
PIPE		12 - 14	6.30 MM	BE	ERW,IS 3589 GR.FE410,IS 3589,	PP521PK00	
PIPE		16 - 18	6.30 MM	BE	LSAW,IS 3589 GR.FE410,IS 3589,	PPT11PK00	
PIPE		20 - 20	6.30 MM	BE	LSAW,IS 3589 GR.FE410,IS 3589,	PPT11PK00	
PIPE		22 - 24	08.00 MM	BE	LSAW,IS 3589 GR.FE410,IS 3589,	PPT11PK00	
PIPE		26 - 28	08.00 MM	BE	LSAW,IS 3589 GR.FE410,IS 3589,	PPT11PK00	
PIPE		30 - 30	08.00 MM	BE	LSAW,IS 3589 GR.FE410,IS 3589,	PPT11PK00	
PIPE		32 - 34	10.00 MM	BE	LSAW,IS 3589 GR.FE410,IS 3589,	PPT11PK00	
PIPE		36 - 38	10.00 MM	BE	LSAW,IS 3589 GR.FE410,IS 3589,	PPT11PK00	
PIPE		40 - 42	12.00 MM	BE	LSAW,IS 3589 GR.FE410,IS 3589,	PPT11PK00	
PIPE		44 - 46	12.00 MM	BE	LSAW,IS 3589 GR.FE410,IS 3589,	PPT11PK00	
PIPE		48 - 48	12.00 MM	BE	LSAW,IS 3589 GR.FE410,IS 3589,	PPT11PK00	
FLANGE							
FLANGE		1/2 - 11/2	150#	SW-RF 125 AARH	CS ASTM A105,ASME B16.5,	FL02L0801	
FLANGE		2 - 24	150#	SO-RF 125 AARH	CS ASTM A105,ASME B16.5,SLIP ON	FL0260801	1
FLANGE		26 - 48	150#	SO-FF	IS2062 GR.B,AWWA C207-D,RING TYPE,SLIP ON	FLA452701	C
LONG W.N.FLANGE		11/2 - 11/2	300#	WN-RF 125 AARH	CS ASTM A105,ASME B16.5,38mmBORE,200mmLONG	LN0270802	
W.N.FLANGE		26 - 48	150#	WN-RF 125 AARH	CS ASTM A105,ASME B16.47 SR.B,WELD NECK	WN0270701	B
W.N.FLANGE		2 - 24	150#	WN-RF 125 AARH	CS ASTM A105,ASME B16.5,WELD NECK	WN0270801	2
SPACER AND BLIND		14 - 24	150#	RF 125 AARH	CS ASTM A105,ASME B16.48,	RS022PO01	
SPECL BLIND		1/2 - 12	150#	RF 125 AARH	CS ASTM A105,ASME B16.48,	SP022PO01	
BLIND FLANGE							
BLIND FLANGE		26 - 48	150#	RF 125 AARH	CS ASTM A105,ASME B16.47 SR.B,	BF0220701	
BLIND FLANGE		1/2 - 24	150#	RF 125 AARH	CS ASTM A105,ASME B16.5,	BF0220801	
GASKET							
GASKET		1/2 - 24	150#	SPRL-WND RF	TP304 SS WDG;GPH FLR;TP304 SS INR RNG;CS OTR RNG,ASME B16.20,	GSQN30301	
GASKET		26 - 48	150#	SPRL-WND RF	TP304 SS WDG;GPH FLR;TP304 SS INR RNG;CS OTR RNG,ASME B16.20/B16.47 SR.B,	GSQN3QJ01	9
GASKET		26 - 48	150#	3.0 MM THK FF	GSKT FLAT RNG,GARLOCK 3000(SYN FBR W/NBR BDR),ASME B16.21/AWWA C207-D,RING TYPE	GSTO8QS01	F
STUD & NUTS							
STUD & 2NUTS HVY HEX		-			ASTM A193 GR.B7/ASTM A194 GR.2H,,	SNDE00000	
FITTING (BW)							
BRANCH WELD		2 - 48		BW	CARBON STEEL,ASME B31.3,	RWOJ11200	
BRANCH WELD WITH RP		2 - 48		BW	CARBON STEEL,ASME B31.3,	WBOJ11200	
CAP		2 - 48		BW	ASTM A234 WPB-SMLS,ASME B16.9,	CP7310900	
ELBOW		2 - 6		BW	ASTM A234 WPB-SMLS,ASME B16.9,	EL7310900	
ELBOW		8 - 48		BW	ASTM A234 WPB-WLDD,ASME B16.9,	ELOY10900	
REDUCER CONC.		2 - 6		BW	ASTM A234 WPB-SMLS,ASME B16.9,	RC7310900	
REDUCER CONC.		8 - 48		BW	ASTM A234 WPB-WLDD,ASME B16.9,	RCOY10900	
REDUCER ECC.		2 - 6		BW	ASTM A234 WPB-SMLS,ASME B16.9,	RE7310900	
REDUCER ECC.		8 - 48		BW	ASTM A234 WPB-WLDD,ASME B16.9,	REOY10900	

PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER,ODISHA

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:1

Class: B22IS

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)	
CONST.WATER,FW	-22	427

RATING ASME	CORROSION ALLOWANCE	MATERIAL
150# RF	1.5 MM	CARBON STEEL

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
TEE		2 - 6		BW	ASTM A234 WPB-SMLS,ASME B16.9,	TE7310900	
TEE		8 - 48		BW	ASTM A234 WPB-WLDD,ASME B16.9,	TEOY10900	
WELDOLET		2 - 48		BW	CS ASTM A105,MSS SP 97,	WL0213300	
FITTING (SW)							
CAP		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	CP0230207	W
COUPLING		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	CN0230207	
ELBOW		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	EL0230207	
SOCKOLET		1/2 - 48	3000#	SOCW	CS ASTM A105,MSS SP 97,	SL0233307	
TEE		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	TE0230207	
FITTING (THD)							
CAP		1/2 - 11/2	3000#	THD	CS ASTM A105,ASME B16.11,	CP0240207	T
PLUG		1/2 - 11/2		THD	CS ASTM A105,ASME B16.11,ROUND HEAD	PG0240200	
THREDOLET		1/2 - 48	3000#	THD	CS ASTM A105,MSS SP 97,	TL0243307	
NIPPLE							
NIPPLE		1/2 - 11/2	SCH 80	PLN-PLN	SMLS,IS1239 BLACK,IS 1239 PART I,	NPD552611	1
NIPPLE		1/2 - 11/2	SCH 80	PLN-THD	SMLS,IS1239 BLACK,IS 1239 PART I,NPT	NPD562611	2
NIPPLE		1/2 - 11/2	SCH 80	THD	SMLS,IS1239 BLACK,IS 1239 PART I,NPT	NPD542611	3
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 11/2		PE	ASTM A234 WPB-SMLS,MSS SP 95,	NC73J4500	P
SWAGE (CONC)		1/2 - 11/2		PLN-THD	ASTM A234 WPB-SMLS,MSS SP 95,	NC7364500	T
SWAGE (ECC)		1/2 - 11/2		PE	ASTM A234 WPB-SMLS,MSS SP 95,	NE73J4500	P
SWAGE (ECC)		1/2 - 11/2		PLN-THD	ASTM A234 WPB-SMLS,MSS SP 95,	NE7364500	T
VALVES							
GATE VALVE		1/2 - 11/2	800#	SOCW	CS BODY ASTM A105,GAV201,	GAV201	W
GATE VALVE		1/2 - 11/2	150#	FLG	CS BODY ASTM A216 GR WCB,GAV210,	GAV210	F
GATE VALVE		2 - 24	150#	FLG	CS BODY ASTM A216 GR WCB,GAV210,	GAV210	
GLOBE VALVE		1/2 - 11/2	800#	SOCW	CS BODY ASTM A105,GLV201,	GLV201	
GLOBE VALVE		2 - 12	150#	FLG	CS BODY ASTM A216 GR WCB,GLV210,	GLV210	
CHECK VALVE		1/2 - 11/2	800#	SOCW	CS BODY ASTM A105,CHV201,	CHV201	
CHECK VALVE		2 - 24	150#	FLG	CS BODY ASTM A216 GR WCB,CHV210,	CHV210	
BALL VALVE		1/2 - 1	800#	SOCW	CS BODY ASTM A105,BAV201,	BAV201	
BALL VALVE		11/2 - 11/2	800#	SOCW	CS BODY ASTM A105,BAV201,	BAV201	W
BALL VALVE		11/2 - 11/2	150#	FLG	CS BODY ASTM A216 GR WCB,BAV210,	BAV210	F
BALL VALVE		2 - 16	150#	FLG	CS BODY ASTM A216 GR WCB,BAV210,	BAV210	
BUTTERFLY VALVE		3 - 24	150#	RF	CS BODY ASTM A216 GR WCB,BUV203,LUG TYPE	BUV203	
PLUG VALVE		1/2 - 1	600#	THRD	CS BODY ASTM A105,PLV201,	PLV201	
PLUG VALVE		11/2 - 24	150#	FLG	CS BODY ASTM A216 GR WCB,PLV202,	PLV202	

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PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER,ODISHA

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:0

Class: B22ISG

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)				
FW	Ref.SI	Ref.SI			
RATING ASME	CORROSION ALLOWANCE	MATERIAL			
150# THD	1.5 MM(MIN.)	CS(GALVANIZED)			

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		1/2 - 3/4	3.20 MM	THD	SMLS,IS1239 GALV.,IS 1239 PART I,HVY	PPDH32600	
PIPE		1 - 11/4	04.00 MM	THD	SMLS,IS1239 GALV.,IS 1239 PART I,HVY	PPDH32600	
PIPE		11/2 - 11/2	04.00 MM	THD	SMLS,IS1239 GALV.,IS 1239 PART I,HVY	PPDH32600	
PIPE		2 - 21/2	04.50 MM	THD	SMLS,IS1239 GALV.,IS 1239 PART I,HVY	PPDH32600	
PIPE		3 - 3	4.80 MM	THD	SMLS,IS1239 GALV.,IS 1239 PART I,HVY	PPDH32600	
PIPE		4 - 4	05.40 MM	THD	SMLS,IS1239 GALV.,IS 1239 PART I,HVY	PPDH32600	
FLANGE							
FLANGE		1/2 - 4	150#	THD-RF 125 AARH	ASTM A105 HOT DIP GALV.,ASME B16.5,	FLFDK0801	
SPECL BLIND		1/2 - 4	150#	RF 125 AARH	ASTM A105 HOT DIP GALV.,ASME B16.48,	SPFD2PO01	
BLIND FLANGE							
BLIND FLANGE		1/2 - 4	150#	RF 125 AARH	ASTM A105 HOT DIP GALV.,ASME B16.5,	BFFD20801	
GASKET							
GASKET		1/2 - 4	150#	SPRL-WND RF	TP304 SS WDG;GPH FLR;TP304 SS INR RNG;CS OTR RNG,ASME B16.20,	GSQN30301	
STUD & NUTS							
STUD & 2NUTS HVY HEX		-			ASTM A193GR.B7/A194GR.2H,HOT DIP GALV.,,	SNZC00000	
FITTING (THD)							
CAP		1/2 - 4	3000#	THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	CPFD40207	
COUPLING		1/2 - 4	3000#	THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	CNFD40207	
ELBOW		1/2 - 4	3000#	THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	ELFD40207	
HALF COUPLING		1/2 - 4	3000#	THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	HFFD40207	
PLUG		1/2 - 11/2		THD	ASTM A105 HOT DIP GALV.,ASME B16.11,ROUND HEAD	PGFD40200	
REDUCER CONC.		2 - 4		THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	RCFD40200	
REDUCER ECC.		2 - 4		THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	REFD40200	
TEE		1/2 - 4	3000#	THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	TEFD40207	
THREDOLET		1/2 - 11/2	3000#	THD	ASTM A105 HOT DIP GALV.,MSS SP 97,	TLFD43307	
NIPPLE							
NIPPLE		1/2 - 11/2		THD	SMLS,ASTM A106 GR.B,HOT DIP GALV.,ASME B36.10,NPT	NPAC41344	
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 11/2		THD	ASTM A105 HOT DIP GALV.,MSS SP 95,	NCFD44500	
SWAGE (ECC)		1/2 - 11/2		THD	ASTM A105 HOT DIP GALV.,MSS SP 95,	NEFD44500	
VALVES							
GATE VALVE		2 - 4	150#	FLG	CS BODY ASTM A216 GR WCB,GAV210,	GAV210	
GATE VALVE		1/2 - 11/2	800#	THRD	CS BODY ASTM A105,GAV207,	GAV207	
CHECK VALVE		1/2 - 11/2	800#	THRD	CS BODY ASTM A105,CHV207,	CHV207	
CHECK VALVE		2 - 4	150#	FLG	CS BODY ASTM A216 GR WCB,CHV210,	CHV210	
BUTTERFLY VALVE		3 - 4	150#	RF	CS BODY ASTM A216 GR WCB,BUV203,LUG TYPE	BUV203	
PLUG VALVE		2 - 4	150#	FLG	CS BODY ASTM A216 GR WCB,PLV202,	PLV202	

PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER,ODISHA

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:1

Class: B24

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)	
BF,CW,RW,FG,FN,FW,NG,PN,PV,SA,SW,VS,PA, LIME SOL.	Ref.SI	Ref.SI

RATING ASME	CORROSION ALLOWANCE	MATERIAL
150# RF	1.5 MM(MIN.)	CS

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		2 - 6	SCH 40	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		8 - 10	SCH 20	BE	ERW,API 5L GR.B,ASME B36.10,	PPA211300	
PIPE		12 - 12	SCH 20	BE	ERW,API 5L GR.B,ASME B36.10,	PPA211300	
PIPE		1/2 - 3/4	SCH 80	PE	SMLS,API 5L GR.B,ASME B36.10,	PPA121300	
PIPE		1 - 11/4	SCH 80	PE	SMLS,API 5L GR.B,ASME B36.10,	PPA121300	
PIPE		11/2 - 11/2	SCH 80	PE	SMLS,API 5L GR.B,ASME B36.10,	PPA121300	
PIPE		14 - 14	SCH 10	BE	ERW,API 5L GR.B,ASME B36.10,	PPA211300	
PIPE		16 - 18	SCH 10	BE	LSAW,API 5L GR.B,ASME B36.10,	PP9611300	
PIPE		20 - 20	SCH 10	BE	LSAW,API 5L GR.B,ASME B36.10,	PP9611300	
PIPE		22 - 24	SCHSTD	BE	LSAW,API 5L GR.B,ASME B36.10,	PP9611300	
PIPE		26 - 28	SCHSTD	BE	LSAW,API 5L GR.B,ASME B36.10,	PP9611300	
PIPE		30 - 32	SCHSTD	BE	LSAW,API 5L GR.B,ASME B36.10,	PP9611300	
PIPE		34 - 34	SCHSTD	BE	LSAW,API 5L GR.B,ASME B36.10,	PP9611300	
PIPE		36 - 38	SCH XS	BE	LSAW,API 5L GR.B,ASME B36.10,	PP9611300	
PIPE		40 - 42	SCH XS	BE	LSAW,API 5L GR.B,ASME B36.10,	PP9611300	
PIPE		44 - 46	SCH XS	BE	LSAW,API 5L GR.B,ASME B36.10,	PP9611300	
PIPE		48 - 48	SCH XS	BE	LSAW,API 5L GR.B,ASME B36.10,	PP9611300	
FLANGE							
FLANGE		1/2 - 24	150#	SO-RF 125 AARH	CS ASTM A105,ASME B16.5,SLIP ON	FL0260801	
LONG W.N.FLANGE		11/2 - 11/2	300#	WN-RF 125 AARH	CS ASTM A105,ASME B16.5,24mm Bore,200mm Long	LN0270802	
W.N.FLANGE		26 - 48	150#	WN-RF 125 AARH	CS ASTM A105,ASME B16.47 SR.B,WELD NECK	WN0270701	
SPACER AND BLIND		14 - 48	150#	RF 125 AARH	CS ASTM A105,ASME B16.48,	RS022PO01	
SPECL BLIND		1/2 - 12	150#	RF 125 AARH	CS ASTM A105,ASME B16.48,	SP022PO01	
BLIND FLANGE							
BLIND FLANGE		26 - 48	150#	RF 125 AARH	CS ASTM A105,ASME B16.47 SR.B,	BF0220701	
BLIND FLANGE		1/2 - 24	150#	RF 125 AARH	CS ASTM A105,ASME B16.5,	BF0220801	
GASKET							
GASKET		1/2 - 24	150#	SPRL-WND RF	TP304 SS WDG;GPH FLR;TP304 SS INR RNG;CS OTR RNG,ASME B16.20,	GSQN30301	
GASKET		26 - 48	150#	SPRL-WND RF	TP304 SS WDG;GPH FLR;TP304 SS INR RNG;CS OTR RNG,ASME B16.20/B16.47 SR.B,	GSQN3QJ01	
STUD & NUTS							
STUD & 2NUTS HVY HEX		-			ASTM A193 GR.B7/ASTM A194 GR.2H,,	SNDE00000	
DRIP RING							
DRIP RING		3 - 3	150#	RF 125 AARH	CS ASTM A105,PDIL-PDS-600,	DR022QK01	
FITTING (BW)							
BRANCH WELD		2 - 48		BW	CARBON STEEL,ASME B31.3,	RWOJ11200	
BRANCH WELD WITH RP		2 - 48		BW	CARBON STEEL,ASME B31.3,	WBOJ11200	
CAP		2 - 48		BW	ASTM A234 WPB-SMLS,ASME B16.9,	CP7310900	
ELBOW		2 - 6		BW	ASTM A234 WPB-SMLS,ASME B16.9,	EL7310900	
ELBOW		8 - 48		BW	ASTM A234 WPB-WLDD,ASME B16.9,	ELOY10900	L
ELBOW		8 - 48		BW	ASTM A234 WPB-WLDD,PDIL-PDS-600,R=3D	ELOY1QK00	3
ELBOW		8 - 48		BW	ASTM A234 WPB-WLDD,PDIL-PDS-600,R=5D	ELOY1QK00	5
ELBOW		8 - 48		BW	ASTM A234 WPB-WLDD,PDIL-PDS-600,R=7D	ELOY1QK00	7
REDUCER CONC.		2 - 6		BW	ASTM A234 WPB-SMLS,ASME B16.9,	RC7310900	
REDUCER CONC.		8 - 48		BW	ASTM A234 WPB-WLDD,ASME B16.9,	RCOY10900	
REDUCER ECC.		2 - 6		BW	ASTM A234 WPB-SMLS,ASME B16.9,	RE7310900	
REDUCER ECC.		8 - 48		BW	ASTM A234 WPB-WLDD,ASME B16.9,	REOY10900	
TEE		2 - 6		BW	ASTM A234 WPB-SMLS,ASME B16.9,	TE7310900	
TEE		8 - 48		BW	ASTM A234 WPB-WLDD,ASME B16.9,	TEOY10900	

PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER,ODISHA

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:1

Class: B24

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)	
BF,CW,RW,FG,FN,FW,NG,PN,PV,SA,SW,VS,PA, LIME SOL.	Ref.SI	Ref.SI

RATING ASME	CORROSION ALLOWANCE	MATERIAL
150# RF	1.5 MM(MIN.)	CS

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
WELDOLET		2 - 48		BW	CS ASTM A105,MSS SP 97,	WL0213300	
FITTING (SW)							
CAP		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	CP0230207	W
COUPLING		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	CN0230207	W
ELBOW		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	EL0230207	
HALF COUPLING		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	HF0230207	
SOCKOLET		1/2 - 48	3000#	SOCW	CS ASTM A105,MSS SP 97,	SL0233307	
TEE		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	TE0230207	
FITTING (THD)							
CAP		1/2 - 11/2	3000#	THD	CS ASTM A105,ASME B16.11,	CP0240207	T
COUPLING		1/2 - 11/2	3000#	THD	CS ASTM A105,ASME B16.11,	CN0240207	T
PLUG		1/2 - 11/2		THD	CS ASTM A105,ASME B16.11,ROUND HEAD	PG0240200	
THREDOLET		1/2 - 48	3000#	THD	CS ASTM A105,MSS SP 97,	TL0243307	
NIPPLE							
NIPPLE		1/2 - 11/2	SCH160	PLN-PLN	SMLS,API 5L GR.B,ASME B36.10,	NPA151312	1
NIPPLE		1/2 - 11/2	SCH160	PLN-THD	SMLS,API 5L GR.B,ASME B36.10,NPT	NPA161312	2
NIPPLE		1/2 - 11/2	SCH160	THD	SMLS,API 5L GR.B,ASME B36.10,NPT	NPA141312	3
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 11/2		PE	ASTM A234 WPB-SMLS,MSS SP 95,	NC73J4500	P
SWAGE (CONC)		1/2 - 11/2		PLN-THD	ASTM A234 WPB-SMLS,MSS SP 95,	NC7364500	T
SWAGE (ECC)		1/2 - 11/2		PE	ASTM A234 WPB-SMLS,MSS SP 95,	NE73J4500	P
SWAGE (ECC)		1/2 - 11/2		PLN-THD	ASTM A234 WPB-SMLS,MSS SP 95,	NE7364500	T
STRAINER							
T-TYPE STRAINER		2 - 24	150#	FLGD	CS ASTM A216 GR WCB,TTS210,	TTS210	
Y-TYPE STRAINER		1/2 - 11/2	600#	SOCW	CS ASTM A105,YTS201,	YTS201	
Y-TYPE STRAINER		2 - 24	150#	FLGD	CS ASTM A216 GR WCB,YTS210,	YTS210	
VALVES							
GATE VALVE		1/2 - 11/2	800#	SOCW	CS BODY ASTM A105,GAV201,	GAV201	
GATE VALVE		2 - 48	150#	FLG	CS BODY ASTM A216 GR WCB,GAV210,	GAV210	
GLOBE VALVE		1/2 - 11/2	800#	SOCW	CS BODY ASTM A105,GLV201,	GLV201	
GLOBE VALVE		2 - 12	150#	FLG	CS BODY ASTM A216 GR WCB,GLV210,	GLV210	
CHECK VALVE		1/2 - 11/2	800#	SOCW	CS BODY ASTM A105,CHV201,	CHV201	
CHECK VALVE		2 - 24	150#	FLG	CS BODY ASTM A216 GR WCB,CHV210,	CHV210	
BALL VALVE		1/2 - 11/2	800#	SOCW	CS BODY ASTM A105,BAV201,	BAV201	
BALL VALVE		2 - 24	150#	FLG	CS BODY ASTM A216 GR WCB,BAV210,	BAV210	
BUTTERFLY VALVE		2 - 24	150#	RF	CS BODY ASTM A216 GR WCB,BUV203,LUG TYPE	BUV203	
BUTTERFLY VALVE		26 - 48	150#	FLG	CS BODY ASTM A216 GR WCB,BUV204,	BUV204	
PLUG VALVE		1/2 - 1	600#	THRD	CS BODY ASTM A105,PLV201,	PLV201	
PLUG VALVE		11/2 - 24	150#	FLG	CS BODY ASTM A216 GR WCB,PLV202,	PLV202	

PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER ,ODISHA.

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:0.

Class: B24D

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)			INSPECTION CLASS
WASTE EFFLUENT,HCL	Ref.SI	Ref.SI		

RATING ASME	CORROSION ALLOWANCE	MATERIAL	VALVE TRIM	STRESS RELIEF	
150# FF	NONE	HDPE			

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		1 - 11/4	CALC	PE	HDPE ASTM D3350 CELL 345464C(PE 3608),D-3035,SDR7	PP5922A00	
PIPE		11/2 - 2	CALC	PE	HDPE ASTM D3350 CELL 345464C(PE 3608),D-3035,SDR7	PP5922A00	
PIPE		3 - 4	CALC	PE	HDPE ASTM D3350 CELL 345464C(PE 3608),D-3035,SDR7	PP5922A00	
PIPE		5 - 6	CALC	PE	HDPE ASTM D3350 CELL 345464C(PE 3608),D-3035,SDR7	PP5922A00	
PIPE		8 - 10	CALC	PE	HDPE ASTM D3350 CELL 345464C(PE 3608),D-3035,SDR7	PP5922A00	
PIPE		12 - 12	CALC	PE	HDPE ASTM D3350 CELL 345464C(PE 3608),D-3035,SDR7	PP5922A00	
FLANGE							
FLANGE		1 - 12	150#	LJ-FF	DI ASTM A536 GR.65-45-12,MF.STD/ASME B16.5,	FL5193501	
BLIND FLANGE							
BLIND FLANGE		1 - 12	150#	FF	CS ASTM A105,ASME B16.5,	BF0210801	
GASKET							
GASKET		1 - 12	150#	3.0 MM THK FF	EPDM,ASME B16.21,	GS7880401	
STUD & NUTS							
STUD & 2NUTS HVY HEX		-			A307 GR.B/A563 GR.B,,	SN3B00000	
FITTING							
ELBOW		1 - 12		PE	HDPE ASTM D3350 CELL 345464C(PE 3608),D-3035/MF.STD,SDR7	EL59J2B00	
REDUCER CONC.		1 - 12		PE	HDPE ASTM D3350 CELL 345464C(PE 3608),D-3035/MF.STD,SDR7	RC59J2B00	
REDUCER ECC.		1 - 12		PE	HDPE ASTM D3350 CELL 345464C(PE 3608),D-3035/MF.STD,SDR7	RE59J2B00	
STUB END		1 - 12		PE	HDPE ASTM D3350 CELL 345464C(PE 3608),MF.STD/ASME B16.5,SDR7	SE59J3500	
TEE		1 - 12		PE	HDPE ASTM D3350 CELL 345464C(PE 3608),D-3035/MF.STD,SDR7	TE59J2B00	
VALVES							
CHECK VALVE		1 - 12	150#	FLG	CS BODY ASTM A216 GR.WCB RUBBER LINED,CHV210D,	CHV210D	
BALL VALVE		1 - 12	150#	FLG	SS BODY ASTM A351 GR CF8M,BAV510,	BAV510	
BUTTERFLY VALVE		1 - 12	150#	FF	CS BODY ASTM A216 GR.WCB RUBBER LINED,BUV203F,LUG TYPE	BUV203F	

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PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER ,ODISHA.

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:0.

Class: B24S

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)			INSPECTION CLASS
SL,SC (IBR)	Ref.SI	Ref.SI		

RATING ASME	CORROSION ALLOWANCE	MATERIAL	VALVE TRIM	STRESS RELIEF	
150# RF	1.5 MM(MIN.)	CS			

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		2 - 6	SCH 40	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		8 - 10	SCH 20	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		12 - 12	SCH 20	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		1/2 - 3/4	SCH 80	PE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03B1300	
PIPE		1 - 11/4	SCH 80	PE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03B1300	
PIPE		11/2 - 11/2	SCH 80	PE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03B1300	
PIPE		14 - 16	SCH 10	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		18 - 20	SCH 10	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		24 - 24	SCHSTD	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		26 - 28	SCHSTD	BE IBR	EFW,ASTM A671 GR.CC60 CL.22,ASME B36.10,	PPRXA1300	
PIPE		30 - 32	SCHSTD	BE IBR	EFW,ASTM A671 GR.CC60 CL.22,ASME B36.10,	PPRXA1300	
PIPE		34 - 34	SCHSTD	BE IBR	EFW,ASTM A671 GR.CC60 CL.22,ASME B36.10,	PPRXA1300	
PIPE		36 - 38	SCH XS	BE IBR	EFW,ASTM A671 GR.CC60 CL.22,ASME B36.10,	PPRXA1300	
PIPE		40 - 42	SCH XS	BE IBR	EFW,ASTM A671 GR.CC60 CL.22,ASME B36.10,	PPRXA1300	
PIPE		44 - 46	SCH XS	BE IBR	EFW,ASTM A671 GR.CC60 CL.22,ASME B36.10,	PPRXA1300	
PIPE		48 - 48	14.27 MM	BE IBR	EFW,ASTM A671 GR.CC60 CL.22,ASME B36.10,	PPRXA1300	
FLANGE							
FLANGE		1/2 - 24	150#	SO-RF 125 AARH IBR	CS ASTM A105,ASME B16.5,SLIP ON	FL02F0801	
W.N.FLANGE		26 - 48	150#	WN-RF 125 AARH IBR	CS ASTM A105,ASME B16.47 SR.B,WELD NECK	WN02G0701	
SPACER AND BLIND		14 - 24	150#	RF 125 AARH IBR	CS ASTM A105,ASME B16.48,	RS02BPO01	
SPECL BLIND		1/2 - 12	150#	RF 125 AARH IBR	CS ASTM A105,ASME B16.48,	SP02BPO01	
BLIND FLANGE							
BLIND FLANGE		26 - 48	150#	RF 125 AARH IBR	CS ASTM A105,ASME B16.47 SR.B,	BF02B0701	
BLIND FLANGE		1/2 - 24	150#	RF 125 AARH IBR	CS ASTM A105,ASME B16.5,	BF02B0801	
GASKET							
GASKET		1/2 - 24	150#	SPRL-WND RF	TP304 SS WDG;GPH FLR;TP304 SS INR RNG;CS OTR RNG,ASME B16.20,	GSQN30301	
GASKET		26 - 48	150#	SPRL-WND RF	TP304 SS WDG;GPH FLR;TP304 SS INR RNG;CS OTR RNG,ASME B16.20/B16.47 SR.B,	GSQN3QJ01	
STUD & NUTS							
STUD & 2NUTS HVY HEX		-			ASTM A193 GR.B7/ASTM A194 GR.2H,,	SNDE00000	
FITTING (BW)							
BRANCH WELD		2 - 48		BW IBR	CARBON STEEL,ASME B31.3,	RWOJA1200	
BRANCH WELD WITH RP		2 - 48		BW IBR	CARBON STEEL,ASME B31.3,	WBOJA1200	
CAP		2 - 48		BW IBR	ASTM A234 WPB-SMLS,ASME B16.9,	CP73A0900	
ELBOW		2 - 24		BW IBR	ASTM A234 WPB-SMLS,ASME B16.9,	EL73A0900	
ELBOW		26 - 48		BW IBR	ASTM A234 WPB-WLDD,ASME B16.9,	ELOYA0900	
REDUCER CONC.		2 - 24		BW IBR	ASTM A234 WPB-SMLS,ASME B16.9,	RC73A0900	
REDUCER CONC.		26 - 48		BW IBR	ASTM A234 WPB-WLDD,ASME B16.9,	RCOYA0900	
REDUCER ECC.		2 - 24		BW IBR	ASTM A234 WPB-SMLS,ASME B16.9,	RE73A0900	
REDUCER ECC.		26 - 48		BW IBR	ASTM A234 WPB-WLDD,ASME B16.9,	REOYA0900	
TEE		2 - 24		BW IBR	ASTM A234 WPB-SMLS,ASME B16.9,	TE73A0900	
TEE		26 - 48		BW IBR	ASTM A234 WPB-WLDD,ASME B16.9,	TEOYA0900	
WELDOLET		2 - 48		BW IBR	CS ASTM A105,MSS SP 97,	WL02A3300	
FITTING (SW)							
CAP		1/2 - 11/2	3000#	SOCW IBR	CS ASTM A105,ASME B16.11,	CP02C0207	W
COUPLING		1/2 - 11/2	3000#	SOCW IBR	CS ASTM A105,ASME B16.11,	CN02C0207	

PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER ,ODISHA.

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:0.

Class: B24S

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)			INSPECTION CLASS
SL,SC (IBR)	Ref.SI	Ref.SI		

RATING ASME	CORROSION ALLOWANCE	MATERIAL	VALVE TRIM	STRESS RELIEF	
150# RF	1.5 MM(MIN.)	CS			

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
ELBOW		1/2 - 11/2	3000#	SOCW IBR	CS ASTM A105,ASME B16.11,	EL02C0207	
HALF COUPLING		1/2 - 11/2	3000#	SOCW IBR	CS ASTM A105,ASME B16.11,	HF02C0207	
SOCKOLET		1/2 - 48	3000#	SOCW IBR	CS ASTM A105,MSS SP 97,	SL02C3307	
TEE		1/2 - 11/2	3000#	SOCW IBR	CS ASTM A105,ASME B16.11,	TE02C0207	
FITTING (THD)							
CAP		1/2 - 11/2	3000#	THD IBR	CS ASTM A105,ASME B16.11,	CP02D0207	T
PLUG		1/2 - 11/2		THD IBR	CS ASTM A105,ASME B16.11,ROUND HEAD	PG02D0200	
THREDOLET		1/2 - 48	3000#	THD IBR	CS ASTM A105,MSS SP 97,	TL02D3307	
NIPPLE							
NIPPLE		1/2 - 11/2	SCH160	PLN-PLN IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	NP03E1312	1
NIPPLE		1/2 - 11/2	SCH160	PLN-THD IBR	SMLS,ASTM A106 GR.B,ASME B36.10,NPT	NP03F1312	2
NIPPLE		1/2 - 11/2	SCH160	THD IBR	SMLS,ASTM A106 GR.B,ASME B36.10,NPT	NP03D1312	3
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 11/2		PE IBR	ASTM A234 WPB-SMLS,MSS SP 95,	NC73Q4500	P
SWAGE (CONC)		1/2 - 11/2		PLN-THD IBR	ASTM A234 WPB-SMLS,MSS SP 95,	NC73F4500	T
SWAGE (ECC)		1/2 - 11/2		PE IBR	ASTM A234 WPB-SMLS,MSS SP 95,	NE73Q4500	P
SWAGE (ECC)		1/2 - 11/2		PLN-THD IBR	ASTM A234 WPB-SMLS,MSS SP 95,	NE73F4500	T
VALVES							
GATE VALVE		1/2 - 11/2	800#	SOCW IBR	CS BODY ASTM A105,GAV201S,	GAV201S	
GATE VALVE		2 - 48	150#	FLG IBR	CS BODY ASTM A216 GR WCB,GAV210S,	GAV210S	
GLOBE VALVE		1/2 - 11/2	800#	SOCW IBR	CS BODY ASTM A105,GLV201S,	GLV201S	
GLOBE VALVE		2 - 12	150#	FLG IBR	CS BODY ASTM A216 GR WCB,GLV210S,	GLV210S	
CHECK VALVE		1/2 - 11/2	800#	SOCW IBR	CS BODY ASTM A105,CHV201S,	CHV201S	
CHECK VALVE		2 - 24	150#	FLG IBR	CS BODY ASTM A216 GR WCB,CHV210S,	CHV210S	

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PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER ,ODISHA.

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:0.

Class: B24FL

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)			INSPECTION CLASS
EFFLUENT,ACIDIC H2O ETC.	Ref.Sl	Ref.Sl		

RATING ASME	CORROSION ALLOWANCE	MATERIAL	VALVE TRIM	STRESS RELIEF	
150# FF	NONE	CS FRP LND.			

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		1 - 11/4	SCH XS	FLGD	CS,SMLS,API 5L GR.B,FRP LND.,ASME B36.10,THK OF LING AS PER MFR.	PP5661300	
PIPE		11/2 - 11/2	SCH XS	FLGD	CS,SMLS,API 5L GR.B,FRP LND.,ASME B36.10,THK OF LING AS PER MFR.	PP5661300	
PIPE		2 - 21/2	SCHSTD	FLGD	CS,SMLS,API 5L GR.B,FRP LND.,ASME B36.10,THK OF LING AS PER MFR.	PP5661300	
PIPE		3 - 4	SCHSTD	FLGD	CS,SMLS,API 5L GR.B,FRP LND.,ASME B36.10,THK OF LING AS PER MFR.	PP5661300	
PIPE		5 - 6	SCHSTD	FLGD	CS,SMLS,API 5L GR.B,FRP LND.,ASME B36.10,THK OF LING AS PER MFR.	PP5661300	
PIPE		8 - 10	SCH 20	FLGD	CS,ERW,API 5L GR.B,FRP LND,ASME B36.10,THK OF LING AS PER MFR.	PP5761300	
PIPE		12 - 12	SCH 20	FLGD	CS,ERW,API 5L GR.B,FRP LND,ASME B36.10,THK OF LING AS PER MFR.	PP5761300	
FLANGE							
FLANGE		1 - 2	150#	SO-FF	CS,ASTM A105,FRP LND.,ASME B16.5,THK OF LING AS PER MFR.	FL5850801	
W.N.FLANGE		1 - 12	150#	WN-FF	CS,ASTM A105,FRP LND.,ASME B16.5,THK OF LING AS PER MFR.	WN58M0801	
SPECL BLIND		1 - 12	150#	FF	CS PLT,ASTM A516 GR.60,FRP LND.,ASME B16.48,THK OF LING AS PER MFR.	SP641PO01	
BLIND FLANGE							
BLIND FLANGE		1 - 12	150#	FF	CS,ASTM A105,FRP LND.,ASME B16.5,THK OF LING AS PER MFR.	BF5810801	
GASKET							
GASKET		1 - 12	150#	FLAT	GASKET,SOFT RUBBER,ASME B16.21,3MM THK.	GSW190401	
STUD & NUTS							
STUD & 2NUTS HVY HEX		-			ASTM A193 GR.B7/ASTM A194 GR.2H,,	SNDE00000	
FITTING							
ELBOW		1 - 6		FLGD	CS,ASTM A234 WPB-SMLS,FRP LND,ASME B16.9,THK OF LING AS PER MFR.	EL62Z0900	
ELBOW		8 - 12		FLGD	CS,ASTM A234 WPB-WLDD,FRP LND.,ASME B16.9,THK OF LING AS PER MFR.	EL63Z0900	
REDUCER CONC.		1 - 6		FLGD	CS,ASTM A234 WPB-SMLS,FRP LND,ASME B16.9,THK OF LING AS PER MFR.	RC62Z0900	
REDUCER CONC.		8 - 12		FLGD	CS,ASTM A234 WPB-WLDD,FRP LND.,ASME B16.9,THK OF LING AS PER MFR.	RC63Z0900	
REDUCER ECC.		1 - 6		FLGD	CS,ASTM A234 WPB-SMLS,FRP LND,ASME B16.9,THK OF LING AS PER MFR.	RE62Z0900	
REDUCER ECC.		8 - 12		FLGD	CS,ASTM A234 WPB-WLDD,FRP LND.,ASME B16.9,THK OF LING AS PER MFR.	RE63Z0900	
TEE		1 - 6		FLGD	CS,ASTM A234 WPB-SMLS,FRP LND,ASME B16.9,THK OF LING AS PER MFR.	TE62Z0900	
TEE		8 - 12		FLGD	CS,ASTM A234 WPB-WLDD,FRP LND.,ASME B16.9,THK OF LING AS PER MFR.	TE63Z0900	
VALVES							
GATE VALVE		2 - 12	150#	FLG	SS BODY ASTM A351 GR CF8,GAV510,	GAV510	
GLOBE VALVE		2 - 12	150#	FLG	SS BODY ASTM A351 GR CF8,GLV510,	GLV510	
CHECK VALVE		2 - 12	150#	FLG	CS BODY ASTM A216 GR.WCB RUBBER LINED,CHV210D,	CHV210D	
BALL VALVE		2 - 12	150#	FLG	SS BODY ASTM A351 GR CF8M,BAV510,	BAV510	
BUTTERFLY VALVE		2 - 12	150#	FF	CS BODY ASTM A216 GR.WCB RUBBER LINED,BUV203,LUG TYPE	BUV203	

NOTE: 1. S.O. Flanges shall be used with pipe spools.
2. All fittings shall have ends connected to flanges.

PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER ,ODISHA.

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:0.

Class: B24P

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)			INSPECTION CLASS
STRONG CAUSTIC ACID,ETP	Ref.SI	Ref.SI		

RATING ASME	CORROSION ALLOWANCE	MATERIAL	VALVE TRIM	STRESS RELIEF	
150# FF	NONE	CPVC			

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		2 - 3	SCH 80	PE	CPVC,ASTM F441,MF.STD/ASTM F441,PLASTIC PIPE	PP552QC00	
PIPE		4 - 6	SCH 80	PE	CPVC,ASTM F441,MF.STD/ASTM F441,PLASTIC PIPE	PP552QC00	
PIPE		8 - 10	SCH 80	PE	CPVC,ASTM F441,MF.STD/ASTM F441,PLASTIC PIPE	PP552QC00	
PIPE		12 - 12	SCH 80	PE	CPVC,ASTM F441,MF.STD/ASTM F441,PLASTIC PIPE	PP552QC00	
PIPE		1/2 - 3/4	SCH 80	PE	CPVC,ASTM F441,MF.STD/ASTM F441,PLASTIC PIPE	PP552QC00	
PIPE		1 - 11/2	SCH 80	PE	CPVC,ASTM F441,MF.STD/ASTM F441,PLASTIC PIPE	PP552QC00	
FLANGE							
FLANGE		1/2 - 12	150#	FF	CPVC,ASTM F441,MF.STD/ASTM F441,SCH80	FL551QC01	
BLIND FLANGE							
BLIND FLANGE		1/2 - 12	150#	FF	CPVC,ASTM F441,MF.STD/ASTM F441,	BF551QC01	
GASKET							
GASKET		1/2 - 12	150#	3.0 MM THK FF	EPDM,MF.STD./ASME B16.21,FULL FACE	GS788PA01	
STUD & NUTS							
STUD & 2NUTS HVY HEX		-			ASTM A193 GR.B7/ASTM A194 GR.2H,,	SNDE00000	
FITTING (BW)							
BRANCH WELD WITH RP		1/2 - 12		PE	CPVC,ASTM F441,MF.STD/ASTM F441,	WB55JQC00	
FITTING (THD)							
CAP		1/2 - 11/2	3000#	THD	CPVC,ASTM F441,MF.STD/ASTM F441,	CP554QC07	
FITTING							
ELBOW		1/2 - 12		PE	CPVC,ASTM F441,MF.STD/ASTM F441,	EL55JQC00	
REDUCER CONC.		1/2 - 12		PE	CPVC,ASTM F441,MF.STD/ASTM F441,	RC55JQC00	
REDUCER ECC.		1/2 - 12		PE	CPVC,ASTM F441,MF.STD/ASTM F441,	RE55JQC00	
TEE		1/2 - 12		PE	CPVC,ASTM F441,MF.STD/ASTM F441,	TE55JQC00	
UNION (GJ)		1/2 - 12		PE	CPVC,ASTM F441,MF.STD/ASTM F441,	UN55JQC00	
NIPPLE							
NIPPLE		1/2 - 11/2	SCH160	PLN-PLN	CPVC,ASTM F441,MF.STD/ASTM F441,	NP555QC12	1
NIPPLE		1/2 - 11/2	SCH160	PLN-THD	CPVC,ASTM F441,MF.STD/ASTM F441,PLASTIC PIPE NPT	NP556QC12	2
NIPPLE		1/2 - 11/2	SCH160	THD	CPVC,ASTM F441,MF.STD/ASTM F441,PLASTIC PIPE NPT	NP554QC12	3
VALVES							
GATE VALVE		1/2 - 12	150#	FF	CPVC BODY W/ PP PLUG & EPDM SEATS,GAV500C,	GAV500C	
CHECK VALVE		1/2 - 12	150#	FF	CPVC BODY,CHV500C,	CHV500C	
BALL VALVE		1/2 - 2	150#	FF	CPVC BODY WITH CPVC BALL,BAV500C,	BAV500C	
BALL VALVE		3 - 6	150#	FF	CPVC BODY WITH CPVC BALL,BAV501C,	BAV501C	

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PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER,ODISHA

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:1

Class: B24RL

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)	
DIL.CAUSTIC ACID,COAGULANT,CHLORINATED WATER	Ref.SI	Ref.SI

RATING ASME	CORROSION ALLOWANCE	MATERIAL
150# FF	1.5 MM	CSRL

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		1/2 - 3/4	SCH 80	FLGD	CS,SMLS,API 5L GR.B,NATURAL RBR LND,ASME B36.10,3MM THK LING	PPX761300	
PIPE		1 - 11/4	SCH 80	FLGD	CS,SMLS,API 5L GR.B,NATURAL RBR LND,ASME B36.10,3MM THK LING	PPX761300	
PIPE		11/2 - 11/2	SCH 80	FLGD	CS,SMLS,API 5L GR.B,NATURAL RBR LND,ASME B36.10,3MM THK LING	PPX761300	
PIPE		2 - 21/2	SCH 40	FLGD	CS,SMLS,API 5L GR.B,NATURAL RBR LND,ASME B36.10,3MM THK LING	PPX761300	
PIPE		3 - 4	SCHSTD	FLGD	CS,SMLS,API 5L GR.B,NATURAL RBR LND,ASME B36.10,3MM THK LING	PPX761300	
PIPE		5 - 6	SCHSTD	FLGD	CS,SMLS,API 5L GR.B,NATURAL RBR LND,ASME B36.10,3MM THK LING	PPX761300	
PIPE		8 - 10	SCHSTD	FLGD	CS,ERW,API 5L GR.B,NATURAL RBR LND,ASME B36.10,3MM THK LING	PP2A61300	
PIPE		12 - 12	SCHSTD	FLGD	CS,ERW,API 5L GR.B,NATURAL RBR LND,ASME B36.10,3MM THK LING	PP2A61300	
FLANGE							
FLANGE		1/2 - 12	150#	SO-FF	CS,ASTM A105,NATURAL RBR LND,ASME B16.5,3MM THK LING	FLX650801	
SPECL BLIND		1 - 12	150#	FF	CS PLT,ASTM A516 GR.60,NATURAL RBR LND,ASME B16.48,3MM THK LING	SPX81PO01	
BLIND FLANGE							
BLIND FLANGE		1 - 12	150#	FF	CS,ASTM A105,NATURAL RBR LND,ASME B16.5,3MM THK LING	BFX610801	
GASKET							
GASKET		1 - 12	150#	FLAT	GASKET,SOFT RUBBER,ASME B16.21,3MM THK.	GSW190401	
STUD & NUTS							
STUD & 2NUTS HVY HEX		-			ASTM A193 GR.B7/ASTM A194 GR.2H,,	SNDE00000	
FITTING							
DIAPH. VALVE		1 - 12	150#	FLG	CS BODY ASTM A216 GR.WCB RUBBER LINED,DPV500,	DPV500	
ELBOW		1/2 - 6		FLGD	CS,ASTM A234 WPB-SMLS,NATURAL RBR LND,ASME B16.9,3MM THK LING	ELX9Z0900	
ELBOW		8 - 12		FLGD	CS,ASTM A234 WPB-WLDD,NATURAL RBR LND,ASME B16.9,3MM THK LING	EL3AZ0900	
REDUCER CONC.		1/2 - 6		FLGD	CS,ASTM A234 WPB-SMLS,NATURAL RBR LND,ASME B16.9,3MM THK LING	RCX9Z0900	
REDUCER CONC.		8 - 12		FLGD	CS,ASTM A234 WPB-WLDD,NATURAL RBR LND,ASME B16.9,3MM THK LING	RC3AZ0900	
REDUCER ECC.		1/2 - 6		FLGD	CS,ASTM A234 WPB-SMLS,NATURAL RBR LND,ASME B16.9,3MM THK LING	REX9Z0900	
REDUCER ECC.		8 - 12		FLGD	CS,ASTM A234 WPB-WLDD,NATURAL RBR LND,ASME B16.9,3MM THK LING	RE3AZ0900	
TEE		1/2 - 6		FLGD	CS,ASTM A234 WPB-SMLS,NATURAL RBR LND,ASME B16.9,3MM THK LING	TEX9Z0900	
TEE		8 - 12		FLGD	CS,ASTM A234 WPB-WLDD,NATURAL RBR LND,ASME B16.9,3MM THK LING	TE3AZ0900	
VALVES							
GATE VALVE		1/2 - 12	150#	FLG	SS BODY ASTM A351 GR CF8,GAV510,	GAV510	
GLOBE VALVE		1/2 - 12	150#	FLG	SS BODY ASTM A351 GR CF8,GLV510,	GLV510	
CHECK VALVE		2 - 12	150#	FLG	CS BODY ASTM A216 GR.WCB RUBBER LINED,CHV210D,	CHV210D	
BALL VALVE		2 - 12	150#	FLG	SS BODY ASTM A351 GR CF8M,BAV510,	BAV510	
BUTTERFLY VALVE		2 - 12	150#	FF	CS BODY ASTM A216 GR.WCB RUBBER LINED,BUV203RL,LUG TYPE	BUV203RL	

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PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER ,ODISHA.

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:0.

Class: B50

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)			INSPECTION CLASS
AF,AW,CD,DM,HZ,IA,MDA,PC,PH,VS,CH	Ref.SI	Ref.SI		

RATING ASME	CORROSION ALLOWANCE	MATERIAL	VALVE TRIM	STRESS RELIEF	
150# RF	NONE	SS 304			

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		26 - 28	06.35 MM	BE	EFW,ASTM A358 GR.TP304 CL.2,ASME B36.10,	PP4111300	
PIPE		30 - 32	SCH 10	BE	EFW,ASTM A358 GR.TP304 CL.2,ASME B36.10,	PP4111300	
PIPE		34 - 36	SCH 10	BE	EFW,ASTM A358 GR.TP304 CL.2,ASME B36.10,	PP4111300	
PIPE		38 - 40	SCHSTD	BE	EFW,ASTM A358 GR.TP304 CL.2,ASME B36.10,	PP4111300	
PIPE		42 - 44	SCHSTD	BE	EFW,ASTM A358 GR.TP304 CL.2,ASME B36.10,	PP4111300	
PIPE		46 - 48	SCHSTD	BE	EFW,ASTM A358 GR.TP304 CL.2,ASME B36.10,	PP4111300	
PIPE		1/2 - 3/4	SCH40S	PE	SMLS,ASTM A312 TP304,ASME B36.19,	PPPE21400	
PIPE		1 - 11/4	SCH40S	PE	SMLS,ASTM A312 TP304,ASME B36.19,	PPPE21400	
PIPE		11/2 - 11/2	SCH40S	PE	SMLS,ASTM A312 TP304,ASME B36.19,	PPPE21400	
PIPE		2 - 4	SCH10S	BE	EFW,STR.WELD,ASTM A312 TP304,ASME B36.19,	PPZ111400	
PIPE		6 - 8	SCH10S	BE	EFW,STR.WELD,ASTM A312 TP304,ASME B36.19,	PPZ111400	
PIPE		10 - 12	SCH10S	BE	EFW,STR.WELD,ASTM A312 TP304,ASME B36.19,	PPZ111400	
PIPE		14 - 16	SCH10S	BE	EFW,STR.WELD,ASTM A312 TP304,ASME B36.19,	PPZ111400	
PIPE		18 - 20	SCH10S	BE	EFW,STR.WELD,ASTM A312 TP304,ASME B36.19,	PPZ111400	
PIPE		22 - 24	SCH10S	BE	EFW,STR.WELD,ASTM A312 TP304,ASME B36.19,	PPZ111400	
FLANGE							
W.N.FLANGE		26 - 48	150#	WN-RF 125 AARH	ASTM A182 F304,ASME B16.47 SR.B,WELD NECK	WN0670701	
W.N.FLANGE		1/2 - 24	150#	WN-RF 125 AARH	ASTM A182 F304,ASME B16.5,WELD NECK	WN0670801	
SPACER AND BLIND		14 - 24	150#	RF 125 AARH	ASTM A182 F304,ASME B16.48,	RS062PO01	
SPECL BLIND		1/2 - 12	150#	RF 125 AARH	ASTM A182 F304,ASME B16.48,	SP062PO01	
BLIND FLANGE							
BLIND FLANGE		26 - 48	150#	RF 125 AARH	ASTM A182 F304,ASME B16.47 SR.B,	BF0620701	
BLIND FLANGE		1/2 - 24	150#	RF 125 AARH	ASTM A182 F304,ASME B16.5,	BF0620801	
GASKET							
GASKET		1/2 - 24	150#	SPRL-WND RF	TP304 SS WDG; GPH FLR; TP304 SS INR RNG/ OTR RNG,ASME B16.20,	GSQL30301	
GASKET		26 - 48	150#	SPRL-WND RF	TP304 SS WDG; GPH FLR; TP304 SS INR RNG/ OTR RNG,ASME B16.20/B16.47 SR.B,	GSQL3QJ01	
STUD & NUTS							
STUD & 2NUTS HVY HEX		-			ASTM A193 GR.B8 CL.2/ASTM A194 GR.8,,	SNA600000	
DRIP RING							
DRIP RING		3 - 3	150#	RF 125 AARH	ASTM A182 F304,PDIL-PDS-600,	DR062QK01	
FITTING (BW)							
BRANCH WELD		2 - 48		BW	STAINLESS STEEL,ASME B31.3,	RWOK11200	
BRANCH WELD WITH RP		2 - 48		BW	STAINLESS STEEL,ASME B31.3,	WBOK11200	
CAP		2 - 48		BW	ASTM A403 WP304-SMLS,ASME B16.9,	CP7410900	
ELBOW		2 - 48		BW	ASTM A403 WP304-WLDD,ASME B16.9,	ELZ410900	
REDUCER CONC.		2 - 48		BW	ASTM A403 WP304-WLDD,ASME B16.9,	RCZ410900	
REDUCER ECC.		2 - 48		BW	ASTM A403 WP304-WLDD,ASME B16.9,	REZ410900	
TEE		2 - 48		BW	ASTM A403 WP304-WLDD,ASME B16.9,	TEZ410900	
WELDOLET		2 - 48		BW	ASTM A182 F304,MSS SP 97,	WL0613300	
FITTING (SW)							
CAP		1/2 - 11/2	3000#	SOCW	ASTM A182 F304,ASME B16.11,	CP0630207	W
COUPLING		1/2 - 11/2	3000#	SOCW	ASTM A182 F304,ASME B16.11,	CN0630207	
ELBOW		1/2 - 11/2	3000#	SOCW	ASTM A182 F304,ASME B16.11,	EL0630207	
HALF COUPLING		1/2 - 11/2	3000#	SOCW	ASTM A182 F304,ASME B16.11,	HF0630207	
SOCKOLET		1/2 - 48	3000#	SOCW	ASTM A182 F304,MSS SP 97,	SL0633307	
TEE		1/2 - 11/2	3000#	SOCW	ASTM A182 F304,ASME B16.11,	TE0630207	
FITTING (THD)							
CAP		1/2 - 11/2	3000#	THD	ASTM A182 F304,ASME B16.11,	CP0640207	T

PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER ,ODISHA.

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:0.

Class: B50

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)			INSPECTION CLASS
AF,AW,CD,DM,HZ,IA,MDA,PC,PH,VS,CH	Ref.SI	Ref.SI		

RATING ASME	CORROSION ALLOWANCE	MATERIAL	VALVE TRIM	STRESS RELIEF	
150# RF	NONE	SS 304			

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PLUG		1/2 - 11/2		THD	ASTM A182 F304,ASME B16.11,ROUND HEAD	PG0640200	
THREDOLET		1/2 - 48	3000#	THD	ASTM A182 F304,MSS SP 97,	TL0643307	
NIPPLE							
NIPPLE		1/2 - 11/2	SCH80S	PLN-PLN	SMLS,ASTM A312 TP304,ASME B36.19,	NPPE51413	1
NIPPLE		1/2 - 11/2	SCH80S	PLN-THD	SMLS,ASTM A312 TP304,ASME B36.19,NPT	NPPE61413	2
NIPPLE		1/2 - 11/2	SCH80S	THD	SMLS,ASTM A312 TP304,ASME B36.19,NPT	NPPE41413	3
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 11/2		PE	ASTM A403 WP304-SMLS,MSS SP 95,	NC74J4500	P
SWAGE (CONC)		1/2 - 11/2		PLN-THD	ASTM A403 WP304-SMLS,MSS SP 95,	NC7464500	T
SWAGE (ECC)		1/2 - 11/2		PE	ASTM A403 WP304-SMLS,MSS SP 95,	NE74J4500	P
SWAGE (ECC)		1/2 - 11/2		PLN-THD	ASTM A403 WP304-SMLS,MSS SP 95,	NE7464500	T
STRAINER							
T-TYPE STRAINER		2 - 24	150#	FLGD	SS ASTM A351 GR CF8,TTS510,	TTS510	
Y-TYPE STRAINER		2 - 24	150#	FLGD	SS ASTM A351 GR CF8,YTS510,	YTS510	
Y-TYPE STRAINER		1/2 - 11/2	600#	SOCW	ASTM A182 F304,YTS501,	YTS501	
VALVES							
GATE VALVE		1/2 - 11/2	800#	SOCW	SS BODY ASTM A182 GR F304,GAV501,	GAV501	
GATE VALVE		2 - 24	150#	FLG	SS BODY ASTM A351 GR CF8,GAV510,	GAV510	
GLOBE VALVE		1/2 - 11/2	800#	SOCW	SS BODY ASTM A182 GR F304,GLV501,	GLV501	
GLOBE VALVE		2 - 12	150#	FLG	SS BODY ASTM A351 GR CF8,GLV510,	GLV510	
CHECK VALVE		1/2 - 11/2	800#	SOCW	SS BODY ASTM A182 GR F304,CHV501,	CHV501	
CHECK VALVE		2 - 24	150#	FLG	SS BODY ASTM A351 GR CF8,CHV510,	CHV510	
CHECK VALVE		26 - 36	150#	FLG	SS BODY ASTM A351 GR CF8,CHV520,	CHV520	
BALL VALVE		1/2 - 11/2	800#	THRD	SS BODY AISI 316,BAV501,	BAV501	
BALL VALVE		2 - 6	150#	FLG	SS BODY ASTM A351 GR CF8M,BAV510,	BAV510	
BALL VALVE		8 - 24	150#	FLG	SS BODY ASTM A351 GR CF8M,BAV520,	BAV520	
BUTTERFLY VALVE		6 - 48	150#	RF	SS BODY ASTM A351 GR CF8,BUV510,WAFER TYPE	BUV510	
PLUG VALVE		1/2 - 1	600#	THRD	SS BODY AISI 316,PLV501,	PLV501	
PLUG VALVE		11/2 - 6	150#	FLG	SS BODY ASTM A351 GR CF8M,PLV510,	PLV510	

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PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER ,ODISHA.

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:1.

Class: B52

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)			INSPECTION CLASS
UL	Ref.SI	Ref.SI		

RATING ASME	CORROSION ALLOWANCE	MATERIAL	VALVE TRIM	STRESS RELIEF	
150# RF	NONE	SS 316L			

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		1/2 - 3/4	SCH40S	PE	SS,SMLS,ASTM A312 TP316L,ASME B36.19,	PP9121400	
PIPE		1 - 11/2	SCH40S	PE	SS,SMLS,ASTM A312 TP316L,ASME B36.19,	PP9121400	
PIPE		2 - 2	SCH10S	PE	SS,SMLS,ASTM A312 TP316L,ASME B36.19,	PP9121400	
PIPE		3 - 4	SCH10S	BE	SS,SMLS,ASTM A312 TP316L,ASME B36.19,	PP9111400	
PIPE		6 - 6	SCH10S	BE	SS,SMLS,ASTM A312 TP316L,ASME B36.19,	PP9111400	
PIPE		8 - 10	SCH10S	BE	SS,EFW,ASTM A358 TP316L CL.5,ASME B36.19,	PP9211400	
PIPE		12 - 14	SCH10S	BE	SS,EFW,ASTM A358 TP316L CL.5,ASME B36.19,	PP9211400	
PIPE		16 - 18	SCH10S	BE	SS,EFW,ASTM A358 TP316L CL.5,ASME B36.19,	PP9211400	
FLANGE							
FLANGE		1/2 - 2	150#	SW-RF 125 AARH	SS,ASTM A182 F316L,ASME B16.5,SOCKET WELD	FL88L0801	5
FLANGE		1/2 - 2	300#	SW-RF 125 AARH	SS,ASTM A182 F316L,ASME B16.5,SOCKET WELD	FL88L0802	6
W.N.FLANGE		3 - 4	150#	WN-RF 125 AARH	SS,ASTM A182 F316L,ASME B16.5,WELD NECK	WN8870801	5
W.N.FLANGE		6 - 18	150#	WN-RF 125 AARH	SS,ASTM A182 F316L,ASME B16.5,WELD NECK	WN8870801	
W.N.FLANGE		3 - 4	300#	WN-RF 125 AARH	SS,ASTM A182 F316L,ASME B16.5,WELD NECK	WN8870802	6
SPACER AND BLIND		18 - 18	150#	RF 125 AARH	ASTM A240 TP316L,ASME B16.48,	RS932PO01	
SPECL BLIND		1/2 - 16	150#	RF 125 AARH	ASTM A240 TP316L,ASME B16.48,	SP932PO01	
BLIND FLANGE							
BLIND FLANGE		1/2 - 18	150#	RF 125 AARH	SS,ASTM A182 F316L,ASME B16.5,	BF8820801	
GASKET							
GASKET		1/2 - 4	150#	SPRL-WND RF	GASKET,TP316L SS WDG;GPH FLR;TP316L SS INR RNG/ OTR RNG,ASME B16.20,	GS0830301	5
GASKET		6 - 18	150#	SPRL-WND RF	GASKET,TP316L SS WDG;GPH FLR;TP316L SS INR RNG/ OTR RNG,ASME B16.20,	GS0830301	
GASKET		1/2 - 4	300#	SPRL-WND RF	GASKET,TP316L SS WDG;GPH FLR;TP316L SS INR RNG/ OTR RNG,ASME B16.20,	GS0830302	6
STUD & NUTS							
STUD & 2NUTS HVY HEX		-			ASTM A193 GR.B7/ASTM A194 GR.2H,,	SNDE00000	
FITTING (BW)							
CAP		3 - 18		BW	SS,ASTM A403 WP316L-SMLS,ASME B16.9,	CP8910900	
ELBOW		3 - 6		BW	SS,ASTM A403 WP316L-SMLS,ASME B16.9,	EL8910900	
ELBOW		8 - 18		BW	SS,ASTM A403 WP316L-WLDD,ASME B16.9,	EL9010900	
REDUCER CONC.		3 - 6		BW	SS,ASTM A403 WP316L-SMLS,ASME B16.9,	RC8910900	
REDUCER CONC.		8 - 18		BW	SS,ASTM A403 WP316L-WLDD,ASME B16.9,	RC9010900	
REDUCER ECC.		3 - 6		BW	SS,ASTM A403 WP316L-SMLS,ASME B16.9,	RE8910900	
REDUCER ECC.		8 - 18		BW	SS,ASTM A403 WP316L-WLDD,ASME B16.9,	RE9010900	
TEE		3 - 6		BW	SS,ASTM A403 WP316L-SMLS,ASME B16.9,	TE8910900	
TEE		8 - 18		BW	SS,ASTM A403 WP316L-WLDD,ASME B16.9,	TE9010900	
WELDOLET		2 - 18		BW	SS,ASTM A182 F316L,MSS SP 97,	WL8813300	
FITTING (SW)							
CAP		1/2 - 2	3000#	SOCW	SS,ASTM A182 F316L,ASME B16.11,	CP8830207	
COUPLING		1/2 - 2	3000#	SOCW	SS,ASTM A182 F316L,ASME B16.11,	CN8830207	W
ELBOW		1/2 - 2	3000#	SOCW	SS,ASTM A182 F316L,ASME B16.11,	EL8830207	
HALF COUPLING		1/2 - 11/2	3000#	SOCW	SS,ASTM A182 F316L,ASME B16.11,	HF8830207	W
SOCKOLET		1/2 - 18	3000#	SOCW	SS,ASTM A182 F316L,MSS SP 97,	SL8833307	
TEE		1/2 - 2	3000#	SOCW	SS,ASTM A182 F316L,ASME B16.11,	TE8830207	
FITTING (THD)							
COUPLING		1/2 - 2	3000#	THD	SS,ASTM A182 F316L,ASME B16.11,	CN8840207	T
ELBOLET		1/2 - 18	3000#	THD	SS,ASTM A182 F316L,MSS SP 97,	ET8843307	
HALF COUPLING		1/2 - 11/2	3000#	THD	SS,ASTM A182 F316L,ASME B16.11,	HF8840207	T
PLUG		1/2 - 2		THD	SS,ASTM A182 F316L,ASME B16.11,ROUND HEAD	PG8840200	

PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER ,ODISHA.

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:1.

Class: B52

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)			INSPECTION CLASS
UL	Ref.SI	Ref.SI		

RATING ASME	CORROSION ALLOWANCE	MATERIAL	VALVE TRIM	STRESS RELIEF	
150# RF	NONE	SS 316L			

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
THREDOLET		1/2 - 18	3000#	THD	SS,ASTM A182 F316L,MSS SP 97,	TL8843307	
NIPPLE							
NIPPLE		1/2 - 2	SCH80S	PLN-PLN	SS,SMLS,ASTM A312 TP316L,ASME B36.19,	NP9151413	1
NIPPLE		1/2 - 2	SCH80S	PLN-THD	SS,SMLS,ASTM A312 TP316L,ASME B36.19,	NP9161413	2
NIPPLE		1/2 - 2	SCH80S	THD	SS,SMLS,ASTM A312 TP316L,ASME B36.19,	NP9141413	3
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 2		PE	SS,ASTM A182 F316L,MSS SP 95,	NC88J4500	
SWAGE (ECC)		1/2 - 2		PE	SS,ASTM A182 F316L,MSS SP 95,	NE88J4500	
VALVES							
GATE VALVE		1/2 - 11/2	800#	SOCW	SS BODY AISI 316L,GAV401,	GAV401	
GATE VALVE		2 - 6	150#	FLG	SS BODY ASTM A351 GR CF3M,GAV410,	GAV410	
GLOBE VALVE		1/2 - 11/2	800#	SOCW	SS BODY AISI 316L,GLV401,	GLV401	
GLOBE VALVE		2 - 6	150#	FLG	SS BODY ASTM A351 GR CF3M,GLV410,	GLV410	
CHECK VALVE		1/2 - 11/2	800#	SOCW	SS BODY AISI 316L,CHV401,	CHV401	
CHECK VALVE		2 - 12	150#	FLG	SS BODY ASTM A351 GR CF3M,CHV410,	CHV410	
BUTTERFLY VALVE		6 - 18	150#	RF	SS BODY ASTM A351 GR CF3M,BUV410,WAFER TYPE	BUV410	

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PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER,ODISHA

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:0

Class: D14

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)				
AG,AL,FG	Ref.SI	Ref.SI			
RATING ASME	CORROSION ALLOWANCE	MATERIAL			
300# RF	1.5 MM(MIN.)	LT CS			

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		2 - 6	SCH 40	BE	SMLS,ASTM A333 GR.6,ASME B36.10,	PPP611300	
PIPE		8 - 10	SCH 30	BE	SMLS,ASTM A333 GR.6,ASME B36.10,	PPP611300	
PIPE		12 - 14	SCH 40	BE	SMLS,ASTM A333 GR.6,ASME B36.10,	PPP611300	
PIPE		1/2 - 3/4	SCH 80	PE	SMLS,ASTM A333 GR.6,ASME B36.10,	PPP621300	
PIPE		1 - 11/4	SCH 80	PE	SMLS,ASTM A333 GR.6,ASME B36.10,	PPP621300	
PIPE		11/2 - 11/2	SCH 80	PE	SMLS,ASTM A333 GR.6,ASME B36.10,	PPP621300	
PIPE		16 - 18	SCH 40	BE	SMLS,ASTM A333 GR.6,ASME B36.10,	PPP611300	
PIPE		20 - 22	SCH 40	BE	SMLS,ASTM A333 GR.6,ASME B36.10,	PPP611300	
PIPE		24 - 24	SCH 40	BE	SMLS,ASTM A333 GR.6,ASME B36.10,	PPP611300	
FLANGE							
LONG W.N.FLANGE		11/2 - 11/2	300#	WN-RF 125 AARH	ASTM A350 LF2 CL.1,ASME B16.5,38mmBORE,200mmLONG	LN3570802	
W.N.FLANGE		1/2 - 24	300#	WN-RF 125 AARH	ASTM A350 LF2 CL.1,ASME B16.5,WELD NECK	WN3570802	
SPACER AND BLIND		14 - 24	300#	RF 125 AARH	ASTM A350 LF2 CL.1,ASME B16.48,	RS352PO02	
SPECL BLIND		1/2 - 12	300#	RF 125 AARH	ASTM A350 LF2 CL.1,ASME B16.48,	SP352PO02	
BLIND FLANGE							
BLIND FLANGE		1/2 - 24	300#	RF 125 AARH	ASTM A350 LF2 CL.1,ASME B16.5,	BF3520802	
GASKET							
GASKET		1/2 - 24	300#	SPRL-WND RF	TP304 SS WDG;GPH FLR;TP304 SS INR RNG;CS OTR RNG,ASME B16.20,	GSQN30302	
STUD & NUTS							
STUD & 2NUTS HVY HEX		-			ASTM A320 GR.L7/ASTM A194 GR.4,,	SNDA00000	
FITTING (BW)							
BRANCH WELD WITH RP		2 - 24		BW	LT CARBON STEEL,ASME B31.3,	WBE211200	
CAP		2 - 24		BW	ASTM A420 WPL6-SMLS,ASME B16.9,	CP4910900	
ELBOW		2 - 24		BW	ASTM A420 WPL6-SMLS,ASME B16.9,	EL4910900	
REDUCER CONC.		2 - 24		BW	ASTM A420 WPL6-SMLS,ASME B16.9,	RC4910900	
REDUCER ECC.		2 - 24		BW	ASTM A420 WPL6-SMLS,ASME B16.9,	RE4910900	
TEE		2 - 24		BW	ASTM A420 WPL6-SMLS,ASME B16.9,	TE4910900	
WELDOLET		2 - 24		BW	ASTM A350 LF2 CL.1,MSS SP 97,	WL3513300	
FITTING (SW)							
CAP		1/2 - 11/2	3000#	SOCW	ASTM A350 LF2 CL.1,ASME B16.11,	CP3530207	W
COUPLING		1/2 - 11/2	3000#	SOCW	ASTM A350 LF2 CL.1,ASME B16.11,	CN3530207	
ELBOW		1/2 - 11/2	3000#	SOCW	ASTM A350 LF2 CL.1,ASME B16.11,	EL3530207	
HALF COUPLING		1/2 - 11/2	3000#	SOCW	ASTM A350 LF2 CL.1,ASME B16.11,	HF3530207	
SOCKOLET		1/2 - 24	3000#	SOCW	ASTM A350 LF2 CL.1,MSS SP 97,	SL3533307	
TEE		1/2 - 11/2	3000#	SOCW	ASTM A350 LF2 CL.1,ASME B16.11,	TE3530207	
FITTING (THD)							
CAP		1/2 - 11/2	3000#	THD	ASTM A350 LF2 CL.1,ASME B16.11,	CP3540207	T
PLUG		1/2 - 11/2		THD	ASTM A350 LF2 CL.1,ASME B16.11,ROUND HEAD	PG3540200	
THREDOLET		1/2 - 24	3000#	THD	ASTM A350 LF2 CL.1,MSS SP 97,	TL3543307	
NIPPLE							
NIPPLE		1/2 - 11/2	SCH160	PLN-PLN	SMLS,ASTM A333 GR.6,ASME B36.10,	NPP651312	1
NIPPLE		1/2 - 11/2	SCH160	PLN-THD	SMLS,ASTM A333 GR.6,ASME B36.10,NPT	NPP661312	2
NIPPLE		1/2 - 11/2	SCH160	THD	SMLS,ASTM A333 GR.6,ASME B36.10,NPT	NPP641312	3
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 11/2		PE	ASTM A420 WPL6-SMLS,MSS SP 95,	NC49J4500	P
SWAGE (CONC)		1/2 - 11/2		PLN-THD	ASTM A420 WPL6-SMLS,MSS SP 95,	NC4964500	T
SWAGE (ECC)		1/2 - 11/2		PE	ASTM A420 WPL6-SMLS,MSS SP 95,	NE49J4500	P
SWAGE (ECC)		1/2 - 11/2		PLN-THD	ASTM A420 WPL6-SMLS,MSS SP 95,	NE4964500	T
VALVES							

PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER,ODISHA

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:0

Class: D14

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)				
AG,AL,FG	Ref.SI	Ref.SI			

RATING ASME	CORROSION ALLOWANCE	MATERIAL			
300# RF	1.5 MM(MIN.)	LT CS			

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
GATE VALVE		1/2 - 1	800#	SOCW	LTCS BODY ASTM A350 GR LF2,GAV101,	GAV101	
GATE VALVE		11/2 - 11/2	800#	SOCW	LTCS BODY ASTM A350 GR LF2,GAV101,	GAV101	W
GATE VALVE		11/2 - 11/2	300#	FLG	LTCS BODY ASTM A352 GR LCB,GAV111,	GAV111	F
GATE VALVE		2 - 24	300#	FLG	LTCS BODY ASTM A352 GR LCB,GAV111,	GAV111	
GLOBE VALVE		1/2 - 11/2	800#	SOCW	LTCS BODY ASTM A350 GR LF2,GLV101,	GLV101	
GLOBE VALVE		2 - 8	300#	FLG	LTCS BODY ASTM A352 GR LCB,GLV111,	GLV111	
CHECK VALVE		1/2 - 11/2	800#	SOCW	LTCS BODY ASTM A350 GR LF2,CHV101,	CHV101	
CHECK VALVE		2 - 24	300#	FLG	LTCS BODY ASTM A352 GR LCB,CHV111,	CHV111	
BALL VALVE		1/2 - 1	800#	SOCW	LTCS BODY ASTM A350 GR LF2,BAV101,	BAV101	
BALL VALVE		11/2 - 11/2	800#	SOCW	LTCS BODY ASTM A350 GR LF2,BAV101,	BAV101	W
BALL VALVE		11/2 - 11/2	300#	FLG	LTCS BODY ASTM A352 GR LCB,BAV111,	BAV111	F
BALL VALVE		2 - 14	300#	FLG	LTCS BODY ASTM A352 GR LCB,BAV111,	BAV111	

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PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER ,ODISHA.

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:0.

Class: D24

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)			INSPECTION CLASS
AG,AL,AW,FG,FN,HG,IAH,IAW,NG,NI,PA,PN,VS ETC.	Ref SI	Ref SI		

RATING ASME	CORROSION ALLOWANCE	MATERIAL	VALVE TRIM	STRESS RELIEF	
300# RF	1.5 MM(MIN)	CS			

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		2 - 6	SCH 40	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		8 - 8	SCH 20	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		1/2 - 3/4	SCH 80	PE	SMLS,API 5L GR.B,ASME B36.10,	PPA121300	
PIPE		1 - 11/4	SCH 80	PE	SMLS,API 5L GR.B,ASME B36.10,	PPA121300	
PIPE		11/2 - 11/2	SCH 80	PE	SMLS,API 5L GR.B,ASME B36.10,	PPA121300	
PIPE		10 - 12	SCH 30	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		14 - 14	SCH 30	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		16 - 18	SCH XS	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		20 - 20	SCH XS	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		22 - 22	17.48 MM	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		24 - 24	SCH 40	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		26 - 28	17.40 MM	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
FLANGE							
LONG W.N.FLANGE		11/2 - 11/2	300#	WN-RF 125 AARH	CS ASTM A105,ASME B16.5,38mmBORE,200mmLONG	LN0270802	
W.N.FLANGE		26 - 28	300#	WN-RF 125 AARH	CS ASTM A105,ASME B16.47 SR.B,WELD NECK	WN0270702	
W.N.FLANGE		1/2 - 24	300#	WN-RF 125 AARH	CS ASTM A105,ASME B16.5,WELD NECK	WN0270802	
SPACER AND BLIND		14 - 24	300#	RF 125 AARH	CS ASTM A105,ASME B16.48,	RS022PO02	
SPECL BLIND		1/2 - 12	300#	RF 125 AARH	CS ASTM A105,ASME B16.48,	SP022PO02	
BLIND FLANGE							
BLIND FLANGE		26 - 28	300#	RF 125 AARH	CS ASTM A105,ASME B16.47 SR.B,	BF0220702	
BLIND FLANGE		1/2 - 24	300#	RF 125 AARH	CS ASTM A105,ASME B16.5,	BF0220802	
GASKET							
GASKET		1/2 - 24	300#	SPRL-WND RF	TP304 SS WDG;GPH FLR;TP304 SS INR RNG;CS OTR RNG,ASME B16.20,	GSQN30302	
GASKET		26 - 28	300#	SPRL-WND RF	TP304 SS WDG;GPH FLR;TP304 SS INR RNG;CS OTR RNG,ASME B16.20/B16.47 SR.B,	GSQN3QJ02	
STUD & NUTS							
STUD & 2NUTS HVY HEX		-			ASTM A193 GR.B7/ASTM A194 GR.2H,,	SNDE00000	
DRIP RING							
DRIP RING		3 - 3	300#	RF 125 AARH	CS ASTM A105,PDIL-PDS-600,	DR022QK02	
FITTING (BW)							
BRANCH WELD		2 - 28		BW	CARBON STEEL,ASME B31.3,	RWOJ11200	
BRANCH WELD WITH RP		2 - 28		BW	CARBON STEEL,ASME B31.3,	WBOJ11200	
CAP		2 - 28		BW	ASTM A234 WPB-SMLS,ASME B16.9,	CP7310900	
ELBOW		2 - 28		BW	ASTM A234 WPB-SMLS,ASME B16.9,	EL7310900	
REDUCER CONC.		2 - 28		BW	ASTM A234 WPB-SMLS,ASME B16.9,	RC7310900	
REDUCER ECC.		2 - 28		BW	ASTM A234 WPB-SMLS,ASME B16.9,	RE7310900	
TEE		2 - 28		BW	ASTM A234 WPB-SMLS,ASME B16.9,	TE7310900	
WELDOLET		2 - 28		BW	CS ASTM A105,MSS SP 97,	WL0213300	
FITTING (SW)							
CAP		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	CP0230207	W
COUPLING		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	CN0230207	
ELBOW		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	EL0230207	
HALF COUPLING		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	HF0230207	
SOCKOLET		1/2 - 28	3000#	SOCW	CS ASTM A105,MSS SP 97,	SL0233307	
TEE		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	TE0230207	
FITTING (THD)							
CAP		1/2 - 11/2	3000#	THD	CS ASTM A105,ASME B16.11,	CP0240207	T
PLUG		1/2 - 11/2		THD	CS ASTM A105,ASME B16.11,ROUND HEAD	PG0240200	
THREDOLET		1/2 - 28	3000#	THD	CS ASTM A105,MSS SP 97,	TL0243307	

PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER ,ODISHA.

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:0.

Class: D24

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)			INSPECTION CLASS
AG,AL,AW,FG,FN,HG,IAH,IAW,NG,NI,PA,PN,VS ETC.	Ref Sl	Ref Sl		

RATING ASME	CORROSION ALLOWANCE	MATERIAL	VALVE TRIM	STRESS RELIEF	
300# RF	1.5 MM(MIN)	CS			

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
NIPPLE							
NIPPLE		1/2 - 11/2	SCH160	PLN-PLN	SMLS,API 5L GR.B,ASME B36.10,	NPA151312	1
NIPPLE		1/2 - 11/2	SCH160	PLN-THD	SMLS,API 5L GR.B,ASME B36.10,NPT	NPA161312	2
NIPPLE		1/2 - 11/2	SCH160	THD	SMLS,API 5L GR.B,ASME B36.10,NPT	NPA141312	3
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 11/2		PE	ASTM A234 WPB-SMLS,MSS SP 95,	NC73J4500	P
SWAGE (CONC)		1/2 - 11/2		PLN-THD	ASTM A234 WPB-SMLS,MSS SP 95,	NC7364500	T
SWAGE (ECC)		1/2 - 11/2		PE	ASTM A234 WPB-SMLS,MSS SP 95,	NE73J4500	P
SWAGE (ECC)		1/2 - 11/2		PLN-THD	ASTM A234 WPB-SMLS,MSS SP 95,	NE7364500	T
VALVES							
GATE VALVE		2 - 24	300#	FLG	CS BODY ASTM A216 GR WCB,GAV211,	GAV211	
GATE VALVE		1/2 - 11/2	800#	SOCW	CS BODY ASTM A105,GAV201,	GAV201	
GLOBE VALVE		1/2 - 11/2	800#	SOCW	CS BODY ASTM A105,GLV201,	GLV201	
GLOBE VALVE		2 - 12	300#	FLG	CS BODY ASTM A216 GR WCB,GLV211,	GLV211	
CHECK VALVE		1/2 - 11/2	800#	SOCW	CS BODY ASTM A105,CHV201,	CHV201	
CHECK VALVE		2 - 24	300#	FLG	CS BODY ASTM A216 GR WCB,CHV211,	CHV211	
BALL VALVE		1/2 - 11/2	800#	SOCW	CS BODY ASTM A105,BAV202,	BAV202	
BALL VALVE		2 - 6	300#	FLG	CS BODY ASTM A216 GR WCB,BAV211,	BAV211	
BALL VALVE		8 - 24	300#	FLG	CS BODY ASTM A216 GR WCB,BAV221,	BAV221	
BUTTERFLY VALVE		3 - 24	300#	RF	CS BODY ASTM A216 GR WCB,BUV202,WAFER TYPE	BUV202	
PLUG VALVE		1/2 - 1	600#	THRD	CS BODY ASTM A105,PLV201,	PLV201	
PLUG VALVE		11/2 - 6	300#	FLG	CS BODY ASTM A216 GR WCB,PLV205,	PLV205	

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PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER ,ODISHA.

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:0.

Class: D50

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)			INSPECTION CLASS
AF,DM,MD,IA	Ref Sl	Ref Sl		

RATING ASME	CORROSION ALLOWANCE	MATERIAL	VALVE TRIM	STRESS RELIEF	
300# RF	NONE	SS 304			

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		14 - 14	SCHSTD	BE	EFW,STR.WELD,ASTM A312 TP304,ASME B36.10,	PPZ111300	
PIPE		16 - 18	SCH XS	BE	EFW,ASTM A358 GR.TP304 CL.2,ASME B36.10,	PP4111300	
PIPE		20 - 20	SCH XS	BE	EFW,ASTM A358 GR.TP304 CL.2,ASME B36.10,	PP4111300	
PIPE		24 - 24	SCH 40	BE	EFW,ASTM A358 GR.TP304 CL.2,ASME B36.10,	PP4111300	
PIPE		26 - 28	17.48 MM	BE	EFW,ASTM A358 GR.TP304 CL.2,ASME B36.10,	PP4111300	
PIPE		1/2 - 3/4	SCH40S	PE	SMLS,ASTM A312 TP304,ASME B36.19,	PPPE21400	
PIPE		1 - 11/4	SCH40S	PE	SMLS,ASTM A312 TP304,ASME B36.19,	PPPE21400	
PIPE		11/2 - 11/2	SCH40S	PE	SMLS,ASTM A312 TP304,ASME B36.19,	PPPE21400	
PIPE		2 - 4	SCH10S	BE	EFW,STR.WELD,ASTM A312 TP304,ASME B36.19,	PPZ111400	
PIPE		6 - 8	SCH40S	BE	EFW,STR.WELD,ASTM A312 TP304,ASME B36.19,	PPZ111400	
PIPE		10 - 12	SCH40S	BE	EFW,STR.WELD,ASTM A312 TP304,ASME B36.19,	PPZ111400	
FLANGE							
W.N.FLANGE		26 - 28	300#	WN-RF 125 AARH	ASTM A182 F304,ASME B16.47 SR.B,WELD NECK	WN0670702	
W.N.FLANGE		1/2 - 24	300#	WN-RF 125 AARH	ASTM A182 F304,ASME B16.5,WELD NECK	WN0670802	
SPACER AND BLIND		14 - 28	300#	RF 125 AARH	ASTM A182 F304,ASME B16.48,	RS062PO02	
SPECL BLIND		1/2 - 12	300#	RF 125 AARH	ASTM A182 F304,ASME B16.48,	SP062PO02	
BLIND FLANGE							
BLIND FLANGE		26 - 28	300#	RF 125 AARH	ASTM A182 F304,ASME B16.47 SR.B,	BF0620702	
BLIND FLANGE		1/2 - 28	300#	RF 125 AARH	ASTM A182 F304,ASME B16.5,	BF0620802	
GASKET							
GASKET		1/2 - 24	300#	SPRL-WND RF	TP304 SS WDG; GPH FLR; TP304 SS INR RNG/ OTR RNG,ASME B16.20,	GSQL30302	
GASKET		26 - 28	300#	SPRL-WND RF	TP304 SS WDG; GPH FLR; TP304 SS INR RNG/ OTR RNG,ASME B16.20/B16.47 SR.B,	GSQL3QJ02	
STUD & NUTS							
STUD & 2NUTS HVY HEX		-			ASTM A193 GR.B8T CL.2/ASTM A194 GR.8TA,,	SNQG00000	
DRIP RING							
DRIP RING		3 - 12	300#	RF 125 AARH	ASTM A182 F304,PDIL-PDS-600,	DR062QK02	
FITTING (BW)							
BRANCH WELD		2 - 28		BW	STAINLESS STEEL,ASME B31.3,	RWOK11200	
BRANCH WELD WITH RP		2 - 28		BW	STAINLESS STEEL,ASME B31.3,	WBOK11200	
CAP		2 - 24		BW	ASTM A403 WP304-SMLS,ASME B16.9,	CP7410900	
ELBOW		2 - 28		BW	ASTM A403 WP304-WLDD,ASME B16.9,	ELZ410900	L
ELBOW		2 - 28	19.05 MM	BW	ASTM A403 WP304-WLDD,PDIL-PDS-600,R=3D	ELZ41QK60	3
REDUCER CONC.		2 - 28		BW	ASTM A403 WP304-WLDD,ASME B16.9,	RCZ410900	
REDUCER ECC.		2 - 28		BW	ASTM A403 WP304-WLDD,ASME B16.9,	REZ410900	
TEE		2 - 28		BW	ASTM A403 WP304-WLDD,ASME B16.9,	TEZ410900	
WELDOLET		2 - 28		BW	ASTM A182 F304,MSS SP 97,	WL0613300	
FITTING (SW)							
CAP		1/2 - 11/2	3000#	SOCW	ASTM A182 F304,ASME B16.11,	CP0630207	W
COUPLING		1/2 - 11/2	3000#	SOCW	ASTM A182 F304,ASME B16.11,	CN0630207	
ELBOW		1/2 - 11/2	3000#	SOCW	ASTM A182 F304,ASME B16.11,	EL0630207	
HALF COUPLING		1/2 - 11/2	3000#	SOCW	ASTM A182 F304,ASME B16.11,	HF0630207	
SOCKOLET		1/2 - 28	3000#	SOCW	ASTM A182 F304,MSS SP 97,	SL0633307	
TEE		1/2 - 11/2	3000#	SOCW	ASTM A182 F304,ASME B16.11,	TE0630207	
FITTING (THD)							
CAP		1/2 - 11/2	3000#	THD	ASTM A182 F304,ASME B16.11,	CP0640207	T
PLUG		1/2 - 11/2		THD	ASTM A182 F304,ASME B16.11,ROUND HEAD	PG0640200	
THREDOLET		1/2 - 28	3000#	THD	ASTM A182 F304,MSS SP 97,	TL0643307	
NIPPLE							

PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER ,ODISHA.

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:0.

Class: D50

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)			INSPECTION CLASS
AF,DM,MD,IA	Ref Sl	Ref Sl		

RATING ASME	CORROSION ALLOWANCE	MATERIAL	VALVE TRIM	STRESS RELIEF	
300# RF	NONE	SS 304			

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
NIPPLE		1/2 - 11/2	SCH80S	PLN-PLN	SMLS,ASTM A312 TP304,ASME B36.19,	NPPE51413	1
NIPPLE		1/2 - 11/2	SCH80S	PLN-THD	SMLS,ASTM A312 TP304,ASME B36.19,NPT	NPPE61413	2
NIPPLE		1/2 - 11/2	SCH80S	THD	SMLS,ASTM A312 TP304,ASME B36.19,NPT	NPPE41413	3
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 11/2		PE	ASTM A403 WP304-SMLS,MSS SP 95,	NC74J4500	P
SWAGE (CONC)		1/2 - 11/2		PLN-THD	ASTM A403 WP304-SMLS,MSS SP 95,	NC7464500	T
SWAGE (ECC)		1/2 - 11/2		PE	ASTM A403 WP304-SMLS,MSS SP 95,	NE74J4500	P
SWAGE (ECC)		1/2 - 11/2		PLN-THD	ASTM A403 WP304-SMLS,MSS SP 95,	NE7464500	T
VALVES							
GATE VALVE		1/2 - 1	800#	SOCW	SS BODY ASTM A182 GR F304,GAV501,	GAV501	
GATE VALVE		11/2 - 11/2	800#	SOCW	SS BODY ASTM A182 GR F304,GAV501,	GAV501	W
GATE VALVE		11/2 - 11/2	300#	FLG	SS BODY ASTM A351 GR CF8M,GAV511,	GAV511	F
GATE VALVE		2 - 24	300#	FLG	SS BODY ASTM A351 GR CF8M,GAV511,	GAV511	
GLOBE VALVE		1/2 - 11/2	800#	SOCW	SS BODY ASTM A182 GR F304,GLV501,	GLV501	
GLOBE VALVE		2 - 12	300#	FLG	SS BODY ASTM A351 GR CF8M,GLV511,	GLV511	
CHECK VALVE		1/2 - 11/2	800#	SOCW	SS BODY ASTM A182 GR F304,CHV501,	CHV501	
CHECK VALVE		2 - 24	300#	FLG	SS BODY ASTM A351 GR CF8M,CHV511,	CHV511	
BALL VALVE		1/2 - 11/2	800#	THRD	SS BODY AISI 316,BAV501,	BAV501	
BALL VALVE		8 - 24	300#	FLG	SS BODY ASTM A351 GR CF8M,BAV521,	BAV521	
PLUG VALVE		1/2 - 1	600#	THRD	SS BODY AISI 316,PLV501,	PLV501	
PLUG VALVE		11/2 - 6	300#	FLG	SS BODY ASTM A351 GR CF8M,PLV511,	PLV511	

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PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER,ODISHA

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:1

Class: D52

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)				
UL	Ref.SI	Ref.SI			
RATING ASME	CORROSION ALLOWANCE	MATERIAL			
300# RF	NONE	SS 316L			

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL	REV
PIPE								
PIPE		1/2 - 3/4	SCH40S	PE	SS,SMLS,ASTM A312 TP316L,ASME B36.19,	PP9121400		0
PIPE		1 - 11/2	SCH40S	PE	SS,SMLS,ASTM A312 TP316L,ASME B36.19,	PP9121400		0
PIPE		2 - 2	SCH10S	PE	SS,SMLS,ASTM A312 TP316L,ASME B36.19,	PP9121400		0
PIPE		3 - 4	SCH10S	BE	SS,SMLS,ASTM A312 TP316L,ASME B36.19,	PP9111400		0
PIPE		6 - 6	SCH10S	BE	SS,SMLS,ASTM A312 TP316L,ASME B36.19,	PP9111400		0
PIPE		8 - 10	SCH10S	BE	SS,EFW,ASTM A358 TP316L CL.5,ASME B36.19,	PP9211400		0
PIPE		12 - 14	SCH10S	BE	SS,EFW,ASTM A358 TP316L CL.5,ASME B36.19,	PP9211400		0
PIPE		16 - 18	SCH10S	BE	SS,EFW,ASTM A358 TP316L CL.5,ASME B36.19,	PP9211400		0
FLANGE								
FLANGE		1/2 - 11/2	300#	SW-RF 125 AARH	SS,ASTM A182 F316L,ASME B16.5,SOCKET WELD	FL88L0802		0
W.N.FLANGE		2 - 18	300#	WN-RF 125 AARH	SS,ASTM A182 F316L,ASME B16.5,WELD NECK	WN8870802		0
SPACER AND BLIND		18 - 18	300#	RF 125 AARH	ASTM A240 TP316L,ASME B16.48,	RS932PO02		0
SPECL BLIND		1/2 - 16	300#	RF 125 AARH	ASTM A240 TP316L,ASME B16.48,	SP932PO02		0
BLIND FLANGE								
BLIND FLANGE		1/2 - 18	300#	RF 125 AARH	SS,ASTM A182 F316L,ASME B16.5,	BF8820802		0
GASKET								
GASKET		1/2 - 18	300#	SPRL-WND RF	GASKET,TP316L SS WDG;GPH FLR;TP316L SS INR RNG/ OTR RNG,ASME B16.20,	GS0830302		0
STUD & NUTS								
STUD & 2NUTS HVY HEX		-			ASTM A193 GR.B7/ASTM A194 GR.2H,,	SNDE00000		0
FITTING (BW)								
CAP		3 - 18		BW	SS,ASTM A403 WP316L-SMLS,ASME B16.9,	CP8910900		0
ELBOW		3 - 6		BW	SS,ASTM A403 WP316L-SMLS,ASME B16.9,	EL8910900		0
ELBOW		8 - 18		BW	SS,ASTM A403 WP316L-WLDD,ASME B16.9,	EL9010900		0
REDUCER CONC.		3 - 6		BW	SS,ASTM A403 WP316L-SMLS,ASME B16.9,	RC8910900		0
REDUCER CONC.		8 - 18		BW	SS,ASTM A403 WP316L-WLDD,ASME B16.9,	RC9010900		0
REDUCER ECC.		3 - 6		BW	SS,ASTM A403 WP316L-SMLS,ASME B16.9,	RE8910900		0
REDUCER ECC.		8 - 18		BW	SS,ASTM A403 WP316L-WLDD,ASME B16.9,	RE9010900		0
TEE		3 - 6		BW	SS,ASTM A403 WP316L-SMLS,ASME B16.9,	TE8910900		0
TEE		8 - 18		BW	SS,ASTM A403 WP316L-WLDD,ASME B16.9,	TE9010900		0
WELDOLET		2 - 18		BW	SS,ASTM A182 F316L,MSS SP 97,	WL8813300		0
FITTING (SW)								
CAP		1/2 - 2	3000#	SOCW	SS,ASTM A182 F316L,ASME B16.11,	CP8830207		0
COUPLING		1/2 - 2	3000#	SOCW	SS,ASTM A182 F316L,ASME B16.11,	CN8830207	W	0
ELBOW		1/2 - 2	3000#	SOCW	SS,ASTM A182 F316L,ASME B16.11,	EL8830207		0
HALF COUPLING		1/2 - 11/2	3000#	SOCW	SS,ASTM A182 F316L,ASME B16.11,	HF8830207	W	0
SOCKOLET		1/2 - 18	3000#	SOCW	SS,ASTM A182 F316L,MSS SP 97,	SL8833307		0
TEE		1/2 - 2	3000#	SOCW	SS,ASTM A182 F316L,ASME B16.11,	TE8830207		0
FITTING (THD)								
COUPLING		1/2 - 2	3000#	THD	SS,ASTM A182 F316L,ASME B16.11,	CN8840207	T	0
ELBOLET		1/2 - 18	3000#	THD	SS,ASTM A182 F316L,MSS SP 97,	ET8843307		0
HALF COUPLING		1/2 - 11/2	3000#	THD	SS,ASTM A182 F316L,ASME B16.11,	HF8840207	T	0
PLUG		1/2 - 2		THD	SS,ASTM A182 F316L,ASME B16.11,ROUND HEAD	PG8840200		0
THREDOLET		1/2 - 18	3000#	THD	SS,ASTM A182 F316L,MSS SP 97,	TL8843307		0
NIPPLE								
NIPPLE		1/2 - 2	SCH80S	PLN-PLN	SS,SMLS,ASTM A312 TP316L,ASME B36.19,	NP9151413	1	0
NIPPLE		1/2 - 2	SCH80S	PLN-THD	SS,SMLS,ASTM A312 TP316L,ASME B36.19,	NP9161413	2	0
NIPPLE		1/2 - 2	SCH80S	THD	SS,SMLS,ASTM A312 TP316L,ASME B36.19,	NP9141413	3	0
SWAGE NIPPLE								
SWAGE (CONC)		1/2 - 2		PE	SS,ASTM A182 F316L,MSS SP 95,	NC88J4500		0

PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER,ODISHA

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:1

Class: D52

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)				
UL	Ref.SI	Ref.SI			
RATING ASME	CORROSION ALLOWANCE	MATERIAL			
300# RF	NONE	SS 316L			

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
SWAGE (ECC)		1/2 - 2		PE	SS,ASTM A182 F316L,MSS SP 95,	NE88J4500	0
VALVES							
GATE VALVE		1/2 - 11/2	800#	SOCW	SS BODY AISI 316L,GAV401,	GAV401	0
GATE VALVE		2 - 6	300#	FLG	SS BODY ASTM A351 GR CF3M,GAV411,	GAV411	0
GLOBE VALVE		1/2 - 11/2	800#	SOCW	SS BODY AISI 316L,GLV401,	GLV401	0
GLOBE VALVE		2 - 6	300#	FLG	SS BODY ASTM A351 GR CF3M,GLV411,	GLV411	0
CHECK VALVE		1/2 - 11/2	800#	SOCW	SS BODY AISI 316L,CHV401,	CHV401	0
CHECK VALVE		2 - 12	300#	FLG	SS BODY ASTM A351 GR CF3M,CHV411,	CHV411	0
BUTTERFLY VALVE		6 - 18	300#	RF	SS BODY ASTM A351 GR CF3M,BUV411,WAFER TYPE	BUV411	0

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PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER ,ODISHA.

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:0.

Class: F24

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)			INSPECTION CLASS
AW,HG,NG,PA,PC,PN,SG,VS	Ref Sl	Ref Sl		

RATING ASME	CORROSION ALLOWANCE	MATERIAL	VALVE TRIM	STRESS RELIEF	
600# RF	1.5 MM(MIN.)	CS			

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		2 - 3	SCH 40	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		4 - 5	SCH 80	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		6 - 8	SCH 80	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		10 - 12	SCH 80	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		14 - 16	SCH 80	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		18 - 20	SCH 80	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		22 - 24	SCH 80	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		1/2 - 3/4	SCH 80	PE	SMLS,API 5L GR.B,ASME B36.10,	PPA121300	
PIPE		1 - 11/4	SCH 80	PE	SMLS,API 5L GR.B,ASME B36.10,	PPA121300	
PIPE		11/2 - 11/2	SCH 80	PE	SMLS,API 5L GR.B,ASME B36.10,	PPA121300	
FLANGE							
LONG W.N.FLANGE		11/2 - 11/2	600#	WN-RF 125 AARH	CS ASTM A105,ASME B16.5,38mmBORE,200mmLONG	LN0270803	
W.N.FLANGE		1/2 - 24	600#	WN-RF 125 AARH	CS ASTM A105,ASME B16.5,WELD NECK	WN0270803	
SPACER AND BLIND		10 - 24	600#	RF 125 AARH	CS ASTM A105,ASME B16.48,	RS022PO03	
SPECL BLIND		1/2 - 8	600#	RF 125 AARH	CS ASTM A105,ASME B16.48,	SP022PO03	
BLIND FLANGE							
BLIND FLANGE		1/2 - 24	600#	RF 125 AARH	CS ASTM A105,ASME B16.5,	BF0220803	
GASKET							
GASKET		1/2 - 24	600#	SPRL-WND RF	TP304 SS WDG;GPH FLR;TP304 SS INR RNG;CS OTR RNG,ASME B16.20,	GSQN30303	
STUD & NUTS							
STUD & 2NUTS HVY HEX		-			ASTM A193 GR.B7/ASTM A194 GR.2H,,	SNDE00000	
FITTING (BW)							
BRANCH WELD		2 - 24		BW	CARBON STEEL,ASME B31.3,	RWOJ11200	
BRANCH WELD WITH RP		2 - 24		BW	CARBON STEEL,ASME B31.3,	WBOJ11200	
CAP		2 - 24		BW	ASTM A234 WPB-SMLS,ASME B16.9,	CP7310900	
ELBOW		2 - 24		BW	ASTM A234 WPB-SMLS,ASME B16.9,	EL7310900	
REDUCER CONC.		2 - 24		BW	ASTM A234 WPB-SMLS,ASME B16.9,	RC7310900	
REDUCER ECC.		2 - 24		BW	ASTM A234 WPB-SMLS,ASME B16.9,	RE7310900	
TEE		2 - 24		BW	ASTM A234 WPB-SMLS,ASME B16.9,	TE7310900	
WELDOLET		2 - 24		BW	CS ASTM A105,MSS SP 97,	WL0213300	
FITTING (SW)							
CAP		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	CP0230207	W
COUPLING		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	CN0230207	
ELBOW		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	EL0230207	
HALF COUPLING		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	HF0230207	
SOCKOLET		1/2 - 24	3000#	SOCW	CS ASTM A105,MSS SP 97,	SL0233307	
TEE		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	TE0230207	
FITTING (THD)							
CAP		1/2 - 11/2	3000#	THD	CS ASTM A105,ASME B16.11,	CP0240207	T
PLUG		1/2 - 11/2		THD	CS ASTM A105,ASME B16.11,ROUND HEAD	PG0240200	
THREDOLET		1/2 - 24	3000#	THD	CS ASTM A105,MSS SP 97,	TL0243307	
NIPPLE							
NIPPLE		1/2 - 11/2	SCH160	PLN-PLN	SMLS,API 5L GR.B,ASME B36.10,	NPA151312	1
NIPPLE		1/2 - 11/2	SCH160	PLN-THD	SMLS,API 5L GR.B,ASME B36.10,NPT	NPA161312	2
NIPPLE		1/2 - 11/2	SCH160	THD	SMLS,API 5L GR.B,ASME B36.10,NPT	NPA141312	3
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 11/2		PE	ASTM A234 WPB-SMLS,MSS SP 95,	NC73J4500	P
SWAGE (CONC)		1/2 - 11/2		PLN-THD	ASTM A234 WPB-SMLS,MSS SP 95,	NC7364500	T
SWAGE (ECC)		1/2 - 11/2		PE	ASTM A234 WPB-SMLS,MSS SP 95,	NE73J4500	P

PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER ,ODISHA.

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:0.

Class: F24

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)			INSPECTION CLASS
AW,HG,NG,PA,PC,PN,SG,VS	Ref Sl	Ref Sl		

RATING ASME	CORROSION ALLOWANCE	MATERIAL	VALVE TRIM	STRESS RELIEF	
600# RF	1.5 MM(MIN.)	CS			

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
SWAGE (ECC)		1/2 - 11/2		PLN-THD	ASTM A234 WPB-SMLS,MSS SP 95,	NE7364500	T
VALVES							
GATE VALVE		11/2 - 11/2	600#	FLG	CS BODY ASTM A216 GR WCB,GAV212,	GAV212	F
GATE VALVE		2 - 24	600#	FLG	CS BODY ASTM A216 GR WCB,GAV212,	GAV212	
GATE VALVE		1/2 - 1	800#	SOCW	CS BODY ASTM A105,GAV201,	GAV201	
GATE VALVE		11/2 - 11/2	800#	SOCW	CS BODY ASTM A105,GAV201,	GAV201	W
GLOBE VALVE		1/2 - 11/2	800#	SOCW	CS BODY ASTM A105,GLV201,	GLV201	
GLOBE VALVE		2 - 8	600#	FLG	CS BODY ASTM A216 GR WCB,GLV212,	GLV212	
CHECK VALVE		1/2 - 11/2	800#	SOCW	CS BODY ASTM A105,CHV201,	CHV201	
CHECK VALVE		2 - 16	600#	FLG	CS BODY ASTM A216 GR WCB,CHV212,	CHV212	
BALL VALVE		4 - 24	600#	FLG	CS BODY ASTM A216 GR WCB,BAV222,	BAV222	
NEEDLE VALVE		1/2 - 1/2	800#	SOCW	SS BODY ASTM A182 GR F316,NEV501,	NEV501	

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PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER,ODISHA

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:0

Class: F24S

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)	
BB,BF,MS,SC (IBR)	Ref Sl	Ref Sl

RATING ASME	CORROSION ALLOWANCE	MATERIAL
600# RF	1.5 MM(MIN.)	CS

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		2 - 6	SCH 40	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		8 - 10	SCH 60	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		12 - 14	SCH 60	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		16 - 18	SCH 60	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		20 - 22	SCH 60	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		24 - 24	SCH 60	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		1/2 - 3/4	SCH 80	PE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03B1300	
PIPE		1 - 11/4	SCH 80	PE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03B1300	
PIPE		11/2 - 11/2	SCH 80	PE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03B1300	
FLANGE							
LONG W.N.FLANGE		11/2 - 11/2	600#	WN-RF 125 AARH IBR	CS ASTM A105,ASME B16.5,38mmBORE,200mmLONG	LN02G0803	
W.N.FLANGE		1/2 - 24	600#	WN-RF 125 AARH IBR	CS ASTM A105,ASME B16.5,WELD NECK	WN02G0803	D
W.N.FLANGE		1/2 - 24	600#	WN-RJ IBR	CS ASTM A105,ASME B16.5,WELD NECK	WN02W0803	R
SPACER AND BLIND		10 - 24	600#	RF 125 AARH IBR	CS ASTM A105,ASME B16.48,	RS02BPO03	
SPECL BLIND		1/2 - 8	600#	RF 125 AARH IBR	CS ASTM A105,ASME B16.48,	SP02BPO03	
BLIND FLANGE							
BLIND FLANGE		1/2 - 24	600#	RF 125 AARH IBR	CS ASTM A105,ASME B16.5,	BF02B0803	
GASKET							
GASKET		1/2 - 24	600#	SPRL-WND RF	TP304 SS WDG;GPH FLR;TP304 SS INR RNG;CS OTR RNG,ASME B16.20,	GSQN30303	
STUD & NUTS							
STUD & 2NUTS HVY HEX		-			ASTM A193 GR.B7/ASTM A194 GR.2H,,	SNDE00000	
FITTING (BW)							
BRANCH WELD		2 - 24		BW IBR	CARBON STEEL,ASME B31.3,	RWOJA1200	
BRANCH WELD WITH RP		2 - 24		BW IBR	CARBON STEEL,ASME B31.3,	WBOJA1200	
CAP		2 - 24		BW IBR	ASTM A234 WPB-SMLS,ASME B16.9,	CP73A0900	
ELBOW		2 - 24		BW IBR	ASTM A234 WPB-SMLS,ASME B16.9,	EL73A0900	
REDUCER CONC.		2 - 24		BW IBR	ASTM A234 WPB-SMLS,ASME B16.9,	RC73A0900	
REDUCER ECC.		2 - 24		BW IBR	ASTM A234 WPB-SMLS,ASME B16.9,	RE73A0900	
TEE		2 - 24		BW IBR	ASTM A234 WPB-SMLS,ASME B16.9,	TE73A0900	
WELDOLET		2 - 24		BW IBR	CS ASTM A105,MSS SP 97,	WL02A3300	
FITTING (SW)							
CAP		1/2 - 11/2	3000#	SOCW IBR	CS ASTM A105,ASME B16.11,	CP02C0207	W
COUPLING		1/2 - 11/2	3000#	SOCW IBR	CS ASTM A105,ASME B16.11,	CN02C0207	
ELBOW		1/2 - 11/2	3000#	SOCW IBR	CS ASTM A105,ASME B16.11,	EL02C0207	
HALF COUPLING		1/2 - 11/2	3000#	SOCW IBR	CS ASTM A105,ASME B16.11,	HF02C0207	
SOCKOLET		1/2 - 24	3000#	SOCW IBR	CS ASTM A105,MSS SP 97,	SL02C3307	
TEE		1/2 - 11/2	3000#	SOCW IBR	CS ASTM A105,ASME B16.11,	TE02C0207	
FITTING (THD)							
CAP		1/2 - 11/2	3000#	THD IBR	CS ASTM A105,ASME B16.11,	CP02D0207	T
PLUG		1/2 - 11/2		THD IBR	CS ASTM A105,ASME B16.11,ROUND HEAD	PG02D0200	
THREDOLET		1/2 - 24	3000#	THD IBR	CS ASTM A105,MSS SP 97,	TL02D3307	
NIPPLE							
NIPPLE		1/2 - 11/2	SCH160	PLN-PLN IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	NP03E1312	1
NIPPLE		1/2 - 11/2	SCH160	PLN-THD IBR	SMLS,ASTM A106 GR.B,ASME B36.10,NPT	NP03F1312	2
NIPPLE		1/2 - 11/2	SCH160	THD IBR	SMLS,ASTM A106 GR.B,ASME B36.10,NPT	NP03D1312	3
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 11/2		PE IBR	ASTM A234 WPB-SMLS,MSS SP 95,	NC73Q4500	P

PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER,ODISHA

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:0

Class: F24S

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)				
BB,BF,MS,SC (IBR)	Ref SI	Ref SI			
RATING ASME	CORROSION ALLOWANCE	MATERIAL			
600# RF	1.5 MM(MIN.)	CS			

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
SWAGE (CONC)		1/2 - 11/2		PLN-THD IBR	ASTM A234 WPB-SMLS,MSS SP 95,	NC73F4500	T
SWAGE (ECC)		1/2 - 11/2		PE IBR	ASTM A234 WPB-SMLS,MSS SP 95,	NE73Q4500	P
SWAGE (ECC)		1/2 - 11/2		PLN-THD IBR	ASTM A234 WPB-SMLS,MSS SP 95,	NE73F4500	T
VALVES							
GATE VALVE		1/2 - 1	800#	SOCW IBR	CS BODY ASTM A105,GAV202S,	GAV202S	
GATE VALVE		11/2 - 11/2	800#	SOCW IBR	CS BODY ASTM A105,GAV202S,	GAV202S	W
GATE VALVE		11/2 - 11/2	600#	FLG IBR	CS BODY ASTM A216 GR WCB,GAV212S,	GAV212S	F
GATE VALVE		2 - 24	600#	FLG IBR	CS BODY ASTM A216 GR WCB,GAV212S,	GAV212S	
GLOBE VALVE		1/2 - 11/2	800#	SOCW IBR	CS BODY ASTM A105,GLV201S,	GLV201S	
GLOBE VALVE		2 - 12	600#	FLG IBR	CS BODY ASTM A216 GR WCB,GLV212S,	GLV212S	
CHECK VALVE		1/2 - 11/2	800#	SOCW IBR	CS BODY ASTM A105,CHV201S,	CHV201S	
CHECK VALVE		2 - 16	600#	FLG IBR	CS BODY ASTM A216 GR WCB,CHV212S,	CHV212S	
NEEDLE VALVE		1/2 - 1/2	800#	SOCW IBR	SS BODY ASTM A182 GR F316,NEV501S,	NEV501S	

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PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER,ODISHA

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:0

Class: H24S

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)				
BB,BF,HS,SC (IBR)	Ref SI	Ref SI			
RATING ASME	CORROSION ALLOWANCE	MATERIAL			
1500# RJ	1.5 MM(MIN.)	CS			

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		1/2 - 3/4	SCH160	PE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03B1300	
PIPE		1 - 11/4	SCH160	PE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03B1300	
PIPE		11/2 - 11/2	SCH160	PE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03B1300	
PIPE		2 - 3	SCH160	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		4 - 5	SCH120	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		6 - 8	SCH120	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		10 - 12	SCH140	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		14 - 16	SCH140	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		18 - 20	SCH140	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		22 - 24	SCH140	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
FLANGE							
LONG W.N.FLANGE		11/2 - 11/2	1500#	WN-RJ IBR	CS ASTM A105,ASME B16.5,38mmBORE,200mmLONG	LN02W0805	
W.N.FLANGE		1/2 - 24	1500#	WN-RJ IBR	CS ASTM A105,ASME B16.5,WELD NECK	WN02W0805	
SPACER AND BLIND		8 - 24	1500#	WN-RJ IBR	CS ASTM A105,ASME B16.48,	RS02WPO05	
SPECL BLIND		1/2 - 6	1500#	WN-RJ IBR	CS ASTM A105,ASME B16.48,	SP02WPO05	
BLIND FLANGE							
BLIND FLANGE		1/2 - 24	1500#	WN-RJ IBR	CS ASTM A105,ASME B16.5,	BF02W0805	
GASKET							
GASKET		1/2 - 24	1500#	RJ OCT	SOFT IRON,ASME B16.20,	GS7940305	
STUD & NUTS							
STUD & 2NUTS HVY HEX		-			ASTM A193 GR.B7/ASTM A194 GR.2H,,	SNDE00000	
FITTING (BW)							
BRANCH WELD		2 - 24		BW IBR	CARBON STEEL,ASME B31.3,	RWOJA1200	
BRANCH WELD WITH RP		2 - 24		BW IBR	CARBON STEEL,ASME B31.3,	WBOJA1200	
CAP		2 - 24		BW IBR	ASTM A234 WPB-SMLS,ASME B16.9,	CP73A0900	
ELBOW		2 - 24		BW IBR	ASTM A234 WPB-SMLS,ASME B16.9,	EL73A0900	
REDUCER CONC.		2 - 24		BW IBR	ASTM A234 WPB-SMLS,ASME B16.9,	RC73A0900	
REDUCER ECC.		2 - 24		BW IBR	ASTM A234 WPB-SMLS,ASME B16.9,	RE73A0900	
TEE		2 - 24		BW IBR	ASTM A234 WPB-SMLS,ASME B16.9,	TE73A0900	
WELDOLET		2 - 24		BW IBR	CS ASTM A105,MSS SP 97,	WL02A3300	
FITTING (SW)							
CAP		1/2 - 11/2	6000#	SOCW IBR	CS ASTM A105,ASME B16.11,	CP02C0208	W
COUPLING		1/2 - 11/2	6000#	SOCW IBR	CS ASTM A105,ASME B16.11,	CN02C0208	
ELBOW		1/2 - 11/2	6000#	SOCW IBR	CS ASTM A105,ASME B16.11,	EL02C0208	
HALF COUPLING		1/2 - 11/2	6000#	SOCW IBR	CS ASTM A105,ASME B16.11,	HF02C0208	
SOCKOLET		1/2 - 24	6000#	SOCW IBR	CS ASTM A105,MSS SP 97,	SL02C3308	
TEE		1/2 - 11/2	6000#	SOCW IBR	CS ASTM A105,ASME B16.11,	TE02C0208	
FITTING (THD)							
CAP		1/2 - 11/2	6000#	THD IBR	CS ASTM A105,ASME B16.11,	CP02D0208	T
PLUG		1/2 - 11/2		THD IBR	CS ASTM A105,ASME B16.11,ROUND HEAD	PG02D0200	
THREDOLET		1/2 - 11/2	6000#	THD IBR	CS ASTM A105,MSS SP 97,	TL02D3308	
NIPPLE							
NIPPLE		1/2 - 11/2	SCHXXS	PLN-PLN IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	NP03E1314	1
NIPPLE		1/2 - 11/2	SCHXXS	PLN-THD IBR	SMLS,ASTM A106 GR.B,ASME B36.10,NPT	NP03F1314	2
NIPPLE		1/2 - 11/2	SCHXXS	THD IBR	SMLS,ASTM A106 GR.B,ASME B36.10,NPT	NP03D1314	3
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 11/2		PE IBR	ASTM A234 WPB-SMLS,MSS SP 95,	NC73Q4500	P
SWAGE (CONC)		1/2 - 11/2		PLN-THD IBR	ASTM A234 WPB-SMLS,MSS SP 95,	NC73F4500	T
SWAGE (ECC)		1/2 - 11/2		PE IBR	ASTM A234 WPB-SMLS,MSS SP 95,	NE73Q4500	P

PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER,ODISHA

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:0

Class: H24S

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)				
BB,BF,HS,SC (IBR)	Ref SI	Ref SI			
RATING ASME	CORROSION ALLOWANCE	MATERIAL			
1500# RJ	1.5 MM(MIN.)	CS			

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
SWAGE (ECC)		1/2 - 11/2		PLN-THD IBR	ASTM A234 WPB-SMLS,MSS SP 95,	NE73F4500	T
VALVES							
GATE VALVE		1/2 - 1	1500#	SOCW IBR	CS BODY ASTM A105,GAV204S,	GAV204S	
GATE VALVE		11/2 - 24	1500#	BW IBR	CS BODY ASTM A216 GR WCB,GAV216S,	GAV216S	
GLOBE VALVE		1/2 - 1	1500#	SOCW IBR	CS BODY ASTM A105,GLV204S,	GLV204S	
GLOBE VALVE		11/2 - 8	1500#	BW IBR	CS BODY ASTM A216 GR WCB,GLV216S,	GLV216S	
CHECK VALVE		1/2 - 1	1500#	SOCW IBR	CS BODY ASTM A105,CHV204S,	CHV204S	
CHECK VALVE		11/2 - 24	1500#	BW IBR	CS BODY ASTM A216 GR WCB,CHV216S,	CHV216S	
NEEDLE VALVE		1/2 - 1/2	1500#	SOCW IBR	SS BODY ASTM A182 GR F316,NEV502S,	NEV502S	

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PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER,ODISHA

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:0

Class: J36S

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)				
HS,SC (IBR)	Ref.SI	Ref.SI			
RATING ASME	CORROSION ALLOWANCE	MATERIAL			
2500#RJ	1.5 MM(MIN.)	AS			

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		1/2 - 3/4	SCHXXS	PE IBR	SMLS,ASTM A335 GR.P22,ASME B36.10,	PP34B1300	
PIPE		1 - 11/4	SCHXXS	PE IBR	SMLS,ASTM A335 GR.P22,ASME B36.10,	PP34B1300	
PIPE		11/2 - 11/2	SCHXXS	PE IBR	SMLS,ASTM A335 GR.P22,ASME B36.10,	PP34B1300	
PIPE		2 - 4	SCHXXS	BE IBR	SMLS,ASTM A335 GR.P22,ASME B36.10,	PP34A1300	
PIPE		6 - 6	24.00 MM	BE IBR	SMLS,ASTM A335 GR.P22,ASME B36.10,	PP34A1300	
PIPE		8 - 8	30.00 MM	BE IBR	SMLS,ASTM A335 GR.P22,ASME B36.10,	PP34A1300	
PIPE		10 - 10	38.00 MM	BE IBR	SMLS,ASTM A335 GR.P22,ASME B36.10,	PP34A1300	
PIPE		12 - 12	44.00 MM	BE IBR	SMLS,ASTM A335 GR.P22,ASME B36.10,	PP34A1300	
PIPE		14 - 14	48.00 MM	BE IBR	SMLS,ASTM A335 GR.P22,ASME B36.10,	PP34A1300	
PIPE		16 - 16	55.00 MM	BE IBR	SMLS,ASTM A335 GR.P22,ASME B36.10,	PP34A1300	
PIPE		18 - 18	62.00 MM	BE IBR	SMLS,ASTM A335 GR.P22,ASME B36.10,	PP34A1300	
PIPE		20 - 20	68.00 MM	BE IBR	SMLS,ASTM A335 GR.P22,ASME B36.10,	PP34A1300	
FLANGE							
LONG W.N.FLANGE		1/2 - 11/2	2500#	WN-RJ IBR	ASTM A182 F22,ASME B16.5,LONG WELD NECK	LN05W0806	
W.N.FLANGE		1/2 - 12	2500#	WN-RJ IBR	ASTM A182 F22,ASME B16.5,WELD NECK	WN05W0806	
SPACER AND BLIND		6 - 12	2500#	WN-RJ IBR	ASTM A182 F22,ASME B16.48,	RS05WPO06	
SPECL BLIND		1 - 4	2500#	WN-RJ IBR	ASTM A182 F22,ASME B16.48,	SP05WPO06	
BLIND FLANGE							
BLIND FLANGE		1/2 - 12	2500#	WN-RJ IBR	ASTM A182 F22,ASME B16.5,	BF05W0806	
GASKET							
GASKET		1/2 - 12	2500#	RJ OCT	ASTM A182 F5,ASME B16.20,	GSB340306	
STUD & NUTS							
STUD & 2NUTS HVY HEX		-			ASTM A193 GR.B16/ASTM A194 GR.4,,	SNB100000	
FITTING (BW)							
BRANCH WELD		2 - 20		BW IBR	ALLOY STEEL,ASME B31.3,	RWE3A1200	
BRANCH WELD WITH RP		2 - 20		BW IBR	ALLOY STEEL,ASME B31.3,	WBE3A1200	
CAP		2 - 20		BW IBR	ASTM A234 WP22,ASME B16.9,	CPD2A0900	
ELBOW		2 - 20		BW IBR	ASTM A234 WP22,ASME B16.9,	ELD2A0900	
REDUCER CONC.		2 - 20		BW IBR	ASTM A234 WP22,ASME B16.9,	RCD2A0900	
REDUCER ECC.		2 - 20		BW IBR	ASTM A234 WP22,ASME B16.9,	RED2A0900	
TEE		2 - 20		BW IBR	ASTM A234 WP22,ASME B16.9,	TED2A0900	
WELDOLET		2 - 20		BW IBR	ASTM A182 F22,MSS SP 97,	WL05A3300	
FITTING (SW)							
CAP		1/2 - 11/2	9000#	SOCW IBR	ASTM A182 F22,ASME B16.11,	CP05C0209	W
COUPLING		1/2 - 11/2	9000#	SOCW IBR	ASTM A182 F22,ASME B16.11,	CN05C0209	
ELBOW		1/2 - 11/2	9000#	SOCW IBR	ASTM A182 F22,ASME B16.11,	EL05C0209	
HALF COUPLING		1/2 - 11/2	9000#	SOCW IBR	ASTM A182 F22,ASME B16.11,	HF05C0209	
SOCKOLET		1/2 - 20	6000#	SOCW IBR	ASTM A182 F22,MSS SP 97,	SL05C3308	
TEE		1/2 - 11/2	9000#	SOCW IBR	ASTM A182 F22,ASME B16.11,	TE05C0209	
FITTING (THD)							
CAP		1/2 - 11/2	6000#	THD IBR	ASTM A182 F22,ASME B16.11,	CP05D0208	T
PLUG		1/2 - 11/2		THD IBR	ASTM A182 F22,ASME B16.11,ROUND HEAD	PG05D0200	
THREDOLET		1/2 - 20	6000#	THD IBR	ASTM A182 F22,MSS SP 97,	TL05D3308	
NIPPLE							
NIPPLE		1/2 - 11/2	SCHXXS	PLN-PLN IBR	SMLS,ASTM A335 GR.P22,ASME B36.10,	NP34E1314	1
NIPPLE		1/2 - 11/2	SCHXXS	PLN-THD IBR	SMLS,ASTM A335 GR.P22,ASME B36.10,NPT	NP34F1314	2
NIPPLE		1/2 - 11/2	SCHXXS	THD IBR	SMLS,ASTM A335 GR.P22,ASME B36.10,NPT	NP34D1314	3
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 11/2		PE IBR	ASTM A234 WP22,MSS SP 95,	NCD2Q4500	P

PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER,ODISHA

Project .:TFL
DOC. No.TFL-PDS-600
Rev.:0

Class: J36S

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE	TEMPERATURE LIMITS (Deg.C)			
HS,SC (IBR)	Ref.SI	Ref.SI		

RATING ASME	CORROSION ALLOWANCE	MATERIAL			
2500#RJ	1.5 MM(MIN.)	AS			

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
SWAGE (CONC)		1/2 - 11/2		PLN-THD IBR	ASTM A234 WP22,MSS SP 95,	NCD2F4500	T
SWAGE (ECC)		1/2 - 11/2		PE IBR	ASTM A234 WP22,MSS SP 95,	NED2Q4500	P
SWAGE (ECC)		1/2 - 11/2		PLN-THD IBR	ASTM A234 WP22,MSS SP 95,	NED2F4500	T
VALVES							
GATE VALVE		1/2 - 1	2500#	SOCW IBR	CR-MO BODY ASTM A182 GR F22,GAV305S,	GAV305S	
GATE VALVE		11/2 - 11/2	2500#	SOCW IBR	CR-MO BODY ASTM A182 GR F22,GAV305S,	GAV305S	W
GATE VALVE		11/2 - 11/2	2500#	BW IBR	CR-MO BODY ASTM A217 GR WC9,GAV326S,	GAV326S	B
GATE VALVE		2 - 16	2500#	BW IBR	CR-MO BODY ASTM A217 GR WC9,GAV326S,	GAV326S	
GLOBE VALVE		1/2 - 11/2	2500#	SOCW IBR	CR-MO BODY ASTM A182 GR F22,GLV305S,	GLV305S	
GLOBE VALVE		2 - 8	2500#	BW IBR	CR-MO BODY ASTM A217 GR WC9,GLV326S,	GLV326S	
CHECK VALVE		1/2 - 11/2	2500#	SOCW IBR	CR-MO BODY ASTM A182 GR F22,CHV305S,	CHV305S	
CHECK VALVE		2 - 18	2500#	BW IBR	CR-MO BODY ASTM A217 GR WC9,CHV326S,	CHV326S	
NEEDLE VALVE		1/2 - 1/2	2500#	SOCW IBR	SS BODY ASTM A182 GR F316,NEV503S,	NEV503S	

:

BRANCH TABLE : TABLE-A1
APPLICABLE PIPING MATERIAL SPECIFICATIONS:B14,D14,B20,B22IS,B24,D24,B24S
PRESSURE RATING <= 300#

```
    <----------------------BRANCH   SIZE---------------------------->
      3   1 1   2        1 1 1 1 1 2 2 2 2 2 3 3 3 3 3 4 4 4 4 4 5 5 5 5 5
    M Q 1 Q M 2 M 3 4 6 8 0 2 4 6 8 0 2 4 6 8 0 2 4 6 8 0 2 4 6 8 0 2 4 6 8

   M T
  3Q E T
   1 E E T
  1Q
  1M E E E   T
   2 S S S   E T
  2M S S S   E E T
   3 S S S   E E E T
   4 S S S   S E E E T
   6 S S S   S W W E E T
   8 S S S   S W W W E E T
  10 S S S   S W W W W E E T
  12 S S S   S W W W W W E E T
  14 S S S   S W W W W W W E E T
  16 S S S   S W W W W W W P E E T
  18 S S S   S W W W W W W P P E E T
  20 S S S   S W W W W W W P P P E E T
  22 S S S   S W W W W W W P P P P E E T
  24 S S S   S W W W W W W P P P P P E E T
  26 S S S   S P P P P P P P P P P P P E E T
  28 S S S   S P P P P P P P P P P P P P E E T
  30 S S S   S P P P P P P P P P P P P P P E E T
  32 S S S   S P P P P P P P P P P P P P P P E E T
  34 S S S   S P P P P P P P P P P P P P P P P E E T
  36 S S S   S P P P P P P P P P P P P P P P P E E T
  38 S S S   S P P P P P P P P P P P P P P P P P E E T
  40 S S S   S P P P P P P P P P P P P P P P P P P E E T
  42 S S S   S P P P P P P P P P P P P P P P P P P P E E T
  44 S S S   S P P P P P P P P P P P P P P P P P P P P E E T
  46 S S S   S P P P P P P P P P P P P P P P P P P P P P E E T
  48 S S S   S P P P P P P P P P P P P P P P P P P P P P P E E T
  50
  52
  54
  56
  58
  A-
```

```
E  TE  REDUCING TEE
P  WB  BRANCH WELD WITH RP
S  SL  SOCKOLET
T  TE  EQUAL TEE
W  WL  WELDOLET
```

BRANCH TABLE: TABLE-A2
APPLICABLE PIPING MATERIAL SPECIFICATIONS: B50, B52,D52, D50.
PRESSURE RATING <=300#

<-----------------------B R A N C H   S I Z E-------------------------->

	M	3Q	1	1Q	1M	2	2M	3	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58
M	T																																			
3Q	E	T																																		
1	E	E	T																																	
1Q																																				
1M	E	E	E		T																															
2	S	S	S		E	T																														
2M																																				
3	S	S	S		E	E		T																												
4	S	S	S		S	E		E	T																											
6	S	S	S		S	P		E	E	T																										
8	S	S	S		S	P		P	E	E	T																									
10	S	S	S		S	P		P	P	E	E	T																								
12	S	S	S		S	P		P	P	P	E	E	T																							
14	S	S	S		S	P		P	P	P	P	E	E	T																						
16	S	S	S		S	P		P	P	P	P	P	E	E	T																					
18	S	S	S		S	P		P	P	P	P	P	P	E	E	T																				
20	S	S	S		S	P		P	P	P	P	P	P	P	E	E	T																			
22	S	S	S		S	P		P	P	P	P	P	P	P	P	E	E	T																		
24	S	S	S		S	P		P	P	P	P	P	P	P	P	P	E	E	T																	
26	S	S	S		S	P		P	P	P	P	P	P	P	P	P	P	E	E	T																
28	S	S	S		S	P		P	P	P	P	P	P	P	P	P	P	P	E	E	T															
30	S	S	S		S	P		P	P	P	P	P	P	P	P	P	P	P	P	E	E	T														
32	S	S	S		S	P		P	P	P	P	P	P	P	P	P	P	P	P	P	E	E	T													
34	S	S	S		S	P		P	P	P	P	P	P	P	P	P	P	P	P	P	P	E	E	T												
36	S	S	S		S	P		P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	E	E	T											
38	S	S	S		S	P		P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	E	E	T										
40	S	S	S		S	P		P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	E	E	T									
42	S	S	S		S	P		P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	E	E	T								
44	S	S	S		S	P		P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	E	E	T							
46	S	S	S		S	P		P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	E	E	T						
48	S	S	S		S	P		P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	E	E	T					
50																																				
52																																				
54																																				
56																																				
58																																				
A-																																				

E	TE	REDUCING TEE
P	WB	BRANCH WELD WITH RP
S	SL	SOCKOLET
T	TE	EQUAL TEE

BRANCH TABLE : TABLE-A3
APPLICABLE PIPING MATERIAL
SPECIFICATIONS:**F24,F24S,H24S,J36S**

```
     <-----------------------B R A N C H    S I Z E---------------------------->
       3   1 1   2         1 1 1 1 1 2 2 2 2 2 3 3 3 3 3 4 4 4 4 4 5 5 5 5 5
     M Q 1 Q M 2 M 3 4 6 8 0 2 4 6 8 0 2 4 6 8 0 2 4 6 8 0 2 4 6 8 0 2 4 6 8

   M T
  3Q E T
   1 E E T
  1Q
  1M E E E   T
   2 S S S   E T
  2M
   3 S S S   E E   T
   4 S S S   S E   E T
   6 S S S   S W   E E T
   8 S S S   S W   W E E T
  10 S S S   S W   W W E E T
  12 S S S   S W   W W W E E T
  14 S S S   S W   W W W W E E T
  16 S S S   S W   W W W W W E E T
  18 S S S   S W   W W W W W W E E T
  20 S S S   S W   W W W W W W W E E T
  22 S S S   S W   W W W W W W W W E E T
  24 S S S   S W   W W W W W W W W W E E T
  26 S S S   S W   W W W W W W W W W W E E T
  28 S S S   S W   W W W W W W W W W W W E E T
  30 S S S   S W   W W W W W W W W W W W W E E T
  32 S S S   S W   W W W W W W W W W W W W W E E T
  34 S S S   S W   W W W W W W W W W W W W W W E E T
  36 S S S   S W   W W W W W W W W W W W W W W W E E T
  38
  40
  42
  44
  46
  48
  50
  52
  54
  56
  58
  A-
```

E TE TEE
S SL SOCKOLET
T TE TEE
W WL WELDOLET

BRANCH TABLE : TABLE-R1
APPLICABLE PIPING MATERIAL SPECIFICATIONS: B22ISG,B24RL,B24FL.
PRESSURE RATING <= 300#

```
   <-----------------B R A N C H    S I Z E------------>
       3   1 1   2         1 1
     M Q 1 Q M 2 M 3 4 6 8 0 2

    M
   3Q
    1     T
   1Q
   1M     E   T
    2     E   E T
   2M
    3     E   E E   T
    4     E   E E   E T
    6     E   E E   E E T
    8     E   E E   E E E T
   10     E   E P   P E E E T
   12     E   E P   P P E E E T

   A-


E  TE  REDUCING TEE
P  WB  BRANCH WELD WITH RP
T  TE  EQUAL TEE
```

BRANCH TABLE : TABLE-R2
APPLICABLE PIPING MATERIAL SPECIFICATIONS: B24D, B24P.
PRESSURE RATING <= 300#

<-----------------------B R A N C H S I Z E-------->

	3	1 1	2	1 1
	M Q 1 Q M 2 M 3 4 6 8 0 2			
M				
3Q				
1				
1Q				
1M				
2		T		
2M				
3		E	T	
4		E	E T	
6		E	E E T	
8		E	E E E T	
10		E	E E E E T	
12		E	E E E E E T	

A-

E TE REDUCING TEE
T TE EQUAL TEE

VALVE DATA SHEETS

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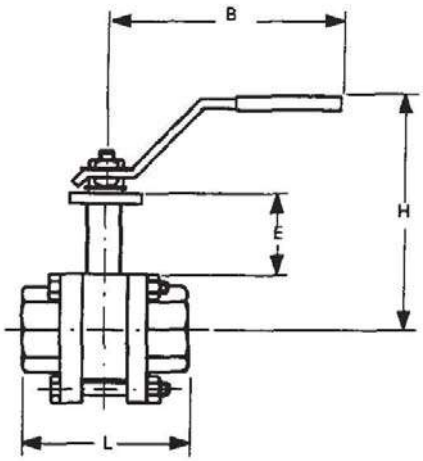
BALL VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BAV 101	
PRESSURE RATING CLASS	800	
FACE	SW	
CONSTRUCTION		
BODY	THREE PIECES TYPE FULL BORE FLOATING BALL	
EXTENDED STEM	YES b)	
WRENCH OPERATED	YES	
GEAR OPERATED	NO	
FIRE SAFE	YES	
NOMINAL SIZE	1/2" - 1 1/2"	
MATERIALS		
BODY	A 350 Gr. LF2	
BALL	AISI 316	
BODY SEAT RING	PTFE	
STEM PACKING	PTFE GRAPHITE	
STEM	13 Cr.	
DESIGN CONDITIONS		
PRESSURE RATING	API 602	
FLUID	Kg/cm2g	°C

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2.
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

API 598, API 602, API 607, API 608, ANSI B16.11, ANSI B16.34

NOTES:

a) SEAT RATING ACC. TO MANUFACTURER'S STANDARD
b) STEM EXTENSION E = 120MM (FOR MAX. 70MM COLD INSULATION)

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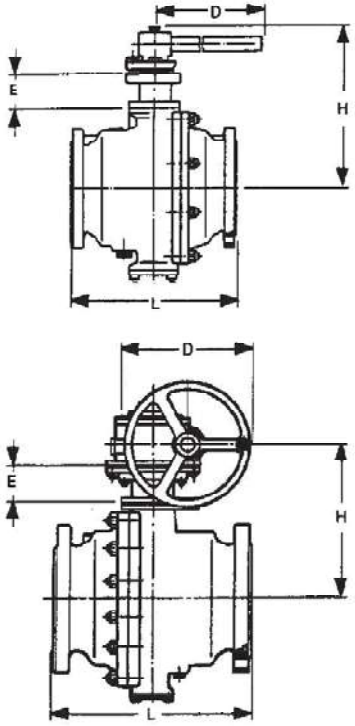
BALL VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BAV 111	
PRESSURE RATING CLASS	300	
FACE	RF	
CONSTRUCTION		
BODY	SPLIT BODY, FULL BORE FLOATING BALL = < 4" TRUN. MOUNT BALL > 4" LONG PATTERN	
EXTENDED STEM	YES b)	
WRENCH OPERATED	1 1/2" - 6"	
GEAR OPERATED	8" - 14"	
FIRE SAFE	YES	
NOMINAL SIZE	1 1/2" - 14"	
MATERIALS		
BODY	A 352 Gr. LCB	
BALL	AISI 316 OR C.S. CHROMEPLATED	
BODY SEAT RING	PTFE	
STEM PACKING	PTFE GRAPHITE	
STEM	13 Cr.	
DESIGN CONDITIONS		
PRESSURE RATING	ANSI B16.34	
FLUID	Kg/cm2g	°C

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2.
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

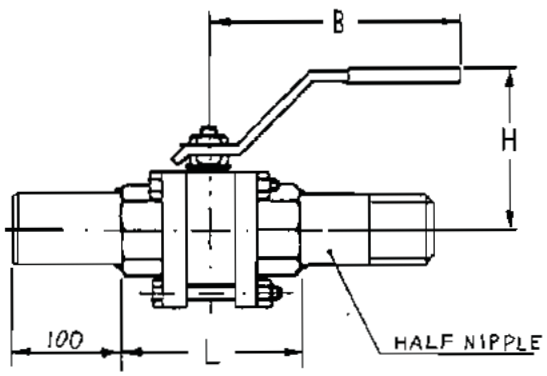
API 598, API 607, API 608, ANSI B16.10, ANSI B16.34, ANSI B16.5

NOTES:

a) SEAT RATING ACC. TO MANUFACTURER'S STANDARD
b) STEM EXTENSION E= 150mm (FOR MAX 100mm COLD INSULATION)

PDIL

BALL VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BAV 201
PRESSURE RATING CLASS	800
FACE	SW b)
CONSTRUCTION	
BODY	THREE PIECES TYPE FULL BORE FLOATING BALL
EXTENDED STEM	NO
WRENCH OPERATED	YES
GEAR OPERATED	NO
FIRE SAFE	YES
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 105
BALL	AISI 316
BODY SEAT RING	PTFE
STEM PACKING	PTFE GRAPHITE
STEM	13 Cr.
DESIGN CONDITIONS	
PRESSURE RATING	API 602

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

2 IF OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

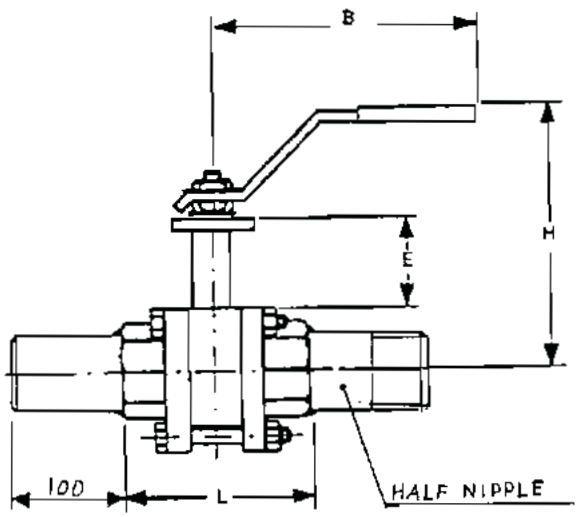
API 598, API 602, API 607, API 608, ANSI B16.11, ANSI B16.34

NOTES:

a) SEAT RATING ACC. TO MANUFACTURER'S STANDARD
b) VALVE PROVIDED WITH EXTENTED ENDS, 100mm LONG SCH 80/HALF NIPPLE

PDIL

BALL VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BAV 202
PRESSURE RATING CLASS	800
FACE	SW c)
CONSTRUCTION	
BODY	THREE PIECES TYPE FULL BORE FLOATING BALL
EXTENDED STEM	YES b)
WRENCH OPERATED	YES
GEAR OPERATED	NO
FIRE SAFE	YES
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 105
BALL	AISI 316
BODY SEAT RING	PTFE
STEM PACKING	PTFE GRAPHITE
STEM	13 Cr.
DESIGN CONDITIONS	
PRESSURE RATING	API 602

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

2 IF OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

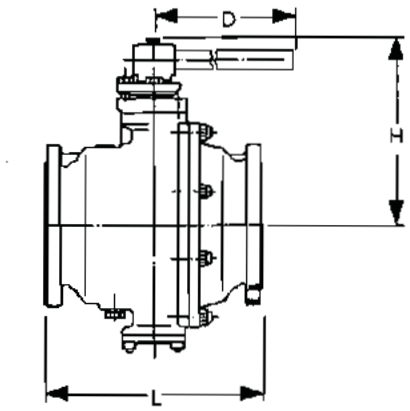
API 598, API 602, API 608, ANSI B16.11, ANSI B16.34

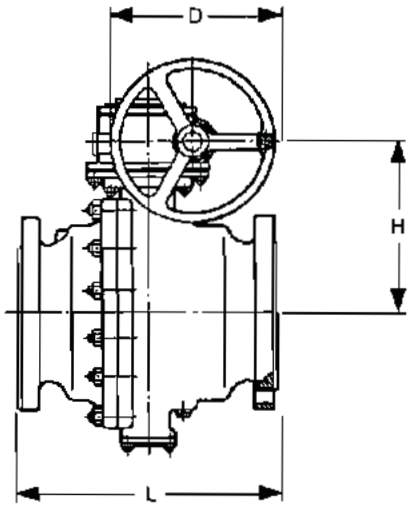
NOTES:

a) SEAT RATING ACC. TO MANUFACTURER'S STANDARD
b) STEM EXTENSION E= 120mm (FOR MAX. 70mm COLD INSULATION)
c) VALVE PROVIDED WITH EXTENDED ENDS, 100mm LONG SCH 80/HALF NIPPLE

PDIL

BALL VALVE





DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BAV 210	
PRESSURE RATING CLASS	150	
FACE	RF	
CONSTRUCTION		
BODY	SPLIT BODY, FULL BORE FLOATING BALL = <4" TRUN. MOUNT BALL >4" LONG PATTERN	
EXTENDED STEM	NO	
WRENCH OPERATED	2" - 6"	
GEAR OPERATED	8" - 24"	
FIRE SAFE	YES	
NOMINAL SIZE	2" - 24"	
MATERIALS		
BODY	A 216 Gr. WCB	
BALL	AISI 316 OR C.S. CHROMEPLATED	
BODY SEAT RING	PTFE	
STEM PACKING	PTFE GRAPHITE	
STEM	13 Cr.	
DESIGN CONDITIONS		
PRESSURE RATING	ANSI B16.34	
FLUID	Kg/cm2g	°C

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

2. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

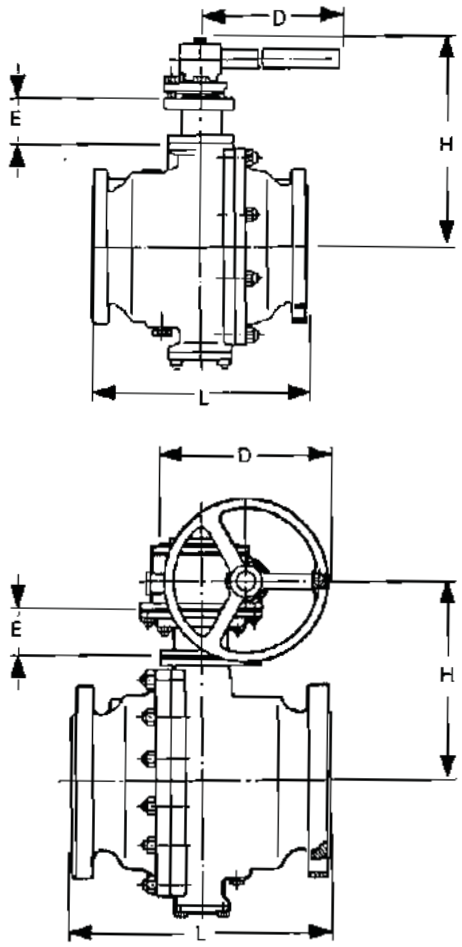
API 598, API 607, API 608, ANSI B16.10, ANSI B16.34, ANSI B16.5

NOTES:

a) SEAT RATING ACC. TO MANUFACTURER'S STANDARD

PDIL

BALL VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BAV 211
PRESSURE RATING CLASS	300
FACE	RF
CONSTRUCTION	
BODY	SPLIT BODY, FULL BORE FLOATING BALL = < 4" TRUN. MOUNT BALL > 4" LONG PATTERN
EXTENDED STEM	YES b)
WRENCH OPERATED	2" - 6"
GEAR OPERATED	8" - 12"
FIRE SAFE	YES
NOMINAL SIZE	2" - 12"
MATERIALS	
BODY	A 216 Gr. WCB
BALL	AISI 316 OR C.S. CHROMEPLATED
BODY SEAT RING	PTFE
STEM PACKING	PTFE GRAPHITE
STEM	13 Cr.
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

2. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

API 598, API 607, API 608, ANSI B16.10, ANSI B16.34, ANSI B16.5

NOTES:

a) SEAT RATING ACC. TO MANUFACTURER'S STANDARD
b) STEM EXTENSION E= 120mm (FOR MAX 70mm COLD INSULATION)

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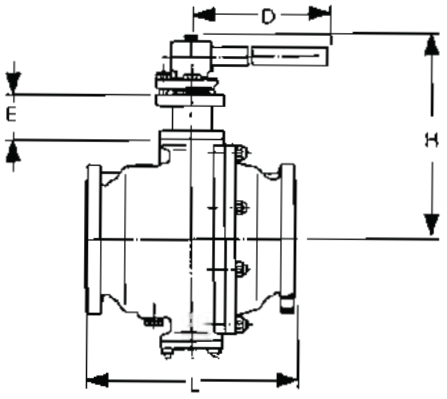
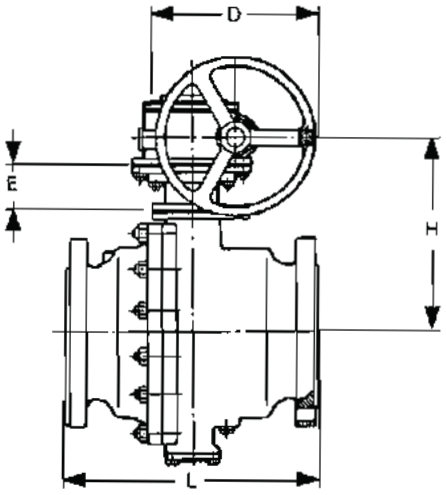
BALL VALVE





DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BAV 222	
PRESSURE RATING CLASS	600	
FACE	RF	
CONSTRUCTION		
BODY	SPLIT BODY FULL BORE TRUNNION MOUNTED BALL LONG PATTERN	
EXTENDED STEM	NO	
WRENCH OPERATED	NO	
GEAR OPERATED	YES	
FIRE SAFE	YES	
NOMINAL SIZE	8" - 24"	
MATERIALS		
BODY	A 216 Gr. WCB	
BALL	A 351 Gr. CF 8M OR CS CHROMEPLATED	
BODY SEAT RING	AISI 316 STELLITED	
STEM PACKING	PTFE GRAPHITE	
STEM	AISI 316	
DESIGN CONDITIONS		
PRESSURE RATING	ANSI B16.34	
FLUID	Kg/cm2g	°C

rev.1

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2.
3.IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

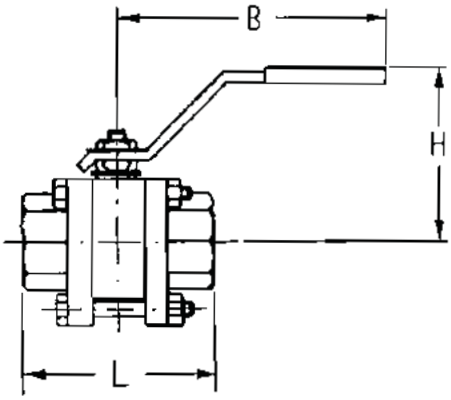
API 598, API 607, API 608, ANSI B16.10, ANSI B16.34, ANSI B16.5

NOTES:

a) SEAT RATING ACC. TO MANUFACTURER'S STANDARD
b) STEM EXTENSION E = 150 mm

PDIL

BALL VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BAV 501
PRESSURE RATING CLASS	800
FACE	THREADED (NPT)
CONSTRUCTION	
BODY	THREE PIECES TYPE FULL BORE FLOATING BALL
EXTENDED STEM	NO
WRENCH OPERATED	YES
GEAR OPERATED	NO
FIRE SAFE	YES
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	AISI 316
BALL	AISI 316
BODY SEAT RING	PTFE
STEM PACKING	PTFE GRAPHITE
STEM	AISI 316
DESIGN CONDITIONS	
PRESSURE RATING	API 602

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

2. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

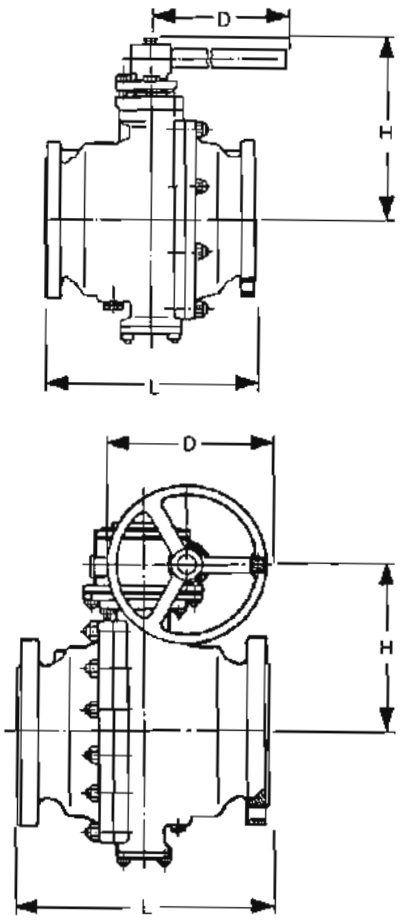
API 598, API 602, API 607, API 608, ANSI B16.11, ANSI B16.34

NOTES:

a) SEAT RATING ACC. TO MANUFACTURER'S STANDARD
b) BOTH ENDS FEMALE SCREWED

PDIL

BALL VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BAV 510
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	SPLIT BODY, FULL BORE, FLOATING BALL = < 4" TRUN. MOUNT BALL > 4" LONG PATTERN
EXTENDED STEM	NO
WRENCH OPERATED	2" - 6"
GEAR OPERATED	8" - 12"
FIRE SAFE	YES
NOMINAL SIZE	2" - 12"
MATERIALS	
BODY	A 351 Gr. CF 8M
BALL	AISI 316
BODY SEAT RING	PTFE
STEM PACKING	PTFE GRAPHITE
STEM	AISI 316
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

2. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

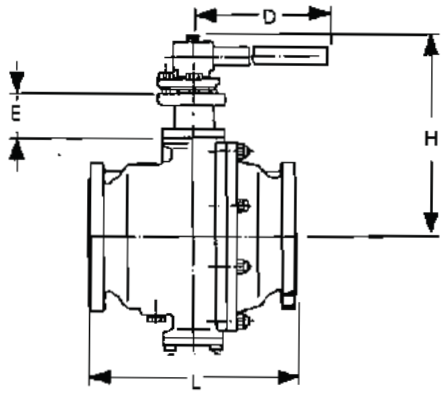
API 598, API 607, API 608, ANSI B16.10, ANSI B16.34, ANSI B16.5

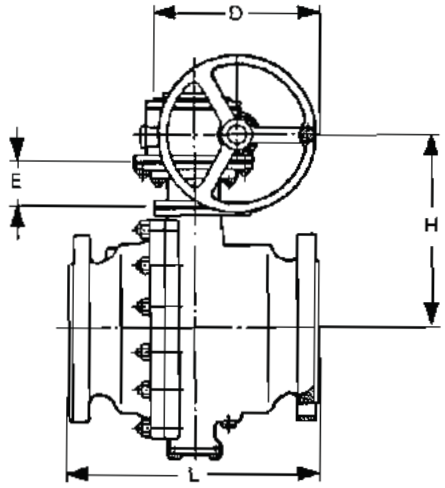
NOTES:

a) SEAT RATING ACC. TO MANUFACTURER'S STANDARD

PDIL

BALL VALVE





DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BAV 520
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	SPLIT BODY FULL BORE TRUNNION MOUNTED BALL LONG PATTERN
EXTENDED STEM	NO
WRENCH OPERATED	NO
GEAR OPERATED	YES
FIRE SAFE	YES
NOMINAL SIZE	8" - 24"
MATERIALS	
BODY	A 351 Gr. CF 8M
BALL	A 351 Gr. CF 8M or CS Chromeplated
BODY SEAT RING	AISI 316 STELLITED
STEM PACKING	PTFE GRAPHITE
STEM	AISI 316
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

2. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

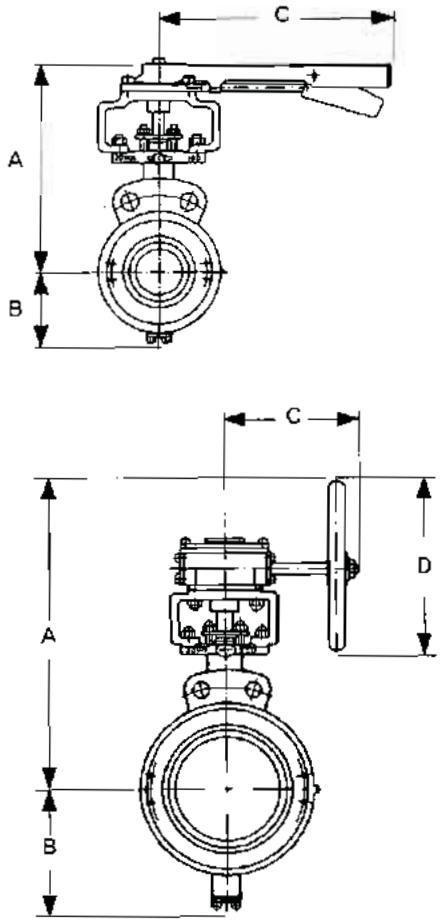
API 598, API 607, API 608, ANSI B16.10, ANSI B16.34, ANSI B16.5

NOTES:

a) SEAT RATING ACC. TO MANUFACTURER'S STANDARD
b) STEM EXTENSION E = 150mm

PDIL

BUTTERFLY VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BUV 202
PRESSURE RATING CLASS	300
FACE	RF
CONSTRUCTION	
BODY	WAFER TYPE
	METAL SEATED
	CATEGORY "B"
GEAR OPERATED	> = 8"
NOMINAL SIZE	3" - 24"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT	A 182 Gr. F6a
DISC	A 216 Gr. WCB HARD FACED
SHAFT	13 Cr.
SHAFT PACKING	GRAFOIL
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. FACE-TO-FACE DIMENSIONS SHALL BE PER API 609

MANDATORY STANDARDS:

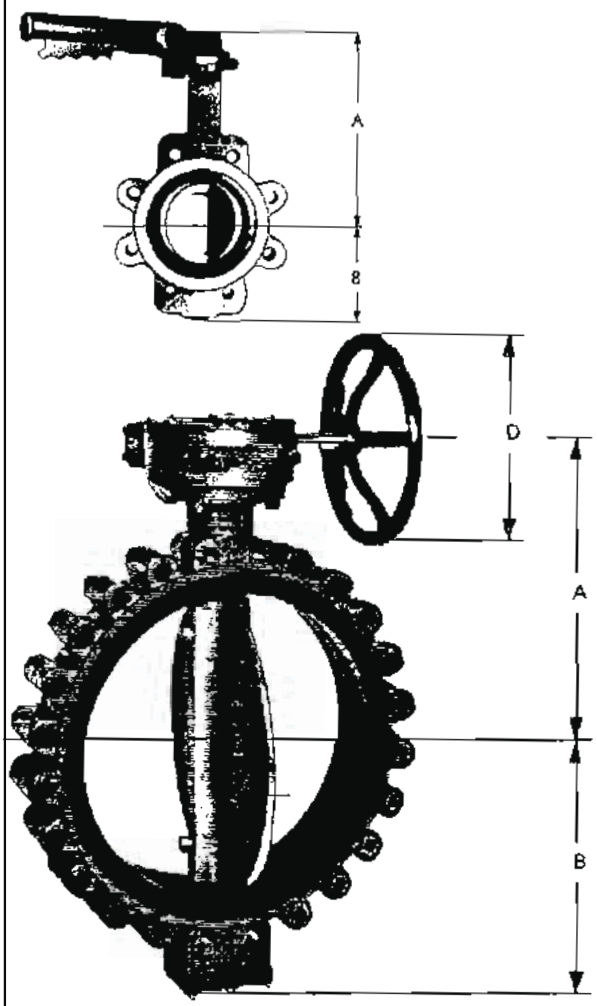
API 609, ANSI B16.34, ANSI B16.5

NOTES:

a) EXTENDED SHAFT TO BE PROVIDED FOR VALVES WITH GEARBOX TO AVOID HEATING OF GEARBOX

PDIL

BUTTERFLY VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	**BUV 203**
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	CAST
	LUG TYPE WITH
	THREADED HOLES
	RUBBER LINED
GEAR OPERATED	YES > = 8"
NOMINAL SIZE	2" - 24"
MATERIALS	
BODY	A 216 Gr. WCB
BODY LINING	ETHYLENE-PROPYLENE
DISC	A216 GR.WCB+
SHAFT	13 Cr
SHAFT PACKING	PTFE
DESIGN CONDITIONS	
PRESSURE RATING	API 609

rev.1

GENERAL

1. RUBBER LINING: THE WETTED SURFACES OF VALVE SHALL BE FULLY LINED AND THE LINING SHALL EXTEND OVER THE FLANGE SEALING FACE
2. LEVER OPERATORS SUITABLE FOR THROTTLING PURPOSES SHALL BE PROVIDED FOR VALVES 6" AND SMALLER
3. FACE-TO-FACE DIMENSIONS SHALL BE PER API 609
4. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

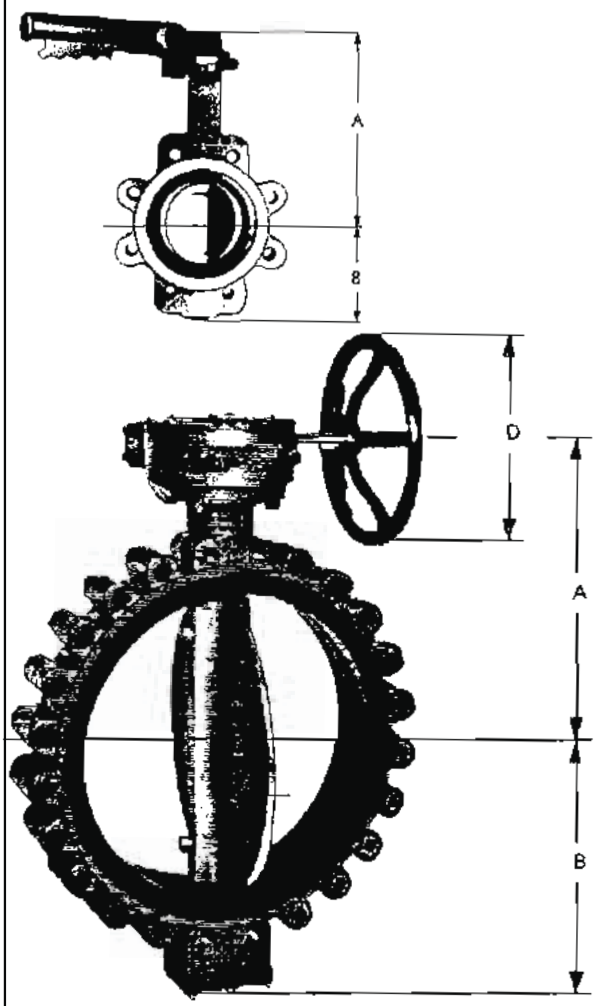
API 609, ANSI B16.5

NOTES:

a) THE VALVE SHALL BE DESIGNED FOR CLOSURE IN DEAD-END-PIPING

PDIL

BUTTERFLY VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BUV 203 RL	
PRESSURE RATING CLASS	150	
FACE	RF	
CONSTRUCTION		
BODY	CAST	
	LUG TYPE WITH	
	THREADED HOLES	
	RUBBER LINED	
GEAR OPERATED	YES >= 8"	
NOMINAL SIZE	2" - 24"	
MATERIALS		
BODY	A 216 Gr. WCB	
BODY LINING	ETHYLENE-PROPYLENE	
DISC	A216 GR.WCB+ RUBBER LINED	rev.1
SHAFT	13 Cr	rev.1
SHAFT PACKING	PTFE	
DESIGN CONDITIONS		
PRESSURE RATING	API 609	

GENERAL

1. RUBBER LINING: THE WETTED SURFACES OF VALVE SHALL BE FULLY LINED AND THE LINING SHALL EXTEND OVER THE FLANGE SEALING FACE
2. LEVER OPERATORS SUITABLE FOR THROTTLING PURPOSES SHALL BE PROVIDED FOR VALVES 6" AND SMALLER
3. FACE-TO-FACE DIMENSIONS SHALL BE PER API 609
4. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

API 609, ANSI B16.5

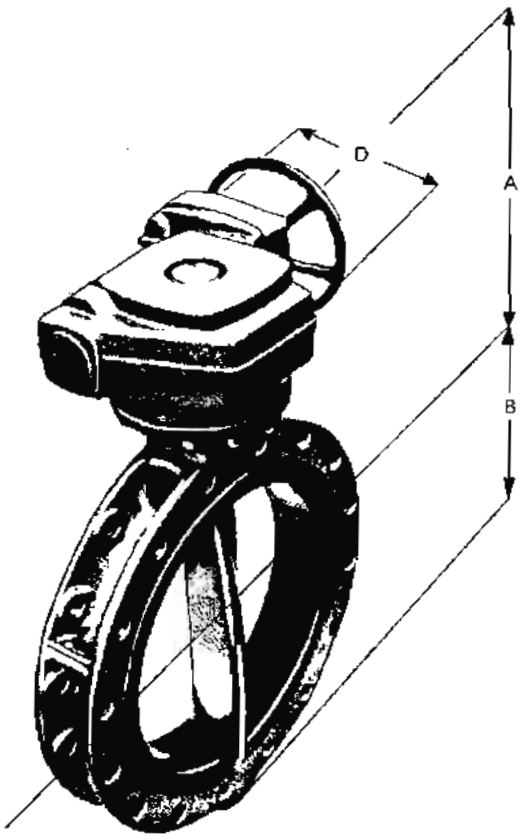
NOTES:

a) THE VALVE SHALL BE DESIGNED FOR CLOSURE IN DEAD-END-PIPING

b)THIS VALVE SHALL BE RUBBERLINED FOR CORROSSIVE SERVICE.

PDIL

BUTTERFLY VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BUV 204	
PRESSURE RATING CLASS	150	
FACE	RF	
CONSTRUCTION		
BODY	FLANGED SHORT BODY	
	FULL-DRILLED	
	BOLTHOLES IN FLANGES	
	RUBBER LINED	
GEAR OPERATED	YES	
NOMINAL SIZE	26" - 64"	
MATERIALS		
BODY	A 216 Gr. WCB	
BODY LINING	ETHYLENE-PROPYLENE	
DISC	A216 GR.WCB+ RUBBER LINED	rev.1
SHAFT	13 Cr	rev.1
SHAFT PACKING	PTFE	
DESIGN CONDITIONS		
PRESSURE RATING	ASME B16.47	

GENERAL

1. RUBBER LINING: THE WETTED SURFACES OF VALVE SHALL BE FULLY LINED AND LINING SHALL EXTEND OVER THE FLANGE SEALING FACE
2. FACE-TO-FACE DIMENSIONS SHALL BE PER AWWA C 504 SHORT-BODY
3. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

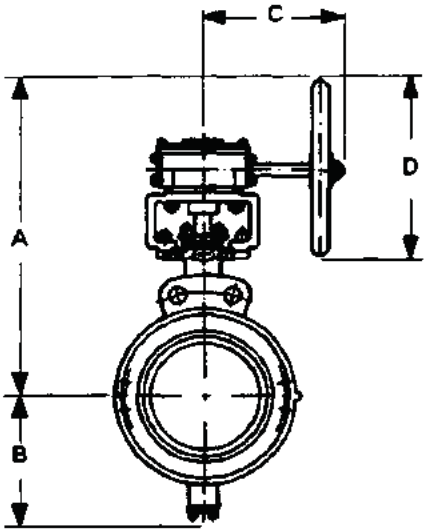
AWWA C 504, ASME B16.47

NOTES:

a) THE VALVE SHALL BE DESIGNED FOR CLOSURE IN DEAD-END-PIPING
b) FLANGES ACC. TO ASME B16.47 SERIES B

PDIL

BUTTERFLY VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BUV 410
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	WAFER TYPE
	CATEGORY "B"
GEAR OPERATED	> = 8"
NOMINAL SIZE	6" - 48"
MATERIALS	
BODY	A351 Gr.CF3M
BODY SEAT	REINFORCED PTFE a)
DISC	SS316L
SHAFT	A276 Gr.316L
SHAFT PACKING	PTFE
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. FASE-TO-FASE DIMENSIONS SHALL BE PER API 609

MANDATORY STANDARDS:

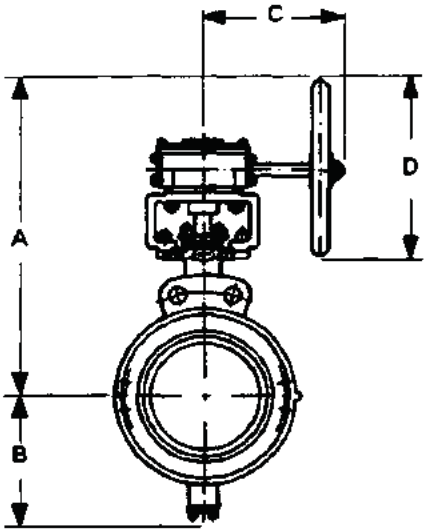
API 609, ANSI B16.34, ANSI B16.47, ANSI B16.5

NOTES:

a) MANUFACTURER MAY RECOMMEND ALTERNATIVE SEAT MATERIAL AND SEAT RATING SUBJECT TO PURCHASER APPROVAL
b) FLANGES > 24" ACC. TO ASME B16.47 SERIES B

PDIL

BUTTERFLY VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BUV 411
PRESSURE RATING CLASS	300
FACE	RF
CONSTRUCTION	
BODY	WAFER TYPE
	CATEGORY "B"
GEAR OPERATED	> = 8"
NOMINAL SIZE	6" - 48"
MATERIALS	
BODY	A351 Gr.CF3M
BODY SEAT	REINFORCED PTFE a)
DISC	SS316L
SHAFT	A276 Gr.316L
SHAFT PACKING	PTFE
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. FASE-TO-FASE DIMENSIONS SHALL BE PER API 609

MANDATORY STANDARDS:

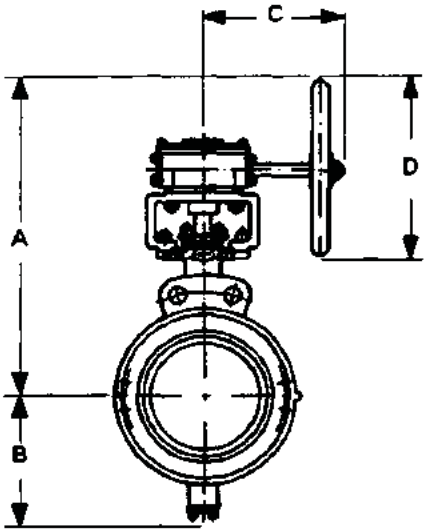
API 609, ANSI B16.34, ANSI B16.47, ANSI B16.5

NOTES:

a) MANUFACTURER MAY RECOMMEND ALTERNATIVE SEAT MATERIAL AND SEAT RATING SUBJECT TO PURCHASER APPROVAL
b) FLANGES > 24" ACC. TO ASME B16.47 SERIES B

PDIL

BUTTERFLY VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BUV 510
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	WAFER TYPE
	CATEGORY "B"
GEAR OPERATED	> = 8"
NOMINAL SIZE	6" - 48"
MATERIALS	
BODY	A 351 Gr. CF8
BODY SEAT	REINFORCED PTFE a)
DISC	STAINLESS TYPE 304
SHAFT	A 276 Gr. 304
SHAFT PACKING	PTFE
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. FASE-TO-FASE DIMENSIONS SHALL BE PER API 609

MANDATORY STANDARDS:

API 609, ANSI B16.34, ANSI B16.47, ANSI B16.5

NOTES:

a) MANUFACTURER MAY RECOMMEND ALTERNATIVE SEAT MATERIAL AND SEAT RATING SUBJECT TO PURCHASER APPROVAL
b) FLANGES > 24" ACC. TO ASME B16.47 SERIES B

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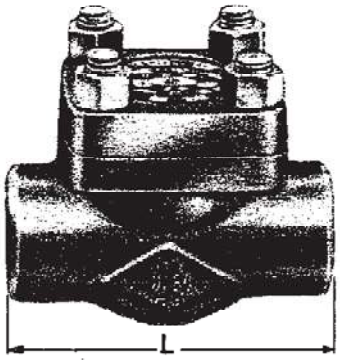
PDIL

CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 101	
PRESSURE RATING CLASS	800	
FACE	SW	
CONSTRUCTION		
BODY	FORGED	
BONNET TO BODY CONNECTION	BOLTED	
SEAT RING	RENEWABLE	
TYPE OF DISC	BALL	
NOMINAL SIZE	1/2" - 1 1/2"	
MATERIALS		
BODY	A 350 Gr. LF2	
BODY SEAT RING	AISI 304	
DISC	AISI 304	
DESIGN CONDITIONS		
PRESSURE RATING	API 602	
FLUID	Kg/cm2g	°C

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. IF NOT OTHERWISE STATED THE VALVE SHALL BE FULL BORE

MANDATORY STANDARDS:

API 598, API 602, ANSI B16.11, ANSI B 16.34

NOTES:

a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602

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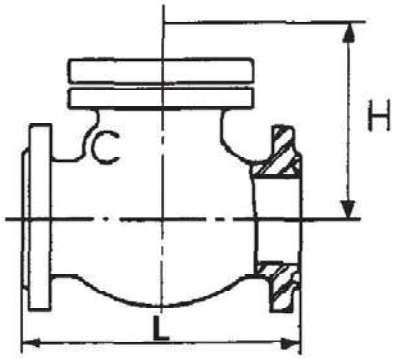
PDIL

CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 111	
PRESSURE RATING CLASS	300	
FACE	RF	
CONSTRUCTION		
BODY	CAST	
BONNET TO BODY CONNECTION	BOLTED	
SEAT RING	RENEWABLE	
TYPE OF DISC	SWING TYPE	
ACCESSORIES	NO	
BY-PASS	NO	
NOMINAL SIZE	2" - 24"	
MATERIALS		
BODY	A 352 Gr. LCB	
BODY SEAT RING	AISI 304	
DISC	AISI 304	
HINGE PIN	AISI 304	
DESIGN CONDITIONS		
PRESSURE RATING	ANSI B16.34	
FLUID	Kg/cm2g	°C
AMMONIA GAS	30	50/-33
AMMONIA LIQUID	40	50/-33

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

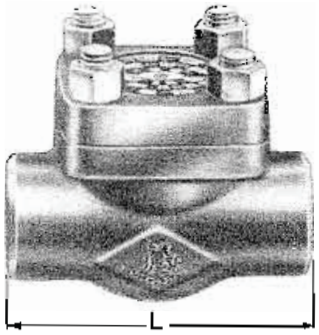
MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

PDIL

CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 201S
PRESSURE RATING CLASS	800
FACE	SW IBR
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
SEAT RING	RENEWABLE
TYPE OF DISC	BALL
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 105
BODY SEAT RING	A 182 Gr. F6a STELLITED
DISC	13 Cr Stellited.
DESIGN CONDITIONS	
PRESSURE RATING	API 602

rev.1

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. IF NOT OTHERWISE STATED THE VALVE SHALL BE FULL BORE

MANDATORY STANDARDS:

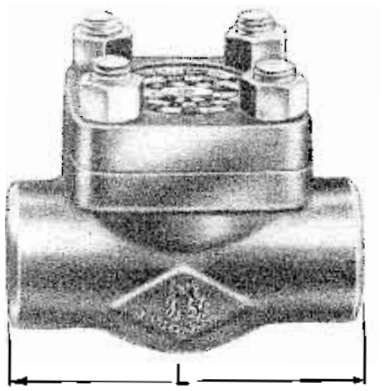
API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602
b) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION

PDIL

CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 201
PRESSURE RATING CLASS	800
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
SEAT RING	RENEWABLE
TYPE OF DISC	BALL
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 105
BODY SEAT RING	A 182 Gr. F6a STELLITED
DISC	A 182 Gr. F6a
DESIGN CONDITIONS	
PRESSURE RATING	API 602

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. IF NOT OTHERWISE STATED THE VALVE SHALL BE FULL BORE

MANDATORY STANDARDS:

API 598, API 602, ANSI B16.11, ANSI B 16.34

NOTES:

a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602

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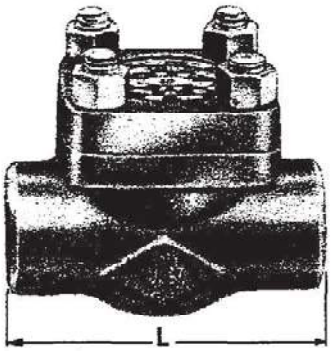
PDIL

CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 204S
PRESSURE RATING CLASS	1500
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
SEAT RING	RENEWABLE
TYPE OF DISC	PISTON
NOMINAL SIZE	1/2" - 1"
MATERIALS	
BODY	A 105
BODY SEAT RING	A 182 Gr. F6a STELLITED
DISC	A 182 Gr. F6a STELLITED
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. IF NOT OTHERWISE STATED THE VALVE SHALL BE FULL BORE

MANDATORY STANDARDS:

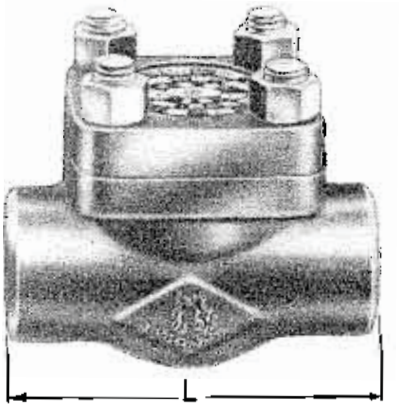
API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602
b) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION

PDIL

CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 207
PRESSURE RATING CLASS	800
FACE	THD
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
SEAT RING	RENEWABLE
TYPE OF DISC	BALL
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 105
BODY SEAT RING	A 182 Gr. F6a STELLITED
DISC	A 182 Gr. F6a
DESIGN CONDITIONS	
PRESSURE RATING	API 602

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. IF NOT OTHERWISE STATED THE VALVE SHALL BE FULL BORE

MANDATORY STANDARDS:

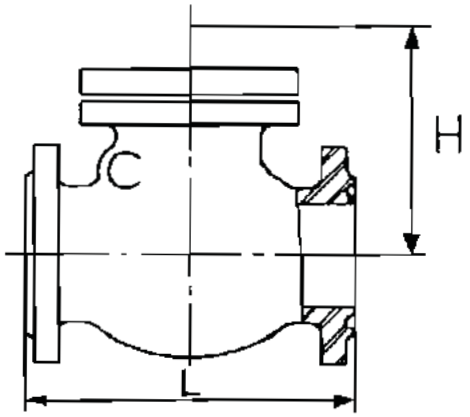
API 598, API 602, ANSI B16.11, ANSI B 16.34

NOTES:

a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602

PDIL

CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 210
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
SEAT RING	RENEWABLE
TYPE OF DISC	SWING TYPE
ACCESSORIES	NO
BY-PASS	NO
NOMINAL SIZE	2" - 24"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT RING	A 105 STELLITED
DISC	A 216 Gr. WCB 13Cr. FACED
HINGE PIN	13 Cr.
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

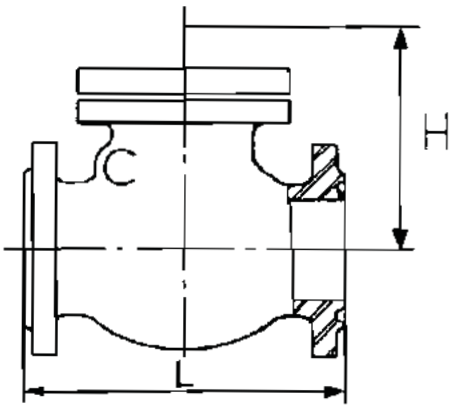
1. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

API 598, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

PDIL

CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 210D
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
SEAT RING	RENEWABLE
TYPE OF DISC	SWING TYPE
ACCESSORIES	NO
BY-PASS	NO
NOMINAL SIZE	2" - 24"
MATERIALS	
BODY	A216 GR.WCB RUBBER LINED
BODY SEAT RING	A 105 STELLITED
DISC	A 216 Gr. WCB 13Cr. FACED
HINGE PIN	13 Cr.
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

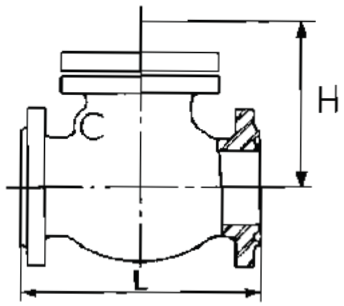
1. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

API 598, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

PDIL

CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	**CHV 210S**	
PRESSURE RATING CLASS	150	
FACE	RF IBR	
CONSTRUCTION		
BODY	CAST	
BONNET TO BODY CONNECTION	BOLTED	
SEAT RING	RENEWABLE	
TYPE OF DISC	SWING TYPE	
ACCESSORIES	NO	
BY-PASS	NO	
NOMINAL SIZE	2" - 24"	
MATERIALS		
BODY	A 216 Gr. WCB	
BODY SEAT RING	A105 STELLITED	
DISC	A 216 Gr. WCB 13Cr. FACED	
HINGE PIN	13 Cr.	
DESIGN CONDITIONS		
PRESSURE RATING	ANSI B16.34	
FLUID	Kg/cm2g	°C

rev.1

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

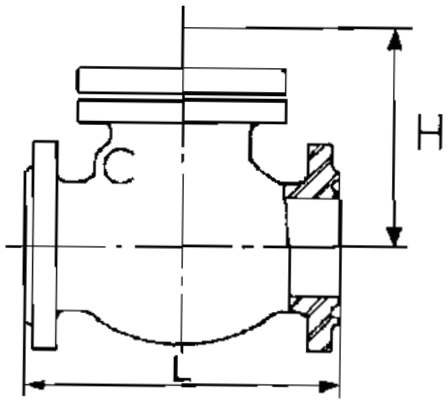
API 598, ANSI B16.10, ANSI B16 34, ANSI B16 5, MSS-SP 45

NOTES:

a) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION

PDIL

CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 211
PRESSURE RATING CLASS	300
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
SEAT RING	RENEWABLE
TYPE OF DISC	SWING TYPE
ACCESSORIES	NO
BY-PASS	NO
NOMINAL SIZE	2" - 24"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT RING	A 105 STELLITED
DISC	A 216 Gr. WCB 13 Cr. FACED
HINGE PIN	13 Cr.
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

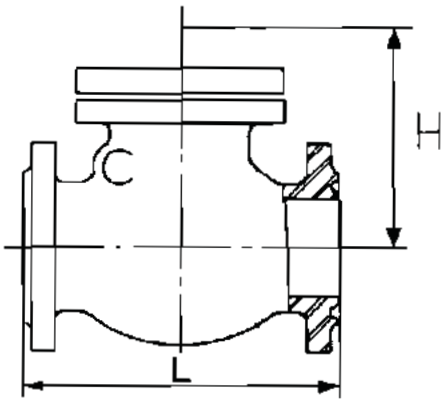
1. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

API 598, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

PDIL

CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 212	
PRESSURE RATING CLASS	600	
FACE	RF	
CONSTRUCTION		
BODY	CAST	
BONNET TO BODY CONNECTION	BOLTED	
SEAT RING	RENEWABLE	
TYPE OF DISC	SWING TYPE	
ACCESSORIES	NO	
BY-PASS	NO	
NOMINAL SIZE	2" - 16"	
MATERIALS		
BODY	A 216 Gr. WCB	
BODY SEAT RING	A 105 STELLITED	
DISC	A 216 Gr. WCB STELLITED	
HINGE PIN	13 Cr.	
DESIGN CONDITIONS		
PRESSURE RATING	ANSI B16.34	
FLUID	Kg/cm2g	°C

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

API 598, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

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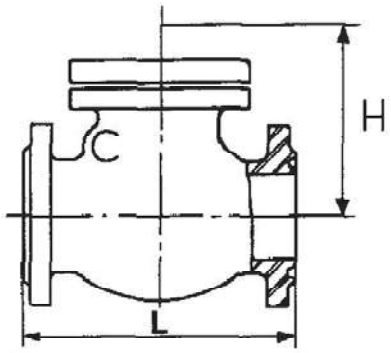
CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 212S
PRESSURE RATING CLASS	600
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
SEAT RING	RENEWABLE
TYPE OF DISC	SWING TYPE
ACCESSORIES	NO
BY-PASS	NO
NOMINAL SIZE	2" - 16"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT RING	A 182 Gr. F6a STELLITED
DISC	A 182 Gr. F6a STELLITED
HINGE PIN	13 Cr.
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

API 598, API 600, ANSI 816.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

a) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION

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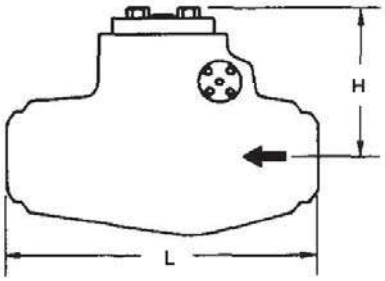
CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 216S
PRESSURE RATING CLASS	1500
FACE	BW
CONSTRUCTION	
BODY	CAST a)
BONNET TO BODY CONNECTION	PRESSURE SEAL
SEAT RING	WELDED
TYPE OF DISC	SWING TYPE
ACCESSORIES	NO
BY-PASS	NO
NOMINAL SIZE	1 1/2" - 24"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT RING	A 105 STELLITED
DISC	A 182 Gr. F6a STELLITED
HINGE PIN	13 Cr.
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

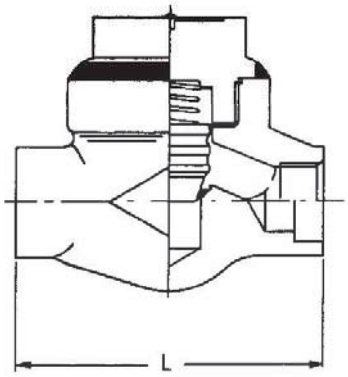
API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

a) END TO END DIMENSIONS SHALL BE SHORT PATTERN
b) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION

PDIL

CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 305S
PRESSURE RATING CLASS	2500
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	WELDED
SEAT RING	INTEGRAL
TYPE OF DISC	PISTON
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 182 Gr. F22
BODY SEAT RING	STELLITED
DISC	A 182 Gr. F6a STELLITED
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16,34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. IF NOT OTHERWISE STATED THE VALVE SHALL BE FULL BORE

MANDATDRY STANDARDS:

API 598, API 602, ANSI B16.11, ANSI B 16.34

NOTES:

a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602
b) VALVE TO BE SUPPLIED WITH I8R CERTIFICATION

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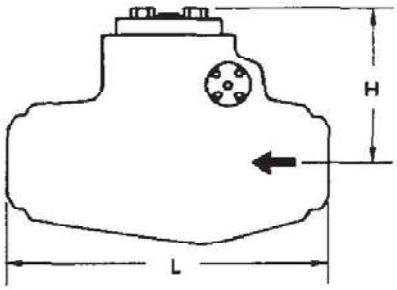
CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 326S
PRESSURE RATING CLASS	2500
FACE	BW
CONSTRUCTION	
BODY	CAST a)
BONNET TO BODY CONNECTION	PRESSURE SEAL
SEAT RING	WELDED
TYPE OF DISC	SWING TYPE
ACCESSORIES	NO
BY-PASS	NO
NOMINAL SIZE	2" - 18"
MATERIALS	
BODY	A 217 Gr. WC9
BODY SEAT RING	A 182 Gr. F22 STELLITED
DISC	A 182 Gr. F22 STELLITED
HINGE PIN	13 Cr.
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

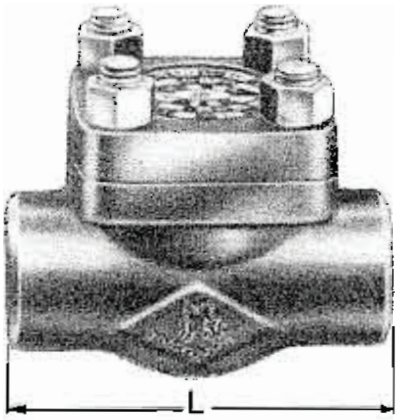
API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

a) END TO END DIMENSIONS SHALL BE SHORT PATTERN
b) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION

PDIL

CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV401
PRESSURE RATING CLASS	800
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
SEAT RING	RENEWABLE
TYPE OF DISC	BALL
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A182 Gr.F316L
BODY SEAT RING	SS316L
DISC	SS316L
DESIGN CONDITIONS	
PRESSURE RATING	API 602

rev.1

rev.1

rev.1

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. IF NOT OTHERWISE STATED THE VALVE SHALL BE FULL BORE

MANDATORY STANDARDS:

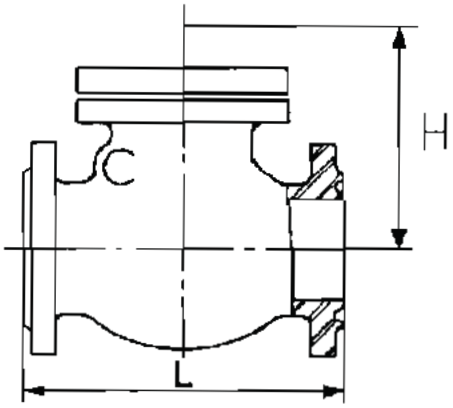
API 598, API 602, ANSI B16.11, ANSI B 16.34

NOTES:

a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602

PDIL

CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV410
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
SEAT RING	INTEGRAL
TYPE OF DISC	SWING TYPE
ACCESSORIES	NO
BY-PASS	NO
NOMINAL SIZE	2" - 24"
MATERIALS	
BODY	A351 Gr.CF3M rev.1
BODY SEAT RING	SS316L rev.1
DISC	SS316L rev.1
HINGE PIN	SS316L rev.1
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

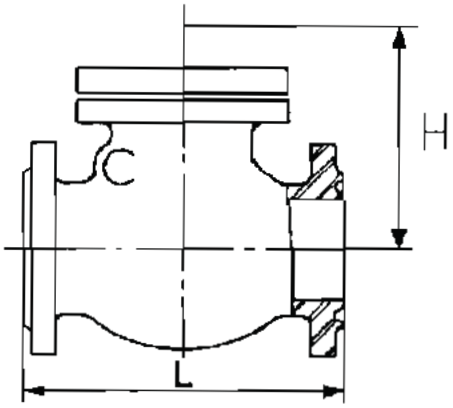
1. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

API 598, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV411	
PRESSURE RATING CLASS	300	
FACE	RF	
CONSTRUCTION		
BODY	CAST	
BONNET TO BODY CONNECTION	BOLTED	
SEAT RING	INTEGRAL	
TYPE OF DISC	SWING TYPE	
ACCESSORIES	NO	
BY-PASS	NO	
NOMINAL SIZE	2" - 24"	
MATERIALS		
BODY	A351 Gr.CF3M	rev.1
BODY SEAT RING	SS316L	rev.1
DISC	SS316L	rev.1
HINGE PIN	SS316L	rev.1
DESIGN CONDITIONS		
PRESSURE RATING	ANSI B16.34	

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

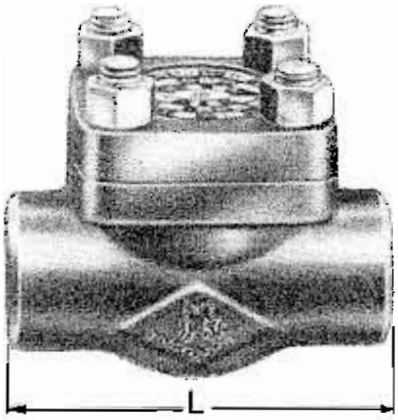
MANDATORY STANDARDS:

API 598, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

PDIL

CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 501
PRESSURE RATING CLASS	800
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
SEAT RING	RENEWABLE
TYPE OF DISC	BALL
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 182 Gr. F304
BODY SEAT RING	AISI 304
DISC	AISI 304
DESIGN CONDITIONS	
PRESSURE RATING	API 602

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. IF NOT OTHERWISE STATED THE VALVE SHALL BE FULL BORE

MANDATORY STANDARDS:

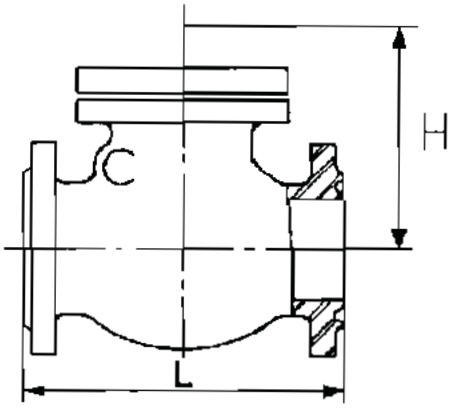
API 598, API 602, ANSI B16.11, ANSI B 16.34

NOTES:

a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602

PDIL

CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	**CHV 510**
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
SEAT RING	INTEGRAL
TYPE OF DISC	SWING TYPE
ACCESSORIES	NO
BY-PASS	NO
NOMINAL SIZE	2" - 24"
MATERIALS	
BODY	A 351 Gr. CF8
BODY SEAT RING	A 182 Gr. F304 OR INTERGRAL
DISC	AISI 304
HINGE PIN	A 276 Gr. 304
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

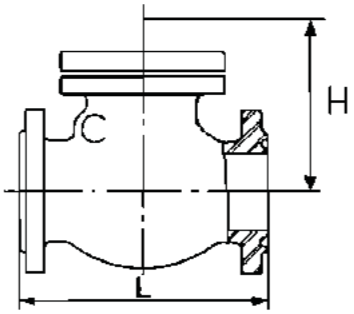
MANDATORY STANDARDS:

API 598, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

PDIL

CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 511F
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
SEAT RING	INTERGRAL
TYPE OF DISC	SWING TYPE
ACCESSORIES	NO
BY-PASS	NO
NOMINAL SIZE	2" - 24"
MATERIALS	
BODY	A 351 Gr. CF8M
BODY SEAT RING	INTEGRAL
DISC	AISI 316
HINGE PIN	A 276 Gr. 316
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

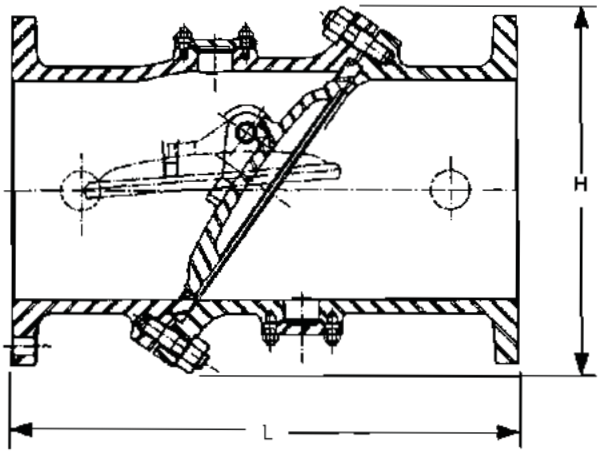
MANDATORY STANDARDS:

API 598, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

PDIL

CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 520
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	CAST
BODY CONNECTION	BOLTED
SEAT RING	RENEWABLE
TYPE OF DISC	TILTING DISC
ACCESSORIES	NO
BY-PASS	NO
NOMINAL SIZE	26" - 36"
MATERIALS	
BODY	A 351 Gr. CF8
BODY SEAT RING	A 182 Gr. F304
DISC	A 351 Gr. CF8
HINGE PIN	A 276 Gr. 304
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

API 598, ANSI B16.10, ANSI B16.34, ASME B16.47 SERIES B

NOTES:

a) DIMENSIONS ACC. TO MANUFACTURERS STANDARD WITH REFERENCE TO ANSI B16.10

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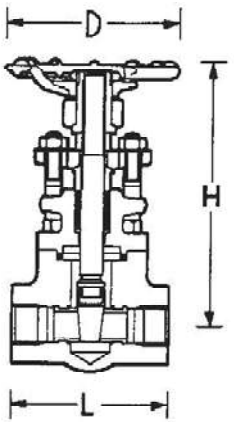
GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 101
PRESSURE RATING CLASS	800
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSS
GEAR OPERATED	NO
BY-PASS VALVE	ND
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 350 Gr. LF2
BODY SEAT RING	AISI 304
GATE	AISI 304
STEM	AISI 304
STEM PACKING	Graphoil
TRIM NUMBER	2

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKAOE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLIO WEB
WDF		DOUBLE	SLIP ON OR SPLIT
PDF	PARALLEL		FLEXIBLE

DESIGN CONDITIONS		
PRESSURE RATING	API 602	
FLUID	Kg/cm2g	°C

GENERAL

1. COPPER AND COPPER ALLOYS NDT PERMITTED
2. GLAND SHALL BE SUITABLE FDR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

a) LENGTH TO BE VERIFIED BY MANUFACTURER

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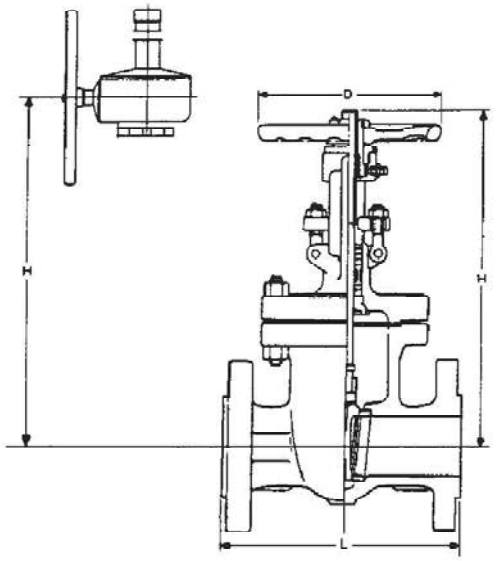
PDIL

GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 111
PRESSURE RATING CLASS	300
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSF OR WDF
GEAR OPERATED	YES > = 10"
BY-PASS VALVE	NO
NOMINAL SIZE	1 1/2" - 24"
MATERIALS	
BODY	A 352 Gr. LCB
BODY SEAT RING	AISI 304
GATE	AISI 304
STEM	AISI 304
STEM PACKING	Graphoil
TRIM NUMBER	2

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF		DOUBLE	SLIP ON OR SPLIT
PDF	PARALLEL		FLEXIBLE

DESIGN CONDITIONS		
PRESSURE RATING	ANSI B16.34	
FLUID	Kg/cm2g	°C

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES > = 10" AND > = 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO API 600 AND MSS-SP 45, LOCATION E-F

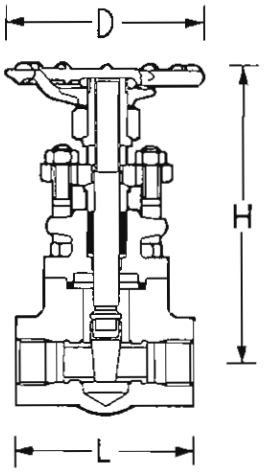
MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

PDIL

GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 201
PRESSURE RATING CLASS	800
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	NON-RISING
STEM (NO CASTING)	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSS
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 105
BODY SEAT RING	A 182 Gr. F6a STELLITED
GATE	A 182 Gr. F6a
STEM	13 Cr.
STEM PACKING	GRAFOIL /GRAPHITE
TRIM NUMBER	8
DESIGN CONDITIONS	
PRESSURE RATING	API 602

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF		DOUBLE	SLIP ON OR SPLIT
PDF	PARALLEL		FLEXIBLE

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

a) LENGTH TO BE VERIFIED BY MANUFACTURER

PDIL

GATE VALVE

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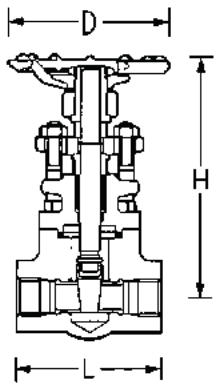

DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 201S
PRESSURE RATING CLASS	800
FACE	SW IBR
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSS
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 105
BODY SEAT RING	A 182 Gr. F6a STELLITED
GATE	A 182 Gr. F6a
STEM	13 Cr.
STEM PACKING	GRAPHITE
TRIM NUMBER	8

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF		DOUBLE	SLIP ON OR SPLIT
PDF	PARALLEL		FLEXIBLE

DESIGN CONDITIONS	
PRESSURE RATING	API 602

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

a) LENGTH TO BE VERIFIED BY MANUFACTURER
b) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION

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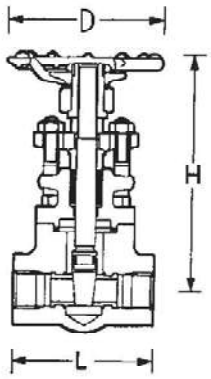
GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 202S
PRESSURE RATING CLASS	800
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSS
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 105
BODY SEAT RING	A 182 Gr. F6a STELLITED
GATE	A 182 Gr. F6a STELLITED
STEM	13 Cr.
STEM PACKING	GRAPHOIL
TRIM NUMBER	5
DESIGN CONDITIONS	
PRESSURE RATING	API 602

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF		DOUBLE	SLIP ON OR SPLIT
PDF	PARALLEL		FLEXIBLE

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDAROS:

API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

a) LENGTH TO BE VERIFIED BY MANUFACTURER
b) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION

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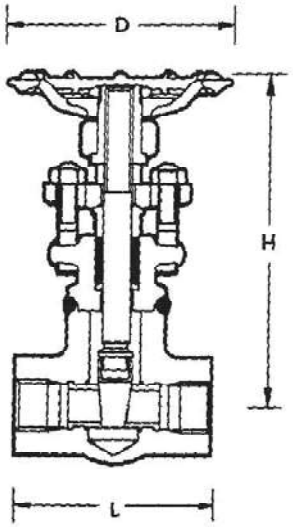
GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 204S
PRESSURE RATING CLASS	1500
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	WELDED
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSS
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1"
MATERIALS	
BODY	A 105
BODY SEAT RING	A 182 Gr. F6a STELLITED
GATE	A 182 Gr. F6a STELLITED
STEM	13 Cr.
STEM PACKING	GRAPHOIL
TRIM NUMBER	8

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF		DOUBLE	SLIP ON OR SPLIT
PDF	PARALLEL		FLEXIBLE

DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

a) LENGTH TO BE VERIFIED BY MANUFACTURER
b) VALVE TO BE SUPPLIED WITH I8R CERTIFICATION

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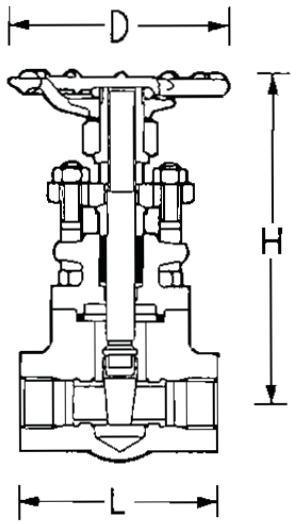
GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 207
PRESSURE RATING CLASS	800
FACE	THD
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	NON-RISING
STEM (NO CASTING)	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSS
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 105
BODY SEAT RING	A 182 Gr. F6a STELLITED
GATE	A 182 Gr. F6a
STEM	13 Cr.
STEM PACKING	GRAFOIL /GRAPHITE
TRIM NUMBER	8
DESIGN CONDITIONS	
PRESSURE RATING	API 602

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF		DOUBLE	SLIP ON OR SPLIT
PDF	PARALLEL		FLEXIBLE

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

a) LENGTH TO BE VERIFIED BY MANUFACTURER

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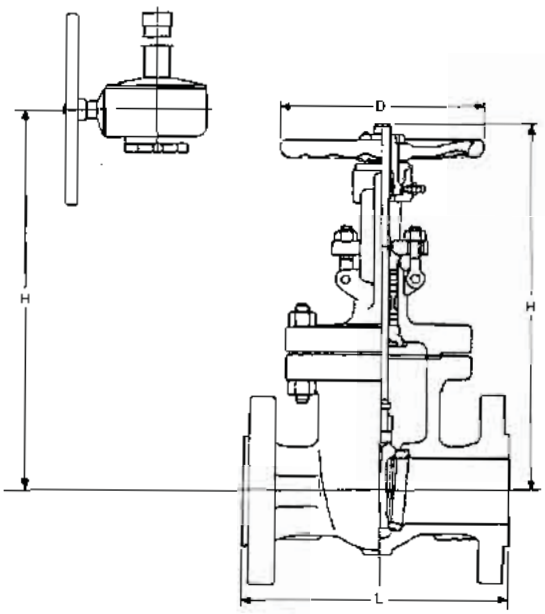
GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 210
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSF OR WDF
GEAR OPERATED	YES > = 14"
BY-PASS VALVE	NO
NOMINAL SIZE	2" - 48"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT RING	A 105 STELLITED
GATE	A 216 Gr. WCB 13 Cr. FACED
STEM (NO CASTING)	13 Cr.
STEM PACKING	GRAFOIL /GRAPHITE
TRIM NUMBER	8
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF		DOUBLE	SLIP ON OR SPLIT
PDF	PARALLEL		FLEXIBLE

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES > = 10" AND > = 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO API 600 AND MSS-SP 45, LOCATION E-F

MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45, ASME B16.47

NOTES:

a) FLANGES > 24" ACC. TO ASME B16.47 SERIES B

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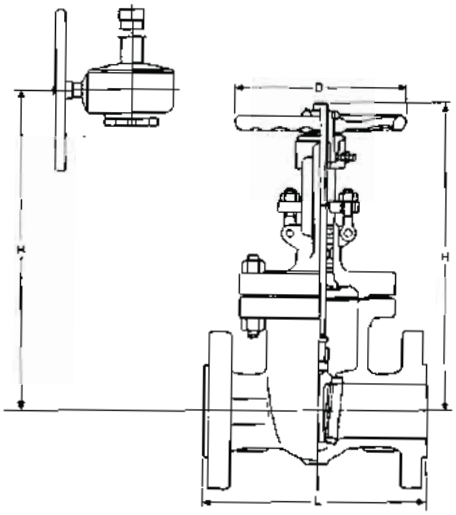
GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 210S
PRESSURE RATING CLASS	150
FACE	RF IBR
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSF OR WDF c)
GEAR OPERATED	YES > = 14"
BY-PASS VALVE	NO
NOMINAL SIZE	1 1/2" - 48"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT RING	A 105 STELLITED
GATE	A 216 Gr. WCB 13 Cr. FACED
STEM	13 Cr.
STEM PACKING	GRAPHITE
TRIM NUMBER	8
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF		DOUBLE	SLIP ON OR SPLIT
PDF	PARALLEL		FLEXIBLE

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES > = 10" AND > = 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO API 600 AND MSS-SP 45, LOCATION E-F

MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45, ASME B16.47

NOTES:

a) FLANGES > 24" ACC. TO ASME B16.47 SERIES B
b) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION
c) WSF IS ACCEPTABLE FOR SIZES < = 12" ONLY

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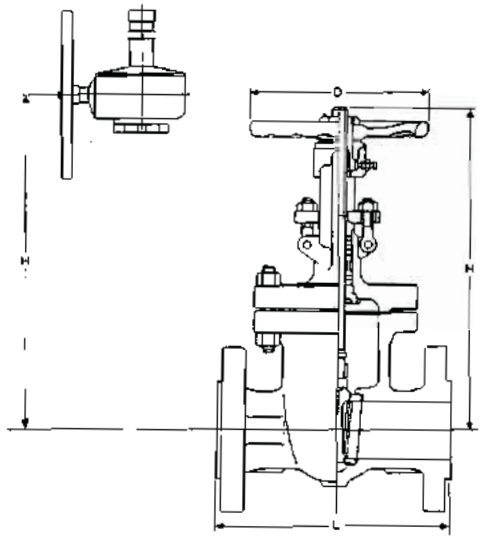
GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 211
PRESSURE RATING CLASS	300
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSF OR WDF a)
GEAR OPERATED	YES > = 10"
BY-PASS VALVE	NO
NOMINAL SIZE	2" - 24"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT RING	A 105 STELLITED
GATE	A 216 Gr. WCB 13 Cr. FACED
STEM (NO CASTING)	13 Cr.
STEM PACKING	GRAFOIL /GRAPHITE
TRIM NUMBER	8
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF		DOUBLE	SLIP ON OR SPLIT
PDF	PARALLEL		FLEXIBLE

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES > = 10" AND > = 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO API 600 AND MSS-SP 45, LOCATION E-F

MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

a) WSF IS ACCEPTABLE FOR SIZES < = 12" ONLY

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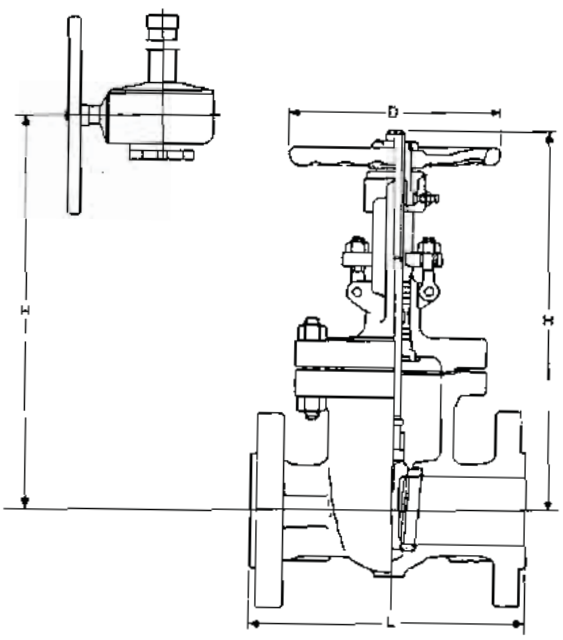
GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 212
PRESSURE RATING CLASS	600
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSF OR WDF a)
GEAR OPERATED	YES > = 8"
BY-PASS VALVE	NO, SEE GEN. NOTE 4
NOMINAL SIZE	1 1/2" - 24"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT RING	A 105 STELLITED
GATE	A 216 Gr. WCB
STEM	13 Cr.
STEM PACKING	GRAFOIL
TRIM NUMBER	8
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF		DOUBLE	SLIP ON OR SPLIT
PDF	PARALLEL		FLEXIBLE

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES > = 10" AND > = 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO API 600 AND MSS-SP 45, LOCATION E-F

MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

a) WSF IS ACCEPYABLE FOR SIZES < = 6" ONLY

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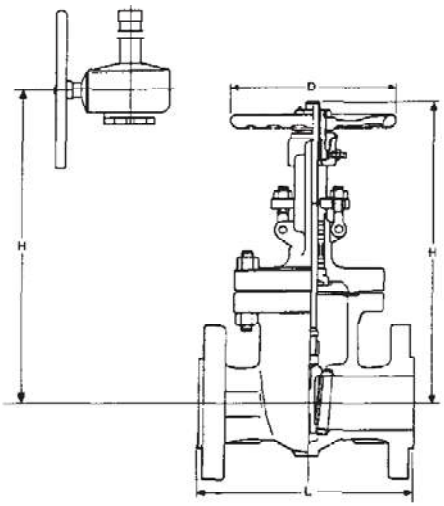
GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 212S
PRESSURE RATING CLASS	600
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSF OR WDF
GEAR OPERATED	YES >= 8"
BY-PASS VALVE	NO, SEE GEN. NOTE 4
NOMINAL SIZE	1 1/2" - 24"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT RING	A 182 Gr. F6a STELLITED
GATE	A 182 Gr. F6a STELLITED
STEM	13 Cr.
STEM PACKING	GRAPHOIL
TRIM NUMBER	5
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF		DOUBLE	SLIP ON OR SPLIT
PDF	PARALLEL		FLEXIBLE

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES >= 10" AND >= 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO API 600 AND MSS SP 45, LOCATION E-F

MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

a) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION

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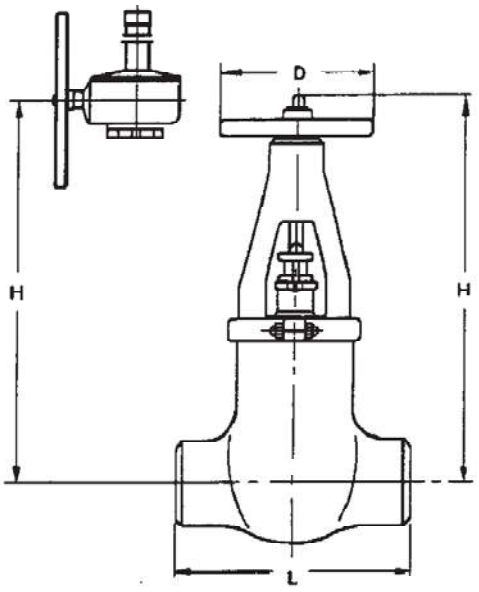
GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 216S
PRESSURE RATING CLASS	1500
FACE	BW
CONSTRUCTION	
BODY	CAST OR FORGED a)
BONNET TO BODY CONNECTION	PRESSURE SEAL
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSF OR WDF
GEAR OPERATED	YES > = 8"
BY-PASS VALVE	NO, SEE GEN. NOTE 4
NOMINAL SIZE	1 1/2" - 24"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT RING	A 182 Gr. F6a STELLITED
GATE	A 182 Gr. F6a STELLITED
STEM	13 Cr.
STEM PACKING	GRAPHOIL
TRIM NUMBER	8
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WOF		DOUBLE	SLIP ON OR SPLIT
PDF	PARALLEL		FLEXIBLE

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES > = 10" AND > = 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO API 600 AND MSS-SP 45, LOCATION E-F

MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

a) END TO END DIMENSION SHALL BE SHORT PATTERN
b) VALVE TO BE SUPPLIED WITH IBR CERFITICATION
c) VALVES > = 6" SHALL HAVE YOKE BUSHING THRUST BEARINGS

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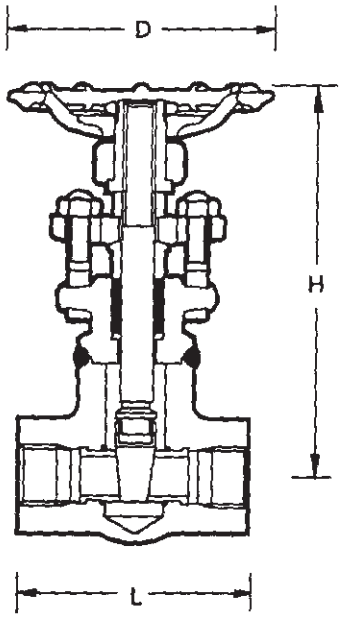
GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 305S
PRESSURE RATING CLASS	2500
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	WELDED
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSS
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 182 Gr. F22
BODY SEAT RING	A 182 Gr. F6a STELLITED
GATE	A 182 Gr. F6a STELLITED
STEM	13 Cr.
STEM PACKING	GRAPHOIL
TRIM NUMBER	5
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF		DOUBLE	SLIP ON OR SPLIT
PDF	PARALLEL		FLEXIBLE

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

a) LENGTH TO BE VERIFIED BY MANUFACTURER
b) VALVE TO BE SUPPLIED WITH IBR CERFITICATION

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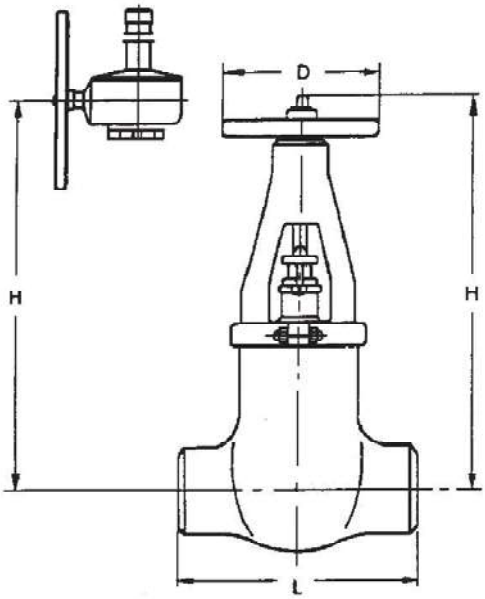
GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 326S
PRESSURE RATING CLASS	2500
FACE	BW
CONSTRUCTION	
BODY	CAST OR FORGED a)
BONNET TO BODY CONNECTION	PRESSURE SEAL
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSF OR WDF
GEAR OPERATED	YES > = 8"
BY-PASS VALVE	ND, SEE GEN. NOTE 4
NOMINAL SIZE	1 1/2" - 16"
MATERIALS	
BODY	A 217 Gr. WC9
BODY SEAT RING	A 182 Gr. F6a STELLITED
GATE	A 182 Gr. F6a STELLITED
STEM	13 Cr.
STEM PACKING	GRAPHOIL
TRIM NUMBER	5
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF		DOUBLE	SLIP ON OR SPLIT
PDF	PARALLEL		FLEXIBLE

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES > = 10" AND > = 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO API 600 AND MSS-SP 45, LOCATION E-F

MANDATORY STANDARDS:

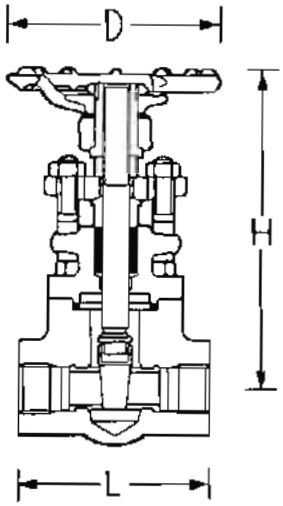
API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5. MSS-SP 45

NOTES:

a) END TO END DIMENSION SHALL BE SHORT PATTERN
b) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION
c) VALVES > = 6" SHALL HAVE YOKE BUSHING THRUST BEARINGS

PDIL

GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 401	
PRESSURE RATING CLASS	800	
FACE	SW	
CONSTRUCTION		
BODY	FORGED	
BONNET TO BODY CONNECTION	BOLTED	
HANDWHEEL	NON-RISING	
STEM	RISING	
STEM AND YOKE TYPE	OS & Y	
GATE TYPE	WSS	
GEAR OPERATED	NO	
BY-PASS VALVE	NO	
NOMINAL SIZE	1/2" - 1 1/2"	
MATERIALS		
BODY	A182 GR.F316L	rev.1
BODY SEAT RING	A182 GR.F316L	rev.1
GATE	A182 GR.F316L	rev.1
STEM	A182 GR.F316L	rev.1
STEM PACKING	GRAFOIL /GRAPHITE	
TRIM NUMBER	2	
DESIGN CONDITIONS		
PRESSURE RATING	API 602	

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF		DOUBLE	SLIP ON OR SPLIT
PDF	PARALLEL		FLEXIBLE

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

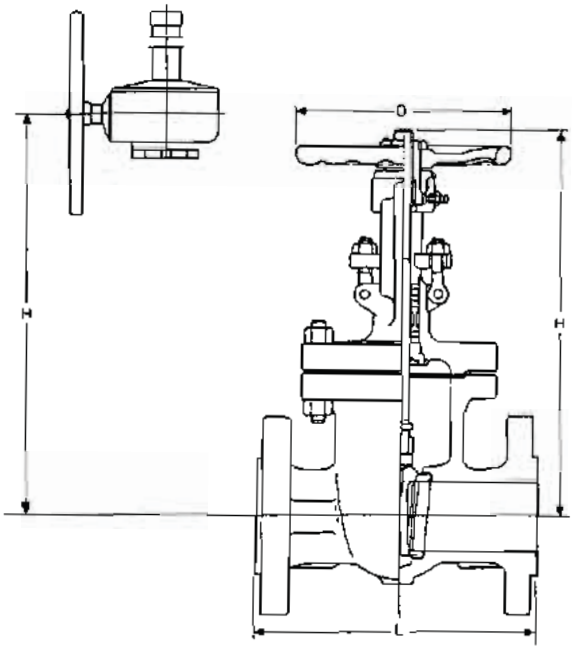
MANDATORY STANDARDS:

API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

a) LENGTH TO BE VERIFIED BY MANUFACTURER

GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 410
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSF OR WDF
GEAR OPERATED	YES > = 14"
BY-PASS VALVE	NO
NOMINAL SIZE	2" - 24"
MATERIALS	
BODY	A351 Gr.CF3M rev.1
BODY SEAT RING	A182 Gr.F316L rev.1
GATE	SS 316L rev.1
STEM	SS 316L rev.1
STEM PACKING	GRAFOIL /GRAPHITE
TRIM NUMBER	2
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF		DOUBLE	SLIP ON OR SPLIT
PDF	PARALLEL		FLEXIBLE

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES > = 10" AND > = 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO API 600 AND MSS-SP 45, LOCATION E-F

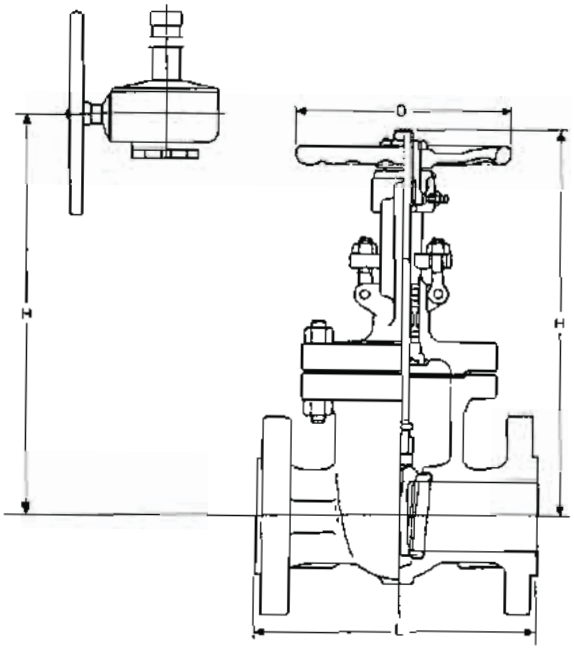
MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

PDIL

GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 411	
PRESSURE RATING CLASS	300	
FACE	RF	
CONSTRUCTION		
BODY	CAST	
BONNET TO BODY CONNECTION	BOLTED	
HANDWHEEL	NON-RISING	
STEM	RISING	
STEM AND YOKE TYPE	OS & Y	
GATE TYPE	WSF OR WDF	
GEAR OPERATED	YES > = 14"	
BY-PASS VALVE	NO	
NOMINAL SIZE	2" - 24"	
MATERIALS		
BODY	A351 Gr.CF3M	rev.1
BODY SEAT RING	A182 Gr.F316L	rev.1
GATE	SS 316L	rev.1
STEM	SS 316L	rev.1
STEM PACKING	GRAFOIL /GRAPHITE	
TRIM NUMBER	2	
DESIGN CONDITIONS		
PRESSURE RATING	ANSI B16.34	

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF		DOUBLE	SLIP ON OR SPLIT
PDF	PARALLEL		FLEXIBLE

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES > = 10" AND > = 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO API 600 AND MSS-SP 45, LOCATION E-F

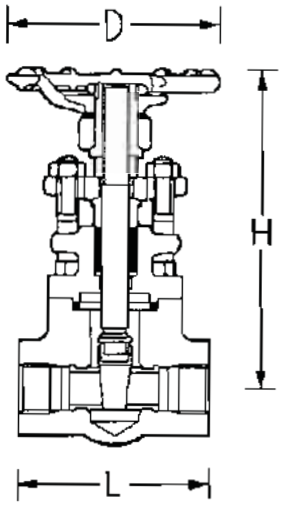
MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

PDIL

GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 501
PRESSURE RATING CLASS	800
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSS
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 182 Gr. F304
BODY SEAT RING	A 182 Gr. F304
GATE	A 182 Gr. F304
STEM	A 276 Gr. 304
STEM PACKING	GRAFOIL /GRAPHITE
TRIM NUMBER	2
DESIGN CONDITIONS	
PRESSURE RATING	API 602

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF		DOUBLE	SLIP ON OR SPLIT
PDF	PARALLEL		FLEXIBLE

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

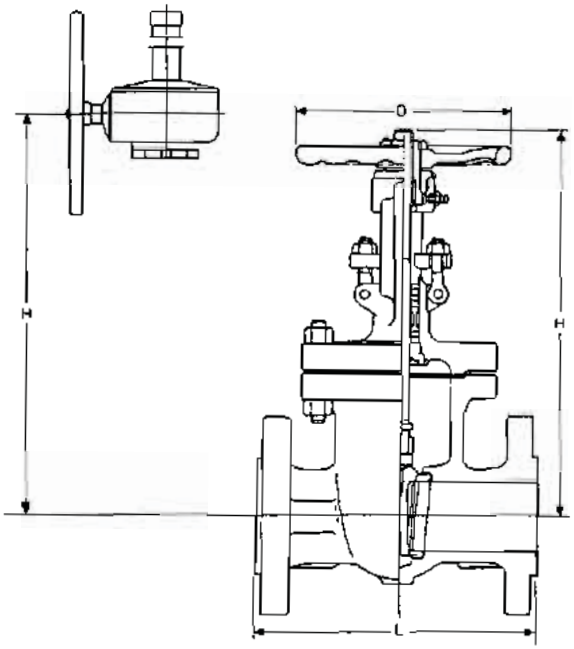
API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

a) LENGTH TO BE VERIFIED BY MANUFACTURER

PDIL

GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 510
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSF OR WDF
GEAR OPERATED	YES > = 14"
BY-PASS VALVE	NO
NOMINAL SIZE	2" - 24"
MATERIALS	
BODY	A 351 Gr. CF8
BODY SEAT RING	A 182 Gr. F304
GATE	AISI 304
STEM	A 276 Gr. 304
STEM PACKING	GRAFOIL /GRAPHITE
TRIM NUMBER	2
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF		DOUBLE	SLIP ON OR SPLIT
PDF	PARALLEL		FLEXIBLE

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES > = 10" AND > = 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO API 600 AND MSS-SP 45, LOCATION E-F

MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

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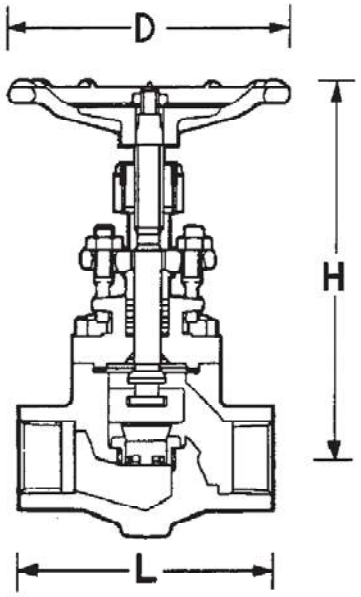
GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GLV 101
PRESSURE RATING CLASS	800
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	SWIVEL PLUG
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 350 Gr. LF2
BODY SEAT RING	AISI 304
DISC	AISI 304
STEM	AISI 304
STEM PACKING	GRAPHOIL
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	API 602

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602
b) LENGTH TO BE VERIFIED BY MANUFACTURER

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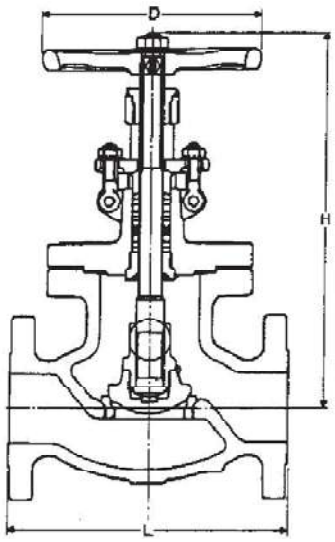
GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GLV 111
PRESSURE RATING CLASS	300
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	PARABOLIC
GEAR OPERATED	ND
BY-PASS VALVE	NO
NOMINAL SIZE	2" - 8"
MATERIALS	
BODY	A 352 Gr. LCB
BODY SEAT RING	AISI 304
DISC	AISI 304
STEM	AISI 304
STEM PACKING	GRAPHOIL
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34
FLUID	Kg/cm2g °C

RATED Cv VALUES: (+-10%)

SIZE	2"	3"	4"	6"	8"	10"	12"		
Cv	50	120	220	490	900	1400	2100		

GENERAL

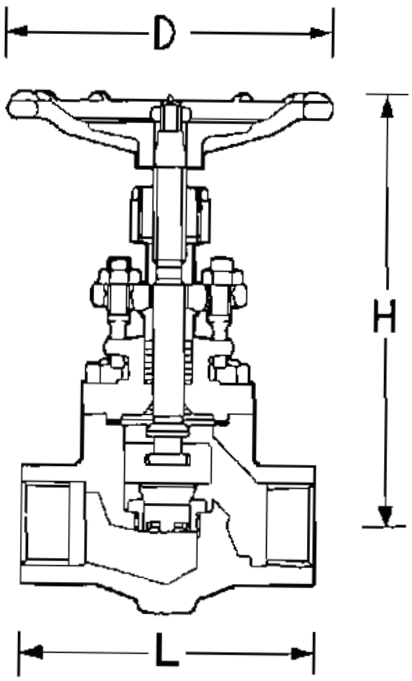
1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES >= 10" AND >= 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO ANSI B16.34 AND MSS-SP 45, LOCATION E-F

MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

PDIL

GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GLV 201
PRESSURE RATING CLASS	800
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	SWIVEL PLUG
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 105
BODY SEAT RING	A 182 Gr. F6a STELLITED
DISC	A 182 Gr. F6a
STEM (NO CASTING)	13 Cr.
STEM PACKING	GRAFOIL/GRAPHITE
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	API 602

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

API 598, API 602, ANSI B16.11, ANSI B16.34

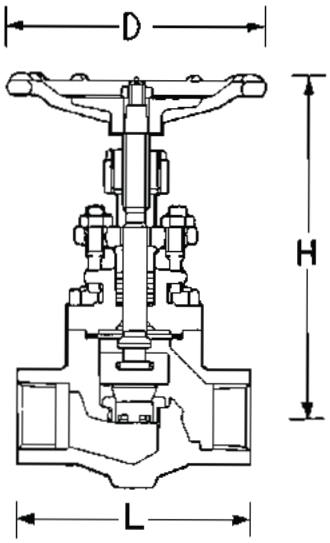
NOTES:

a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602
b) LENGTH TO BE VERIFIED BY MANUFACTURER

PDIL

rev.1

GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	**GLV 201S**
PRESSURE RATING CLASS	800
FACE	SW IBR
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	SWIVEL PLUG
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 105
BODY SEAT RING	A 182 Gr. F6a STELLITED
DISC	A 182 Gr. F6a
STEM	13 Cr.
STEM PACKING	GRAPHITE
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	API 602

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602
b) LENGTH TO BE VERIFIED BY MANUFACTURER
c) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION

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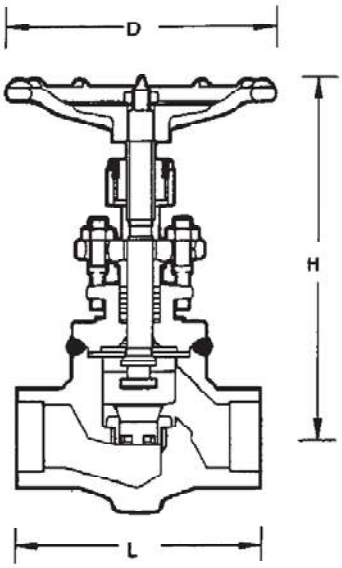
GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GLV 204S
PRESSURE RATING CLASS	1500
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	WELDED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	SWIVEL PLUG
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 105
BODY SEAT RING	A 182 Gr. F6a STELLITED
DISC	A 1B2 Gr. F6a STELLITED
STEM	13 Cr.
STEM PACKING	GRAPHOIL
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

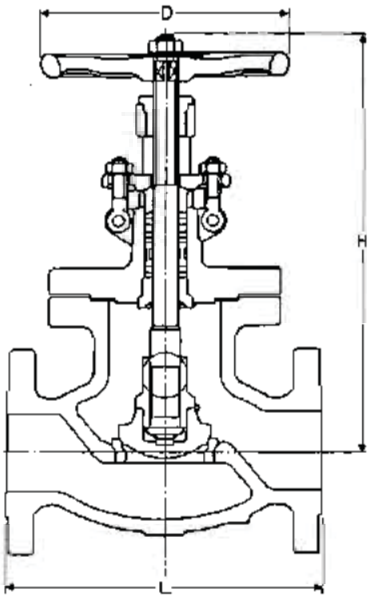
API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602
b) LENGTH TO BE VERIFIED BY MANUFACTURER
c) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION

PDIL

GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GLV 210
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	PARABOLIC
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	2" - 12"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT RING	A 105 STELLITED
DISC	A 216 Gr. WCB 13 Cr. FACING
STEM (NO CASTING)	13 Cr.
STEM PACKING	GRAFOIL/GRAPHITE
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

RATED Cv VALUES: (+-10%)

SIZE	2"	3"	4"	6"	8"	10"	12"		
Cv	50	120	220	490	900	1400	2100		

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES > = 10" AND > = 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO ANSI B16.34 AND MSS-SP 45, LOCATION E-F

MANDATORY STANDARDS:

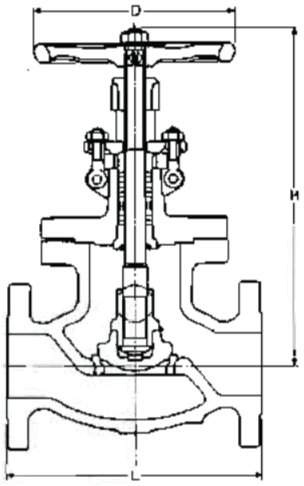
API 598, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

PDIL

GLOBE VALVE

rev.1



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GLV 210S
PRESSURE RATING CLASS	150
FACE	RF IBR
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	PARABOLIC
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	2" - 12"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT RING	A 105 STELLITED
DISC	A 216 Gr. WCB 13 Cr. FACING
STEM	13 Cr.
STEM PACKING	GRAPHITE
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

RATED Cv VALUES: (+-10%)

SIZE	2"	3"	4"	6"	8"	10"	12"		
Cv	50	120	220	490	900	1400	2100		

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES > = 10" AND > = 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO ANSI B16.34 AND MSS-SP 45, LOCATION E-F

MANDATORY STANDARDS:

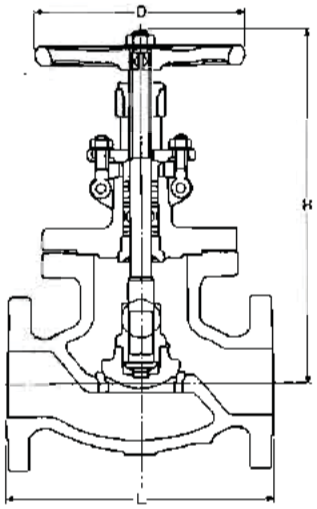
API 598, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

a) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION

PDIL

GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GLV 211
PRESSURE RATING CLASS	300
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	PARABOLIC
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	2" - 12"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT RING	A 105 STELLITED
DISC	A 216 Gr. WCB 13 Cr. FACING
STEM (NO CASTING)	13 Cr.
STEM PACKING	GRAFOIL
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

RATED Cv VALUES: (+-10%)

SIZE	2"	3"	4"	6"	8"	10"	12"		
Cv	50	120	220	490	900	1400	2100		

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES >= 10" AND >= 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO ANSI B16.34 AND MSS-SP 45, LOCATION E-F

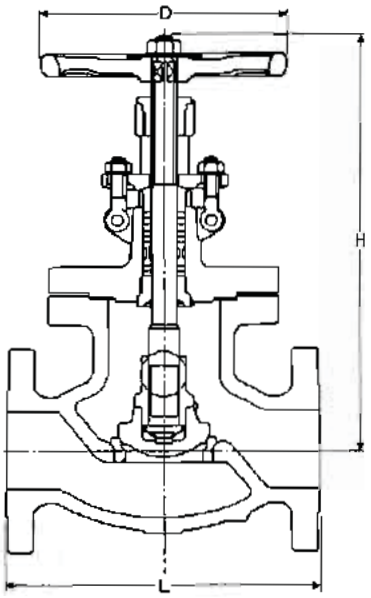
MANDATORY STANDARDS:

API 598, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

PDIL

GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GLV 212
PRESSURE RATING CLASS	600
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	PARABOLIC
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	2" - 8"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT RING	A 105 STELLITED
DISC	A 216 Gr. WCB 13 Cr. FACING
STEM	13 Cr.
STEM PACKING	Grafoil
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

RATED Cv VALUES: (+-10%)

SIZE	2"	3"	4"	6"	8"	10"	12"		
Cv	50	120	220	490	900	1400	2100		

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES > = 10" AND > = 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO ANSI B16.34 AND MSS-SP 45, LOCATION E-F

MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

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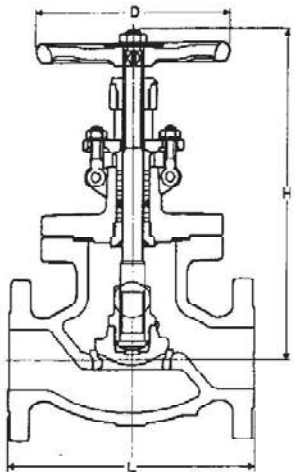
GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GLV 212S
PRESSURE RATING CLASS	600
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	PARABOLIC
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	2" - 8"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT RING	A 182 Gr. F6a STELLITED
DISC	A 182 Gr. F6a STELLITED
STEM	13 Cr.
STEM PACKING	GRAPHOIL
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

RATED Cv VALUES: (+-10%)

SIZE	2"	3"	4"	6"	8"	10"	12"
Cv	50	120	220	490	900	1400	2100

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES >= 10" AND >= 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO ANSI B16.34 AND MSS-SP 45, LOCATION E-F

MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

a) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION

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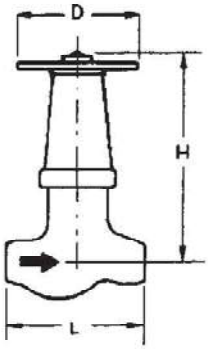
GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GLV 216S
PRESSURE RATING CLASS	1500
FACE	BW
CONSTRUCTION	
BODY	CAST OR FORGED a)
BONNET TO BODY CONNECTION	PRESSURE SEAL c)
HANDWHEEL	NON-RISING c)
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	PARABOLIC
GEAR OPERATED	YES >= 8"
BY-PASS VALVE	NO
NOMINAL SIZE	1 1/2" - 8"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT RING	INTEGRAL STELLITED
DISC	A 182 Gr. F6a STELLITED
STEM	13 Cr.
STEM PACKING	GRAPHOIL
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	ANSI 816.34

RATED Cv VALUES: (+-10%)

SIZE	2"	3"	4"	6"	8"		1½		
Cv	50	120	220	490	900		30		

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES >= 10" AND >= 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO ANSI B16.34 AND MSS-SP 45, LOCATION E-F

MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

a) END TO END DIMENSION SHALL BE SHORT PATTERN
b) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION
c) WELDED BONNET AND RISING STEM ARE ACCEPTABLE FOR SIZE 1 1/2"
d) VALVES >= 6" SHALL HAVE YOKE BUSHING THRUST BEARINGS

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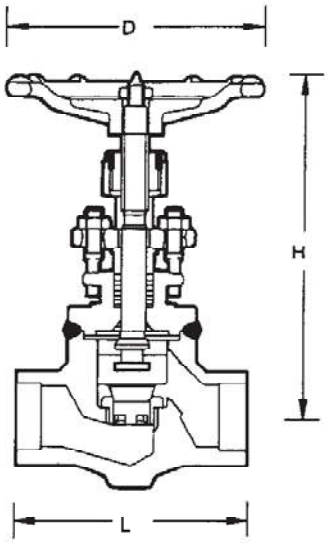
GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GLV 305S
PRESSURE RATING CLASS	2500
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	WELDED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	SWIVEL PLUG
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 182 Gr. F22
BODY SEAT RING	A 182 Gr. F6a STELLITED
DISC	A 182 Gr. F6a STELLITED
STEM	13 Cr.
STEM PACKING	GRAPHOIL
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602
b) LENGTH TO BE VERIFIED BY MANUFACTURER
c) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION

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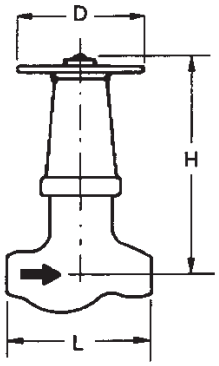
GLOBE VALVE



ITEM NO	GLV 326S
PRESSURE RATING CLASS	2500
FACE	BW
CONSTRUCTION	
BODY	CAST OR FORGED a)
BONNET TO BODY CONNECTION	PRESSURE SEAL
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	PARABOLIC
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	2" - 4"
MATERIALS	
BODY	A 217 Gr. WC9
BODY SEAT RING	INTEGRAL STELLITED
DISC	A 182 Gr. F6a STELLITED
STEM	13 Cr.
STEM PACKING	GRAPHOIL
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

DESIGN (ILLUSTRATIVE ONLY)

RATED Cv VALUES: (+-10%)

SIZE	2"	3"	4"	6"	8"				
Cv	50	120	220	490	900				

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES > = 10" AND > = 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO ANSI B16.34 AND MSS-SP 45, LOCATION E-F

MANDATORY STANDARDS:

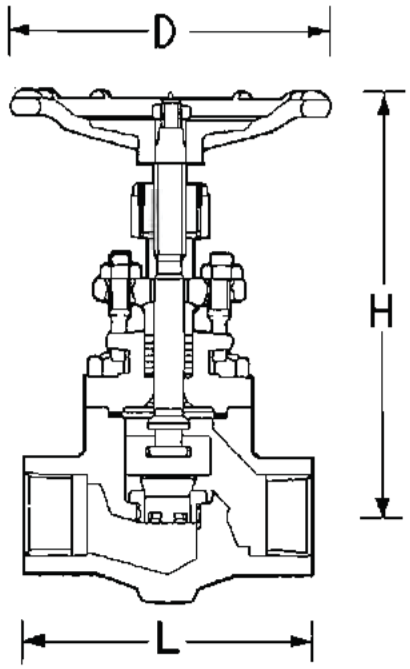
API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

a) END TO END DIMENSION SHALL BE SHORT PATTERN
b) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION

PDIL

GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	**GLV** 401	
PRESSURE RATING CLASS	800	
FACE	SW	
CONSTRUCTION		
BODY	FORGED	
BONNET TO BODY CONNECTION	BOLTED	
HANDWHEEL	RISING	
STEM	RISING	
STEM AND YOKE TYPE	OS & Y	
DISC TYPE	SWIVEL PLUG	
GEAR OPERATED	NO	
BY-PASS VALVE	NO	
NOMINAL SIZE	1/2" - 1 1/2"	
MATERIALS		
BODY	A182 GR.F316L	rev.1
BODY SEAT RING	A182 GR.F316L	rev.1
DISC	A182 GR.F316L	rev.1
STEM	SS316L	rev.1
STEM PACKING	GRAFOIL	
TRIM NUMBER		
DESIGN CONDITIONS		
PRESSURE RATING	API 602	

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602
b) LENGTH TO BE VERIFIED BY MANUFACTURER

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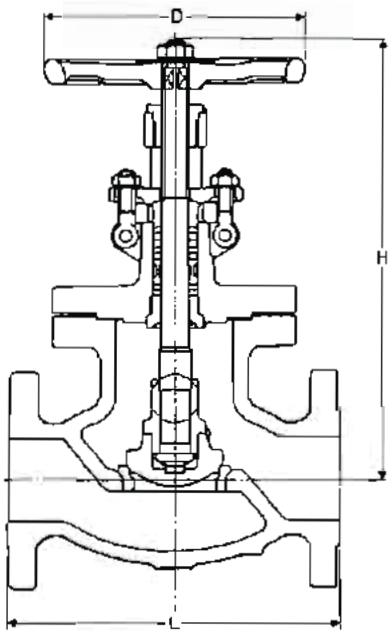
GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GLV 410
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	PARABOLIC
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	2"-24"
MATERIALS	
BODY	A 351 GR.CF3M rev.1
BODY SEAT RING	A182 GR.F316L rev.1
DISC	AISI 316L rev.1
STEM	AISI 316L rev.1
STEM PACKING	GRAFOIL
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

RATED Cv VALUES: (+-10%)

SIZE	2"	3"	4"	6"	8"	10"	12"		
Cv	50	120	220	490	900	1400	2100		

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES > = 10" AND > = 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO ANSI B16.34 AND MSS-SP 45, LOCATION E-F

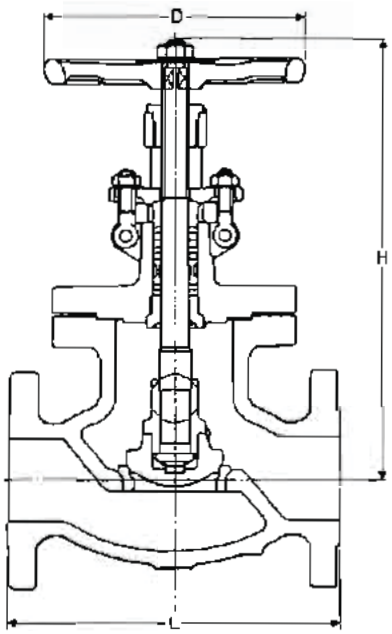
MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

PDIL

GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GLV411
PRESSURE RATING CLASS	300
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	PARABOLIC
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	2"-24"
MATERIALS	
BODY	A 351 GR.CF3M
BODY SEAT RING	A182 GR.F316L
DISC	AISI 316L
STEM	AISI 316L
STEM PACKING	GRAFOIL
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

RATED Cv VALUES: (+-10%)

SIZE	2"	3"	4"	6"	8"	10"	12"		
Cv	50	120	220	490	900	1400	2100		

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES > = 10" AND > = 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO ANSI B16.34 AND MSS-SP 45, LOCATION E-F

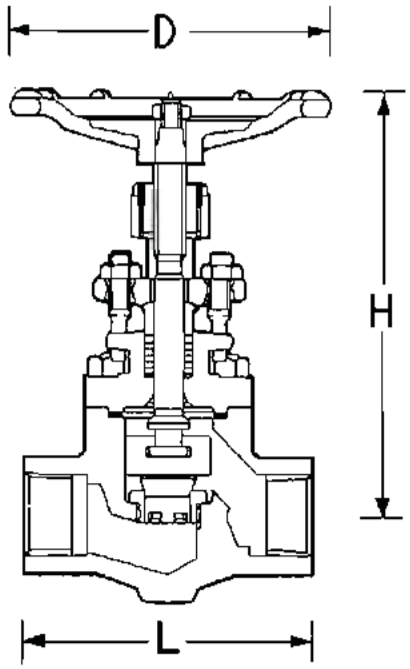
MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

PDIL

GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	**GLV 501**
PRESSURE RATING CLASS	800
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	SWIVEL PLUG
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 182 Gr. F304
BODY SEAT RING	A 182 Gr. F304
DISC	A 182 Gr. F304
STEM	A 276 Gr. 304
STEM PACKING	GRAFOIL
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	API 602

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

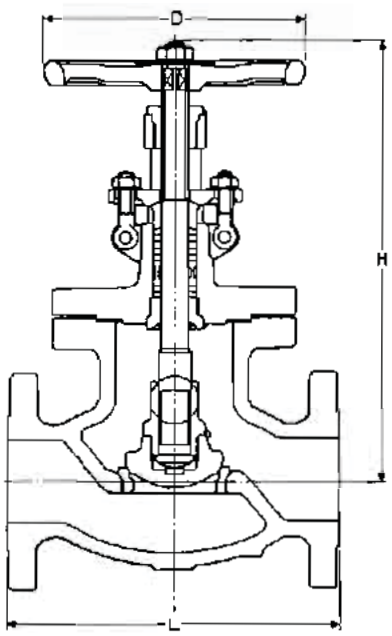
API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602
b) LENGTH TO BE VERIFIED BY MANUFACTURER

PDIL

GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GLV 510
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	PARABOLIC
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	2" - 8"
MATERIALS	
BODY	A 351 Gr. CF8
BODY SEAT RING	A 182 Gr. F304
DISC	AISI 304
STEM	A 276 Gr. 304
STEM PACKING	GRAFOIL
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

RATED Cv VALUES: (+-10%)

SIZE	2"	3"	4"	6"	8"	10"	12"		
Cv	50	120	220	490	900	1400	2100		

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES > = 10" AND > = 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO ANSI B16.34 AND MSS-SP 45, LOCATION E-F

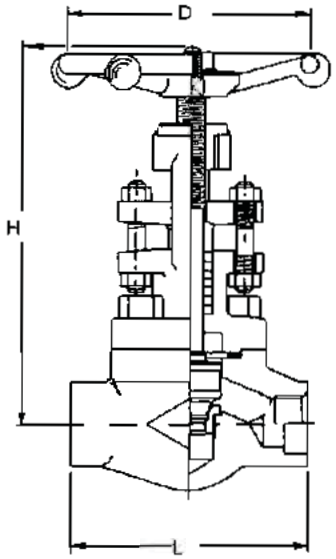
MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

PDIL

NEEDLE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	NEV 501	
PRESSURE RATING CLASS	800	
FACE	SW	
CONSTRUCTION		
BODY	FORGED b)	
BONNET TO BODY CONNECTION	BOLTED	
HANDWHEEL	RISING	
STEM	RISING	
STEM AND YOKE TYPE	OS & Y	
DISC TYPE	SWIVEL NEEDLE	
GEAR OPERATED	NO	
BY-PASS VALVE	NO	
NOMINAL SIZE	1/2" - 1 1/2"	
MATERIALS		
BODY	A 182 Gr. F316	
BODY SEAT RING	INTEGRAL STELLITED	
DISC	A 182 Gr. F316 STELLITED	
STEM	A 276 Gr. 316	
STEM PACKING	GRAFOIL	
TRIM NUMBER		
DESIGN CONDITIONS		
PRESSURE RATING	API 602	
FLUID	Kg/cm2g	°C

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602
b) REDUCED BORE (LOW VOLUME TYPE)

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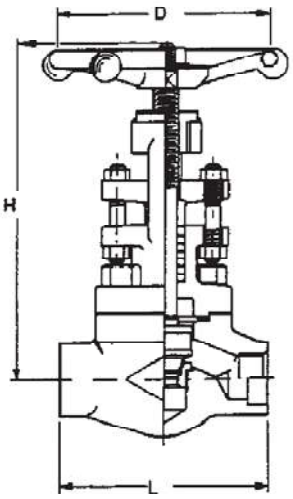
NEEDLE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	NEV 501S
PRESSURE RATING CLASS	800
FACE	SW
CONSTRUCTION	
BODY	FORGED b)
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	DS & Y
DISC TYPE	SWIVEL NEEDLE
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 182 Gr. F316
BODY SEAT RING	INTEGRAL STELLITED
DISC	A 182 Gr. F316 STELLITED
STEM	A 276 Gr. 316
STEM PACKING	GRAPHOIL
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	API 602

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

API 598, API 602, ANSI B16.11, ANSI B16.34

NDTES:

a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602
b) REDUCED BORE (LOW VOLUME TYPE)
c) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION

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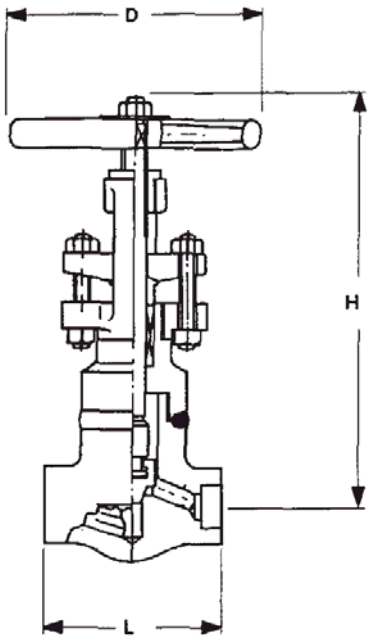
NEEDLE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	NEV 502S
PRESSURE RATING CLASS	1500
FACE	SW
CONSTRUCTION	
BODY	FORGED b)
BONNET TO BODY CONNECTION	WELDED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	SWIVEL NEEDLE
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 182 Gr. F316
BODY SEAT RING	INTEGRAL STELLITED
DISC	A 182 Gr. F316 STELLITED
STEM	A 276 Gr. 316
STEM PACKING	GRAPHOIL
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602
b) REDUCED BORE (LOW VOLUME TYPE)
c) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION

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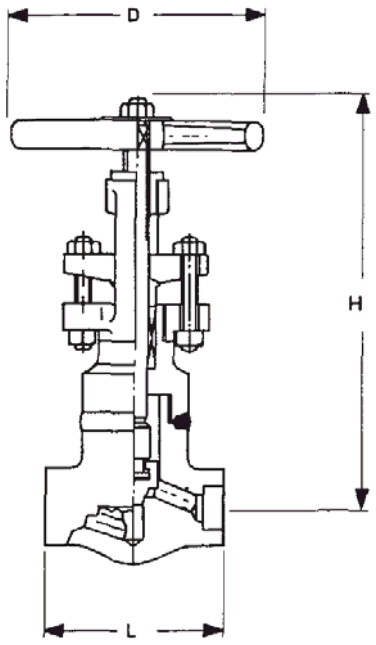
NEEDLE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	NEV 503S
PRESSURE RATING CLASS	2500
FACE	SW
CONSTRUCTION	
BODY	FORGED b)
BONNET TO BODY CONNECTION	WELDED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	SWIVEL NEEDLE
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 182 Gr. F316
BODY SEAT RING	INTEGRAL STELLITED
DISC	A 182 Gr. F316 STELLITED
STEM	A 276 Gr. 316
STEM PACKING	GRAPHOIL
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	ANSI 816.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

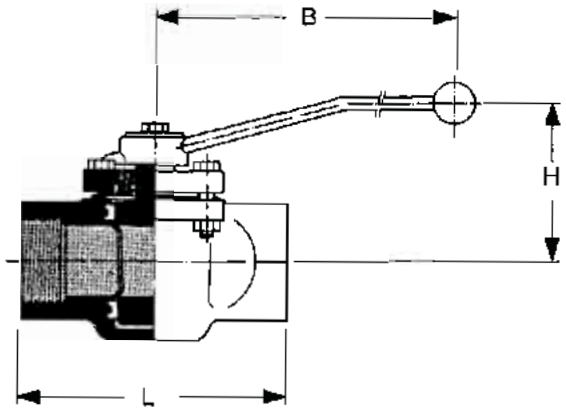
API 598, API 602, ANSI 816.11, ANSI B16.34

NOTES:

a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602
b) REDUCED BORE (LOW VOLUME TYPE)
c) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION

PDIL

PLUG VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	PLV 201
PRESSURE RATING CLASS	600
FACE	TREADED (NPT)
CONSTRUCTION	
BODY	FULL BORE NON-LUBRICATED
PLUG	TAPER PLUG
WRENCH OPERATED	YES
GEAR OPERATED	NO
FIRE SAFE	NO
NOMINAL SIZE	1/2" - 1"
MATERIALS	
BODY	A 105 a)
PLUG	A 105 CHROMEPLATED a)
BODY SEAT RING	REINFORCED PTFE
STEM PACKING	PTFE
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

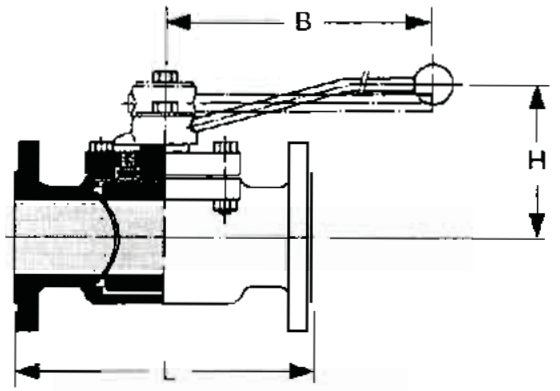
API 598, API 6D, ANSI B16.11, ANSI B16.34

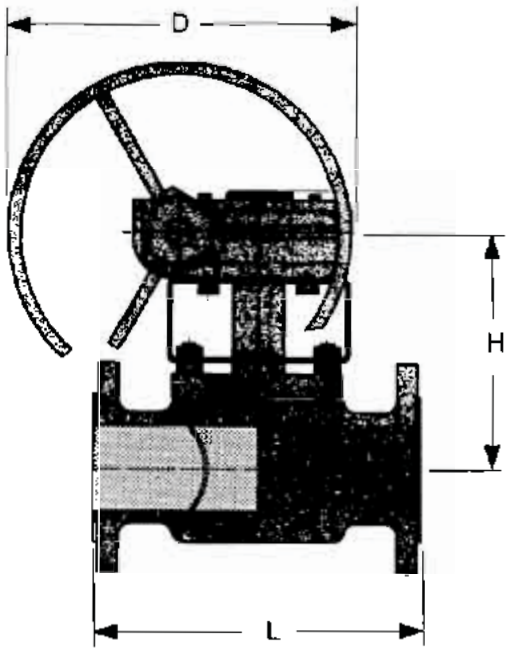
NOTES:

a) EQUIVALENT CAST MATERIAL IS ACCEPTABLE

PDIL

PLUG VALVE





DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	PLV 202
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	NON-LUBRICATED FULL BORE
PLUG	TAPER PLUG
WRENCH OPERATED	1 1/2" - 4"
GEAR OPERATED	6"
FIRE SAFE	NO
NOMINAL SIZE	1 1/2" - 6"
MATERIALS	
BODY	A 216 Gr. WCB
PLUG	A 105 CHROMEPLATED a)
BODY SEAT RING	REINFORCED PTFE
STEM PACKING	PTFE
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

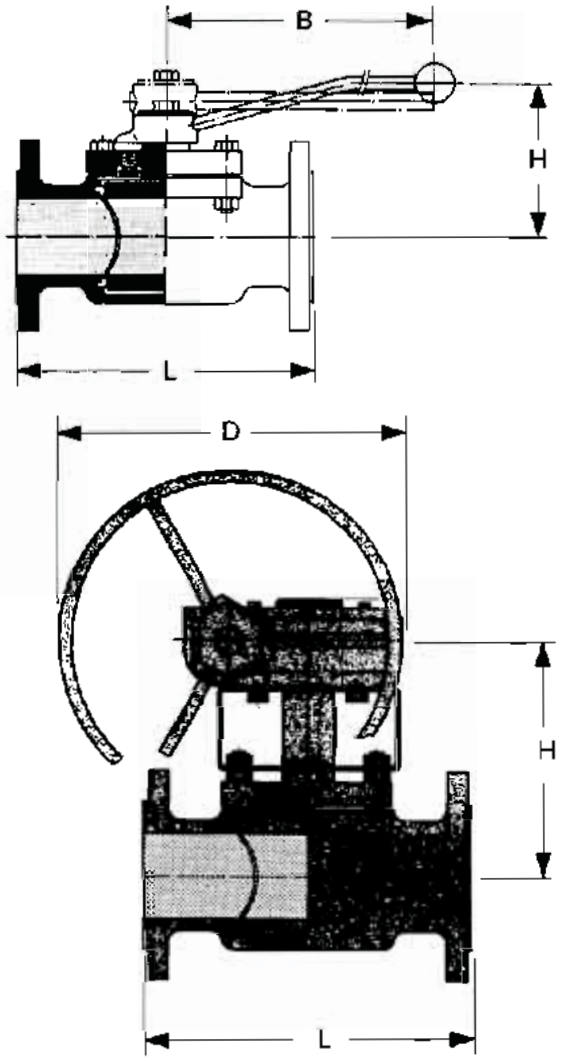
API 598, API 599, ANSI B16.10, ANSI B16.5

NOTES:

a) EQUIVALENT CAST MATERIAL IS ACCEPTABLE

PDIL

PLUG VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	PLV 205
PRESSURE RATING CLASS	300
FACE	RF
CONSTRUCTION	
BODY	NON-LUBRICATED FULL BORE
PLUG	TAPER PLUG
WRENCH OPERATED	1 1/2" - 4"
GEAR OPERATED	6"
FIRE SAFE	NO
NOMINAL SIZE	1 1/2" - 6"
MATERIALS	
BODY	A 216 Gr. WCB
PLUG	A 105 CHROMEPLATED a)
BODY SEAT RING	REINFORCED PTFE
STEM PACKING	PTFE
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

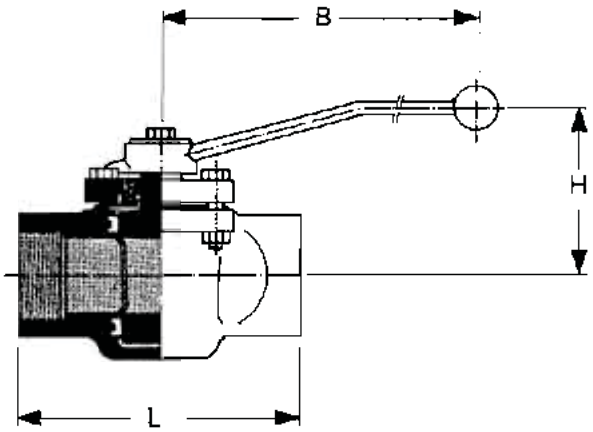
API 598, API 599, ANSI B16.10, ANSI B16.5

NOTES:

a) EQUIVALENT CAST MATERIAL IS ACCEPTABLE

PDIL

PLUG VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	PLV 501
PRESSURE RATING CLASS	600
FACE	TREADED (NPT)
CONSTRUCTION	
BODY	FULL BORE NON-LUBRICATED
PLUG	TAPER PLUG
WRENCH OPERATED	YES
GEAR OPERATED	NO
FIRE SAFE	NO
NOMINAL SIZE	1/2" - 1"
MATERIALS	
BODY	AISI 316
PLUG	AISI 316
BODY SEAT RING	REINFORCED PTFE
STEM PACKING	PTFE
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

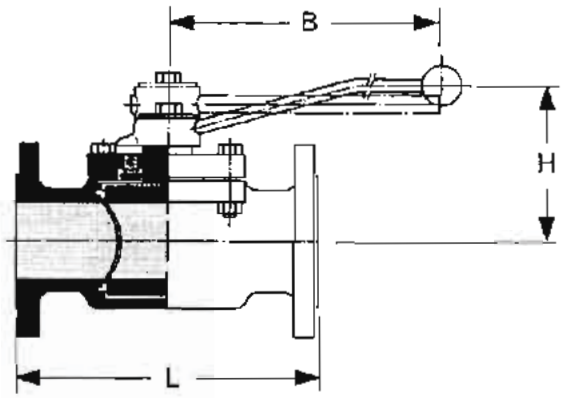
MANDATORY STANDARDS:

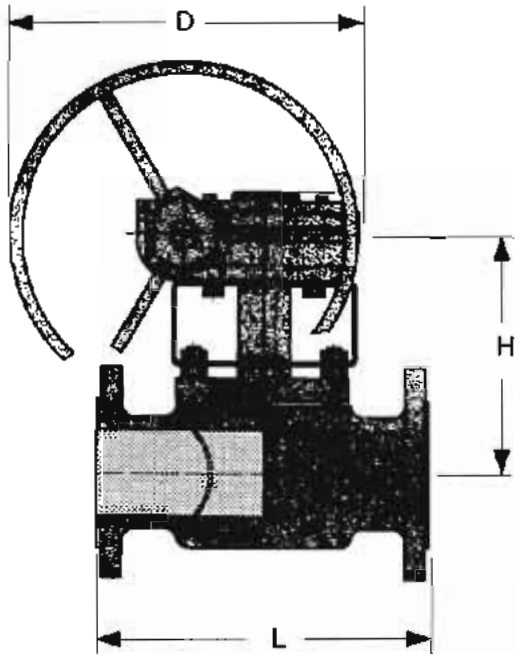
API 598, API 6D, ANSI B16.11, ANSI B16.34

NOTES:

PDIL

PLUG VALVE





DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	PLV 510
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	NON-LUBRICATED FULL BORE
PLUG	TAPER PLUG
WRENCH OPERATED	1 1/2" - 4"
GEAR OPERATED	6"
FIRE SAFE	NO
NOMINAL SIZE	1 1/2" - 6"
MATERIALS	
BODY	A 351 Gr. CF8M
PLUG	A 182 Gr. F316 a)
BODY SEAT RING	REINFORCED PTFE
STEM PACKING	PTFE
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

API 598, API 599, ANSI B16.10, ANSI B16.5

NOTES:

a) EQUIVALENT CAST MATERIAL IS ACCEPTABLE

GAV500C :FLANGED GATE VALVE ; 150# ;CPVC BODY(ASTM F441);POLY PROPYLENE PLUG; EPDM SEALS ;TAPERED CYLINDRICAL PLUG DESIGN; BOLTED BONNET; FLAT FACE; FLANGE DIMENSION AS PER ASME B16.1 .

CHV500C :SOCKET WELD CHECK VALVE ; 150# ; H OR V ; UNION OR BOLTED COVER ; BALL TYPE CPVC BODY(ASTM F441);TRIM AS PER BODY MATERIAL ; SOCKET WELD ENDS AS PER ASME B16.11 MANUFACTURER'S STANDARD CONSTRUCTION .

BAV500C :SOCKET WELD BALL VALVE ; 150# ; FLOATING BALL;FULL PORT ;WRENCH OPERATED ; CPVC BODY(ASTM F441);CPVC BALL;VITON O RING SEALS; SOCKET WELD ENDS AS PER ASME B16.11 MANUFACTURER'S STANDARD CONSTRUCTION .

BAV501C : FLANGED BALL VALVE ; 150# ; FLOATING BALL;FULL PORT ;WRENCH OPERATED ; CPVC BODY(ASTM F441);CPVC BALL;VITON O RING SEALS; FLAT FACE; FLANGE DIMENSION AS PER ASME B16.1 ;MANUFACTURER'S STANDARD CONSTRUCTION .

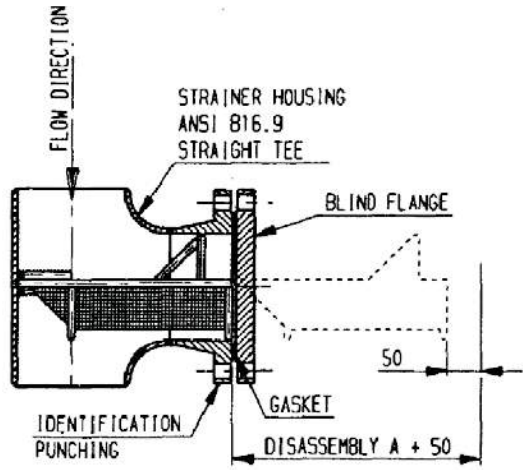
DPV500 : DIAPHRAGM VALVE :150#; RUBBER DIAPHRAGM; FLANGED END; BODY ASTM A216GR.WCB RUBBER LINED ; BONNET ASTM A216 GR.WCB ; STEM/COMPRESSOR 13% CR. ; MANUFACTURER'S STANDARD CONSTRUCTION. rev.1

DPV501 : DIAPHRAGM VALVE :150#; RUBBER DIAPHRAGM; FLANGED END; BODY AUSTENITIC SS 304 ; BONNET SS304 ; STEM/COMPRESSOR SS304 ; MANUFACTURER'S STANDARD CONSTRUCTION. rev.1

STRAINER DATA SHEETS

PDIL

T -TYPE STRAINER



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	TTS 210	
PRESSURE RATING CLASS	150	
FACE	RF	
CONSTRUCTION		
BODY	CAST	
BODY TO BONNET CONNECTION	BOLTED	
STRAINER	PERFORATED PLATE	
STRAINER HOLES, SIZE	Ø 1,5 MM	
NOS STRAINER HOLES / SQ.CM	18	
BLOW OFF CONNECTION	NOTE 1	
NOMINAL SIZE	2" - 24"	
MATERIALS		
BODY	A 216 Gr. WCB	
STRAINER	AISI 304	
DESIGN CONDITIONS		
PRESSURE RATING	ASME B16.34	
FLUID	Kg/cm2g	°C

GENERAL

1. STRAINER MUST BE REMOVABLE
2. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

ASME B16.34, ASME B16.5, MSS-SP 45

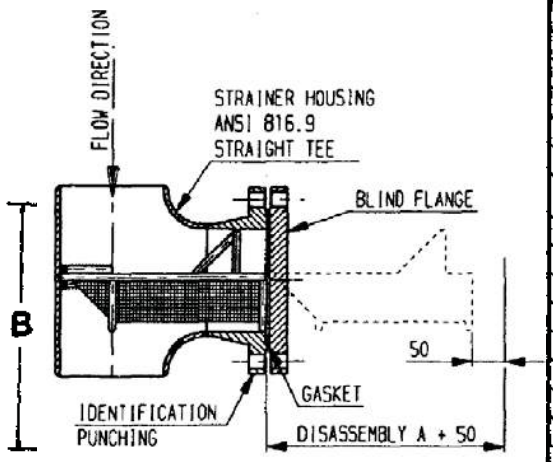
NOTES:

1.

STRAINER SIZE	-	BLOW OFF CONNECTION
2" - 4"		3/4" NPT PLUG
6" - 8"		1" NPT PLUG
10"		1 1/4" NPT PLUG
12" - 24"		1 1/2" NPT PLUG

PDIL

T-TYPE STRAINER



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	TTS 510	
PRESSURE RATING CLASS	150	
FACE	RF	
CONSTRUCTION		
BODY	CAST	
BODY TO BONNET CONNECTION	BOLTED	
STRAINER	PERFORATED PLATE	
STRAINER HOLES, SIZE	Ø 1,5 MM	
NOS STRAINER HOLES / SQ.CM	18	
BLOW OFF CONNECTION	NOTE 1	
NOMINAL SIZE	2" - 24"	
MATERIALS		
BODY	A 351 Gr. CF8	
STRAINER	AISI 304	
DESIGN CONDITIONS		
PRESSURE RATING	ASME B16.34	
FLUID	Kg/cm2g	°C

GENERAL

1. STRAINER MUST BE REMOVABLE
2. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

ASME B16.34, ASME B16.5, MSS-SP 45

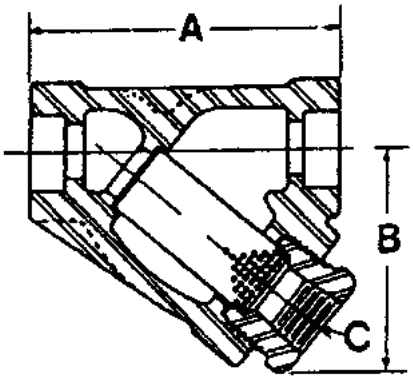
NOTES:

1.

STRAINER SIZE	-	BLOW OFF CONNECTION
2" - 4"		3/4" NPT PLUG
6" - 8"		1" NPT PLUG
10"		1 1/4" NPT PLUG
12" - 24"		1 1/2" NPT PLUG

PDIL

Y-TYPE STRAINER



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	YTS 201	
PRESSURE RATING CLASS	600	
FACE	SW	
CONSTRUCTION		
BODY	FORGED	
BODY TO BONNET CONNECTION	SCREWED	
STRAINER	PERFORATED PLATE	
STRAINER HOLES, SIZE	Ø 0,8 MM	
NOS STRAINER HOLES / SQ.CM	40	
BLOW OFF CONNECTION	NOTE 1	
NOMINAL SIZE	1/2" - 1 1/2"	
MATERIALS		
BODY	A 105	
STRAINER	AISI 304	
DESIGN CONDITIONS		
PRESSURE RATING	ASME B16.34	
FLUID	Kg/cm2g	°C

GENERAL

1. STRAINER MUST BE REMOVABLE
2. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

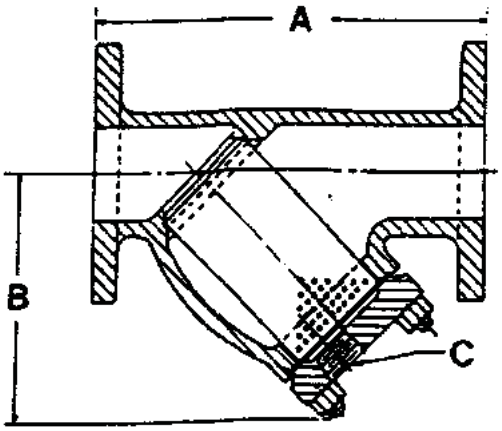
ASME B16.11, ASME B16.34

NOTES:

1. STRAINER SIZE - BLOW OFF CONNECTION
   1/2" - 3/4" 1/4" NPT PLUG
   1" - 1 1/2" 3/4" NPT PLUG

PDIL

Y-TYPE STRAINER



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	YTS 210	
PRESSURE RATING CLASS	150	
FACE	RF	
CONSTRUCTION		
BODY	CAST	
BODY TO BONNET CONNECTION	BOLTED	
STRAINER	PERFORATED PLATE	
STRAINER HOLES, SIZE	Ø 1,5 MM	
NOS STRAINER HOLES / SQ.CM	18	
BLOW OFF CONNECTION	NOTE 1	
NOMINAL SIZE	2" - 24"	
MATERIALS		
BODY	A 216 Gr. WCB	
STRAINER	AISI 304	
DESIGN CONDITIONS		
PRESSURE RATING	ASME B16.34	
FLUID	Kg/cm2g	°C

GENERAL

1. STRAINER MUST BE REMOVABLE
2. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

ASME B16.34, ASME B16.5, MSS-SP 45

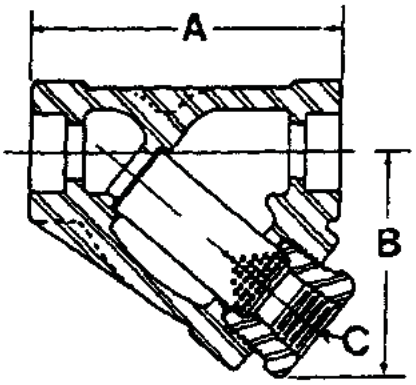
NOTES:

1.

STRAINER SIZE	BLOW OFF CONNECTION
2" - 4"	3/4" NPT PLUG
6" - 8"	1" NPT PLUG
10"	1 1/4" NPT PLUG
12" - 24"	1 1/2" NPT PLUG

PDIL

Y-TYPE STRAINER



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	YTS 501	
PRESSURE RATING CLASS	600	
FACE	SW	
CONSTRUCTION		
BODY	FORGED	
BODY TO BONNET CONNECTION	SCREWED	
STRAINER	PERFORATED PLATE	
STRAINER HOLES, SIZE	Ø 0,8 MM	
NOS STRAINER HOLES / SQ.CM	40	
BLOW OFF CONNECTION	NOTE 1	
NOMINAL SIZE	1/2" - 1 1/2"	
MATERIALS		
BODY	A 182 Gr. F304	
STRAINER	AISI 304	
DESIGN CONDITIONS		
PRESSURE RATING	ASME B16.34	
FLUID	Kg/cm2g	°C

GENERAL

1. STRAINER MUST BE REMOVABLE
2. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

ASME B16.11, ASME B16.34

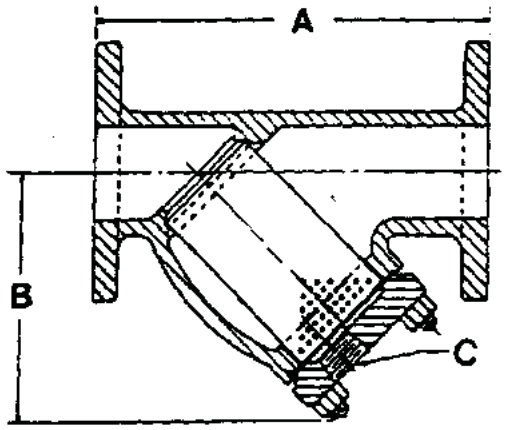
NOTES:

1.

STRAINER SIZE	BLOW OFF CONNECTION
1/2" - 3/4"	1/4" NPT PLUG
1" - 1 1/2"	3/4" NPT PLUG

PDIL

Y-TYPE STRAINER



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	YTS 510	
PRESSURE RATING CLASS	150	
FACE	RF	
CONSTRUCTION		
BODY	CAST	
BODY TO BONNET CONNECTION	BOLTED	
STRAINER	PERFORATED PLATE	
STRAINER HOLES, SIZE	Ø 1,5 MM	
NOS STRAINER HOLES / SQ.CM	18	
BLOW OFF CONNECTION	NOTE 1	
NOMINAL SIZE	2" - 24"	
MATERIALS		
BODY	A 351 Gr. CF8	
STRAINER	AISI 304	
DESIGN CONDITIONS		
PRESSURE RATING	ASME B16.34	
FLUID	Kg/cm2g	°C

GENERAL

1. STRAINER MUST BE REMOVABLE
2. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

ASME B16.34, ASME B16.5, MSS-SP 45

NOTES:

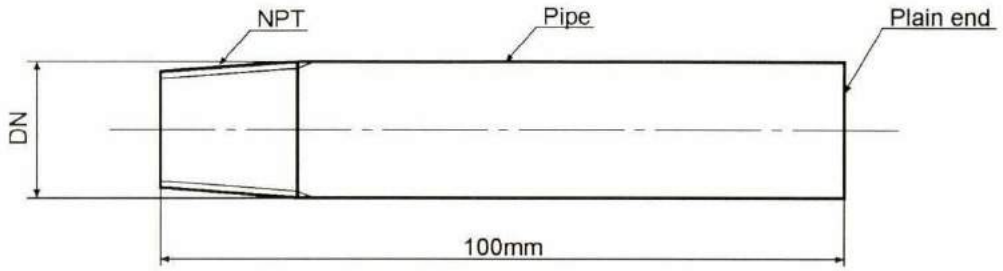
1. STRAINER SIZE - BLOW OFF CONNECTION

STRAINER SIZE	BLOW OFF CONNECTION
2" - 4"	3/4" NPT PLUG
6" - 8"	1" NPT PLUG
10"	1 1/4" NPT PLUG
12" - 24"	1 1/2" NPT PLUG

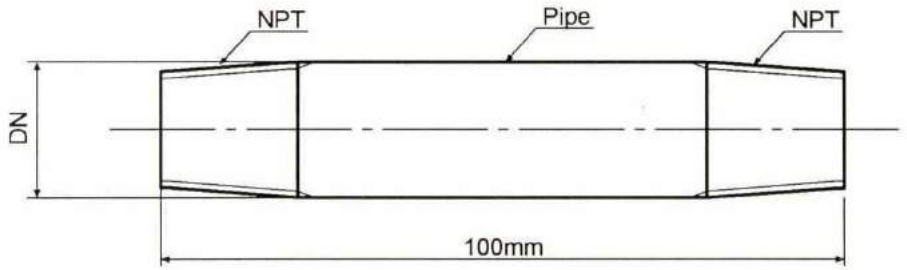
OTHER STANDARDS/DATASHEETS

NIPPLES

1) Half nipple (1/2-nipple)



2) Nipple

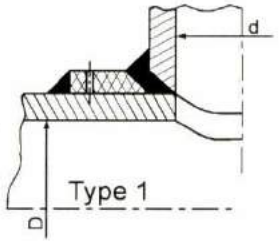


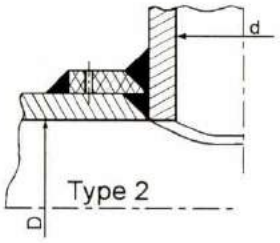
DN = 1/2", 3/4", 1" or 11/2"
Schedule and material of pipe acc. to
piping class specification

Threading acc. to ANSI B 1.20.1-1983

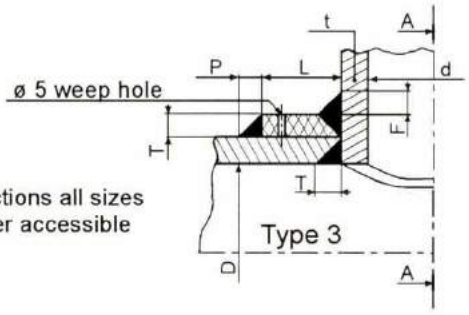
REINFORCING RINGS

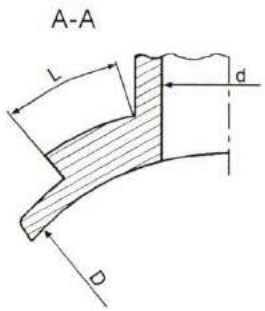
Branch connections-sizes under 24"
inside of header inaccessible





Branch connections all sizes
inside of header accessible





1. Reinforcing of branch connections shall be in accordance with limitations given in the General Piping Specification.
"Reinforcing rings" shall conform to the requirements of this specification.

2. All welds are to be continuous. Fillet welds to have concave contour.

3. Backchipping or gouging to sound metal before welding reverse side is required.

4. The periphery of the cut hole should be examined for laminations when using type 1.

5. Weld details for inclined nozzles are to be similar to the details shown for 90 degree nozzles.

6: The type must be determined by the frabricator.

Legend

T - Thickness of reinforcing ring, to be of the same thickness as header and of equal or better material. Preferably cut from header.

P - Fillet weld leg dimension, equal to T.

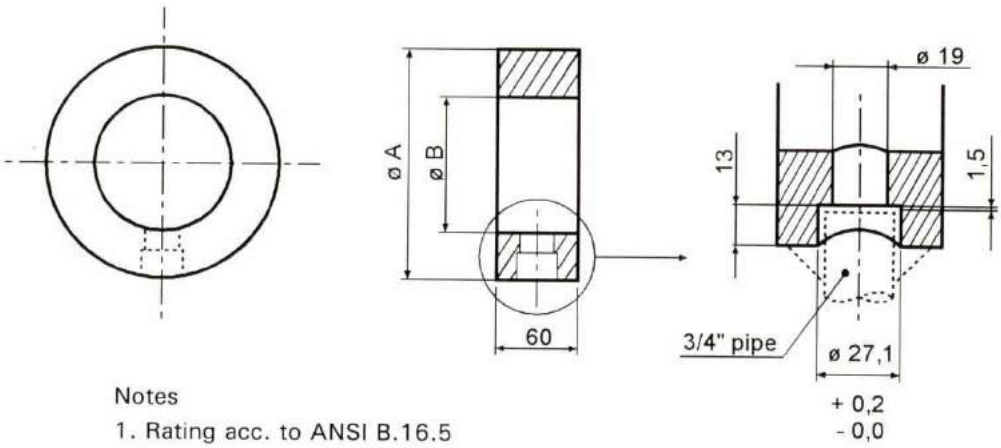
F - Fillet weld leg dimension equal to t.

L - Width of reinforcing ring, see table. For branch sizes > 36" L = d/2

Reinforcing ring table

Nom. Branch size "d" inch.	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	26"	28"	30"	32"	34"	36"
Ring width "L" mm	30	45	55	80	105	130	150	170	190	215	240	290	310	330	360	380	405	430

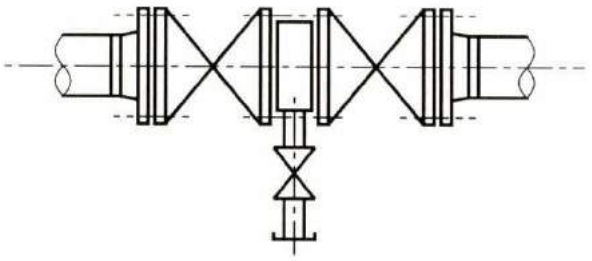
DRIP RING



Notes

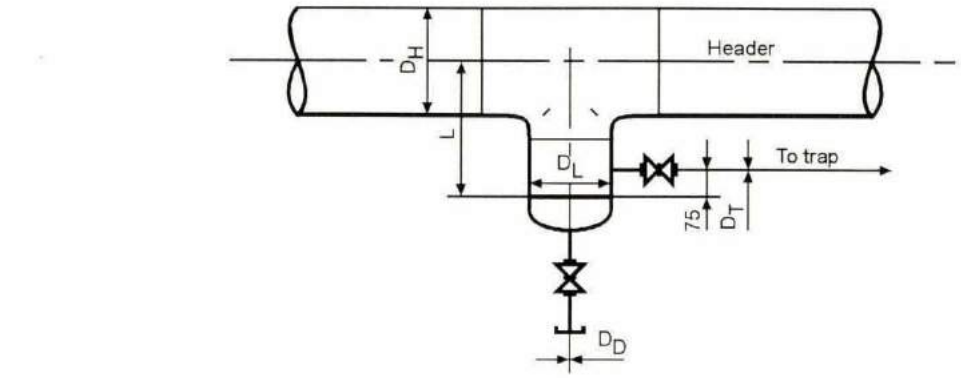
1. Rating acc. to ANSI B.16.5
2. Material in accordance with piping class
3. Faces to be machined parallel and finish to be in accordance with ANSI B.16.5
4. Nom. dia., rating and material to be engraved on edge in letters min. 5mm high e.g. 3"-CL. 600-A 182 Gr. F1

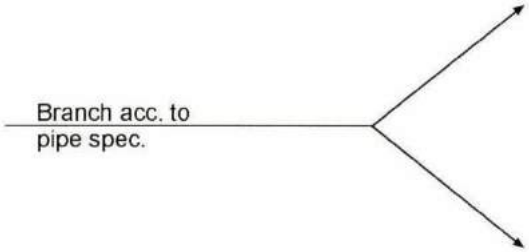
DN Inch.	Class 150 RF		Class 300 RF		Class 600 RF	
	A mm	B mm	A mm	B mm	A mm	B mm
2"	100	52	107	52	107	52
3"	132	78	145	78	145	78
4"	170	102	177	102	190	102
6"	220	154	247	154	263	154
8"	276	206	304	205	317	198
10"	336	260	358	254	396	247
12"	406	311	418	303	453	295
14"	447	343	480	334	487	317
16"	510	394	535	381	560	363
18"	545	445	592	429	608	409
20"	602	495	650	478	678	455
24"	713	590	770	575	786	547

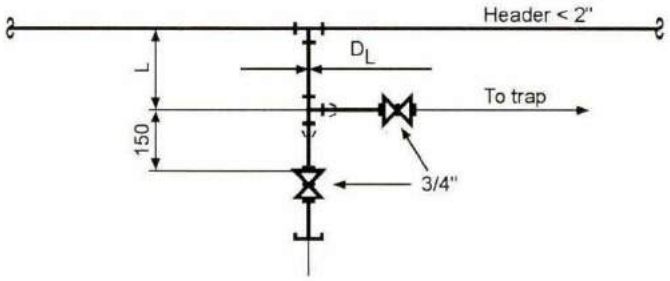


Only where no alternative installation is possible, driprings shall be used.

DRIP LEG ON STEAM HEADERS



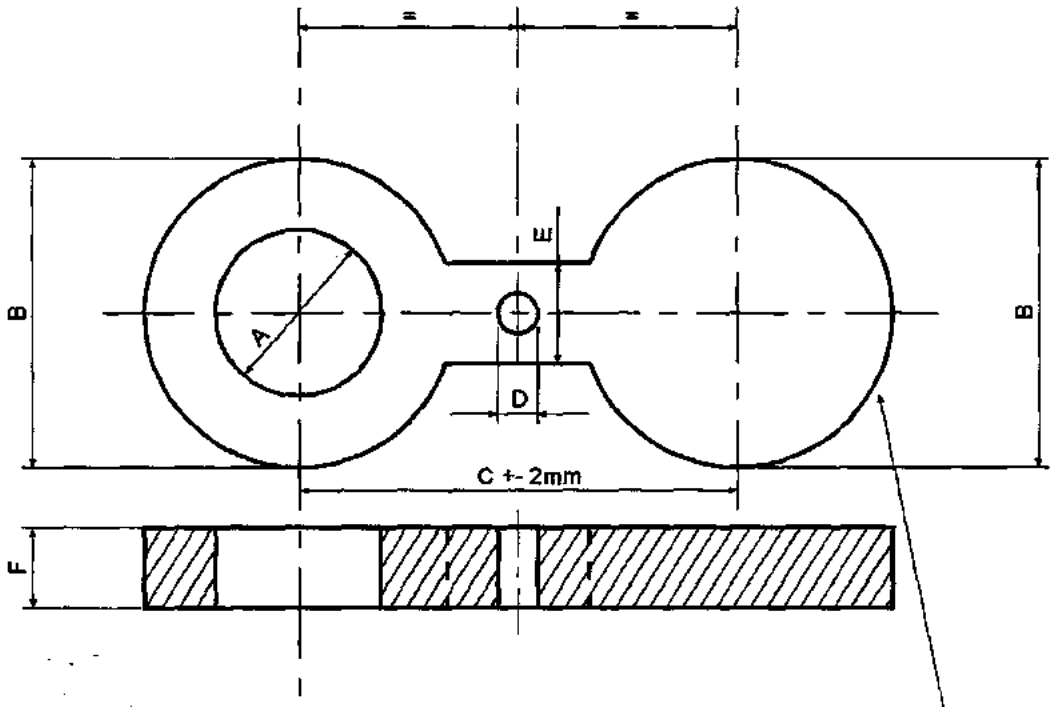




*) D_L = Header size

D_H	= < 2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"
D_L	*)	3"	4"	6"	6"	8"	8"	10"	12"	12"	12"	12"
L	250	300	300	350	350	400	400	450	500	525	550	600
D_D	3/4"	3/4"	3/4"	1"	1"	1"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"
D_T	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	1"	1"	1"	1"	1"	1"

SPECTACLE PLATE CLASS 150 RF

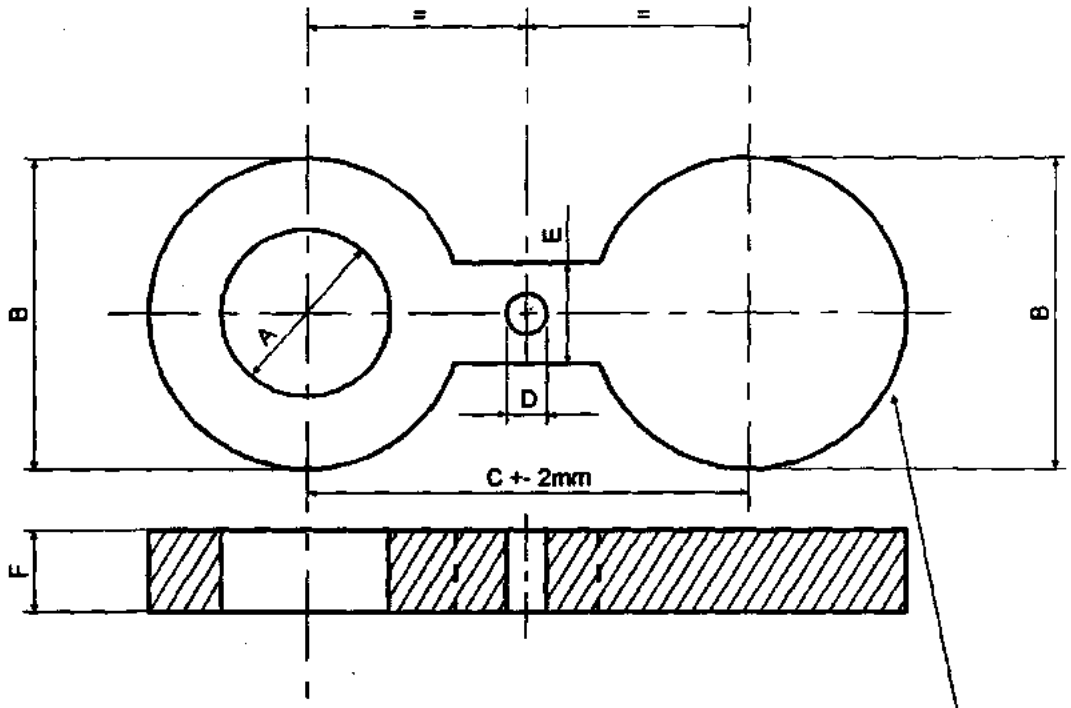


Spectacle plate suitable for flanges acc. to ANSI B16.5. Material as for flanges acc. to piping class.

Nom. dia., rating and material to be engraved on edge in letters min. 5 mm high for example thus: 3"-class 150 -A105

Nominal diameter inches	Min. reqd. overlength bolt	A	B	C	D	E	F
1"	8	33	64	79	16	38	6
1 1/2"	8	48	83	99	16	38	6
2"	8	60	102	121	20	51	6
3"	8	89	133	152	20	64	6
4"	8	114	171	191	20	64	6
6"	12	168	218	241	22	76	10
8"	15	219	277	299	22	76	13
10"	18	273	337	362	26	102	16
12"	24	324	407	432	26	102	22
14"	27	356	447	476	30	108	25
16"	27	406	511	540	30	108	25
18"	27	457	546	578	33	114	25
20"	31	508	603	635	33	121	29
24"	37	610	714	749	36	140	35

SPECTACLE PLATE CLASS 300 RF

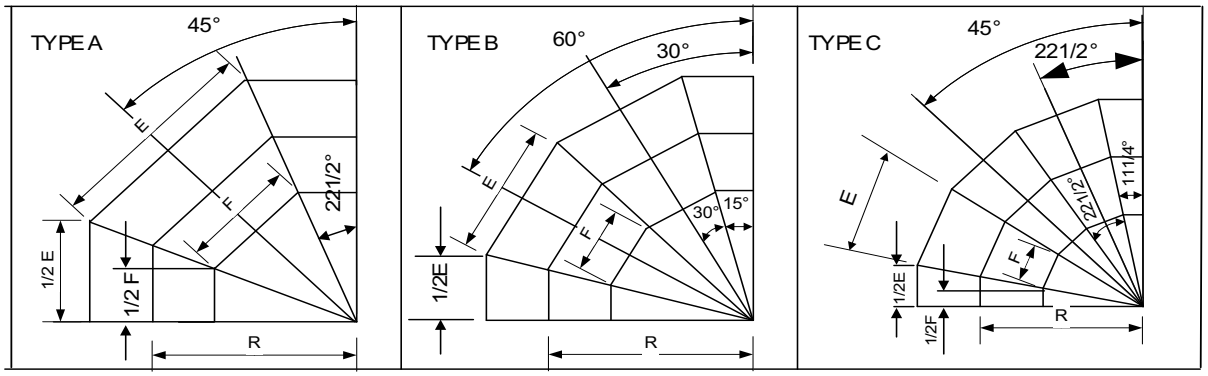


Spectacle plate suitable for flanges acc. to ANSI B16.5. Material as for flanges acc. to piping class.

Nom. dia., rating and material to be engraved on edge in letters min. 5 mm high for example thus: 3"-class 300 -A105

Nominal diameter inches	Min. reqd. overlength bolt	A	B	C	D	E	F
1"	8	33	70	89	20	38	6
1 1/2"	8	48	92	114	22	51	6
2"	8	60	108	127	20	51	6
3"	12	89	146	168	22	64	10
4"	15	114	178	200	22	64	13
6"	18	168	248	270	22	76	16
8"	21	219	305	330	26	89	19
10"	27	273	358	387	30	102	25
12"	31	324	419	451	33	102	29
14"	34	356	482	514	33	121	32
16"	39	405	537	572	36	124	37
18"	43	457	594	629	36	114	41
20"	46	508	651	686	36	121	44
24"	56	610	772	813	42	140	54

MITRE BENDS

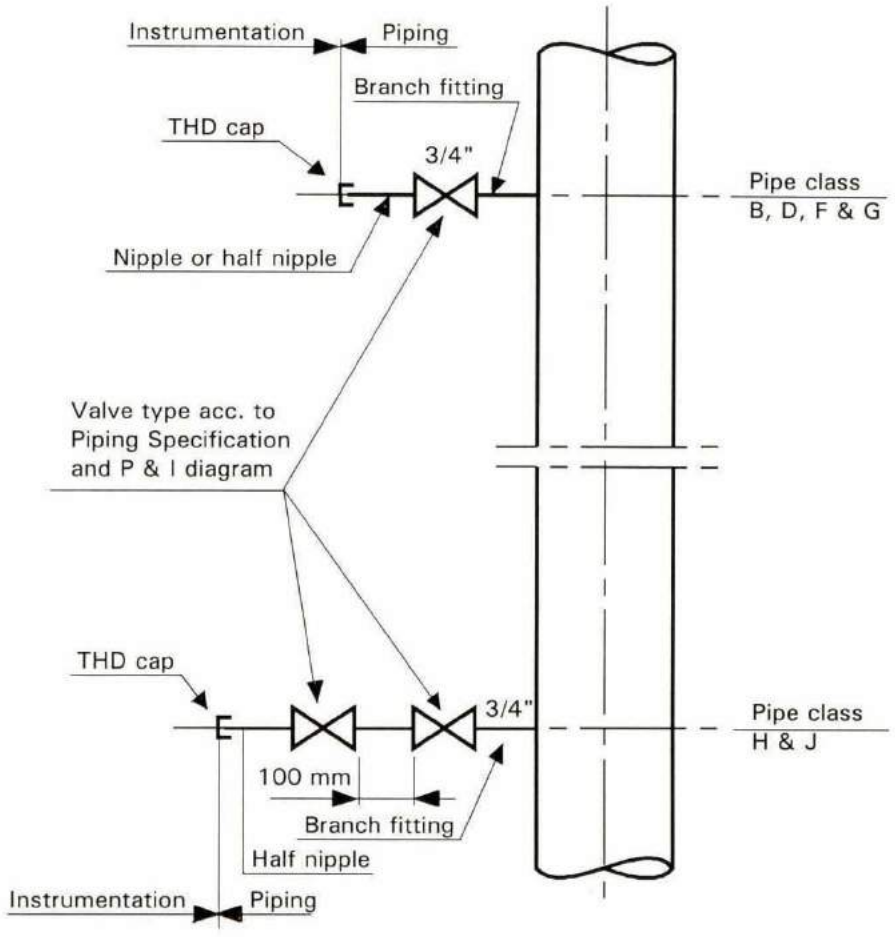


NOM SIZE INCH	OUTSIDE DIAM D mm	R =1.5D mm	30° 60°	45°	90°	$22^1/_2°$	DIMENSION					
							TYPE A		TYPE B		TYPE C	
							E mm	F mm	E mm	F mm	E mm	F mm
2	60.3	76	B	A	A	C	88	38	57	24	42	18
3	88.9	114	B	A	A	C	131	58	85	37	63	28
4	114.3	152	B	A	A	C	173	79	112	51	83	38
6	168.3	229	B	A	A	C	259	120	168	78	125	58
8	219.1	305	B	A	B	C	343	162	222	105	165	78
10	273.1	381	B	A	B	C	429	203	277	131	206	97
12	323.9	457	B	A	B	C	513	244	332	158	246	117
14	355.6	533	B	C	B	C			381	190	283	141
16	406.4	610	B	C	B	C			436	218	323	162
18	457	686	B	C	B	C			490	245	364	182
20	508	762	B	C	B	C			544	272	404	202
22	559	838	B	C	B	C			599	300	445	222
24	610	914	B	C	B	C			654	327	485	243
26	660	991	B	C	C	C			707	354	525	263
28	711	1,067	B	C	C	C			762	381	566	283
30	762	1,143	B	C	C	C			817	408	606	303
32	813	1,219	B	C	C	C			871	436	647	323
34	864	1,295	B	C	C	C			926	463	687	344
36	914	1,372	B	C	C	C			980	490	727	364
38	965	1,448	B	C	C	C			1,034	517	768	384
40	1,016	1,524	B	C	C	C			1,089	544	808	404
42	1,067	1,600	B	C	C	C			1,144	572	849	424
44	1,118	1,677	B	C	C	C			1,198	599	890	445
46	1,168	1,752	B	C	C	C			1,252	626	929	465
48	1,219	1,829	B	C	C	C			1,307	653	970	485
52	1,321	1,982	B	C	C	C			1,416	708	1,051	526
56	1,422	2,134	B	C	C	C			1,524	762	1,131	566
60	1,524	2,286	B	C	C	C			1,633	817	1,213	606
64	1,626	2,439	B	C	C	C			1,743	871	1,294	647
68	1,727	2,591	B	C	C	C			1,851	925	1,374	687
72	1,829	2,743	B	C	C	C			1,960	980	1,455	728
76	1,931	2,897	B	C	C	C			-	-	1536	768

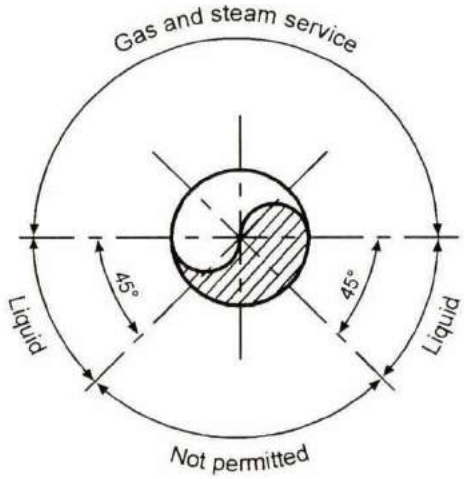
P1	27.12.2017		FOR REVIEW/COMMENT	NAZ	NS	GL/HOD
P	21.10.2017		FOR REVIEW/COMMENT	NAZ	NS	DM
REV	REV DATE	EFFDATE	PURPOSE	PREPD	REVWD	APPD

BRANCH FOR ANALYSIS - AND PRESSURE CONNECTIONS ON PIPING

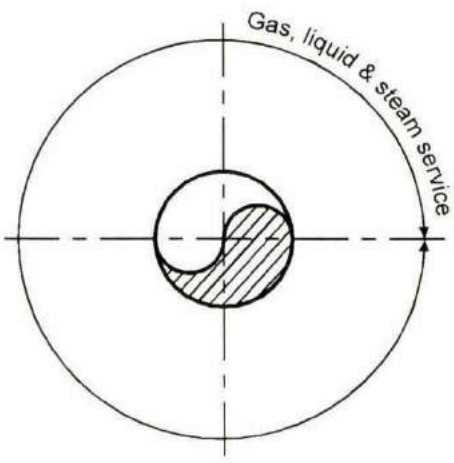
(FOR ANALYSIS CONNECTIONS WITH PROBE SEE SPECIAL DRAWINGS)



Location of branch in horizontal line

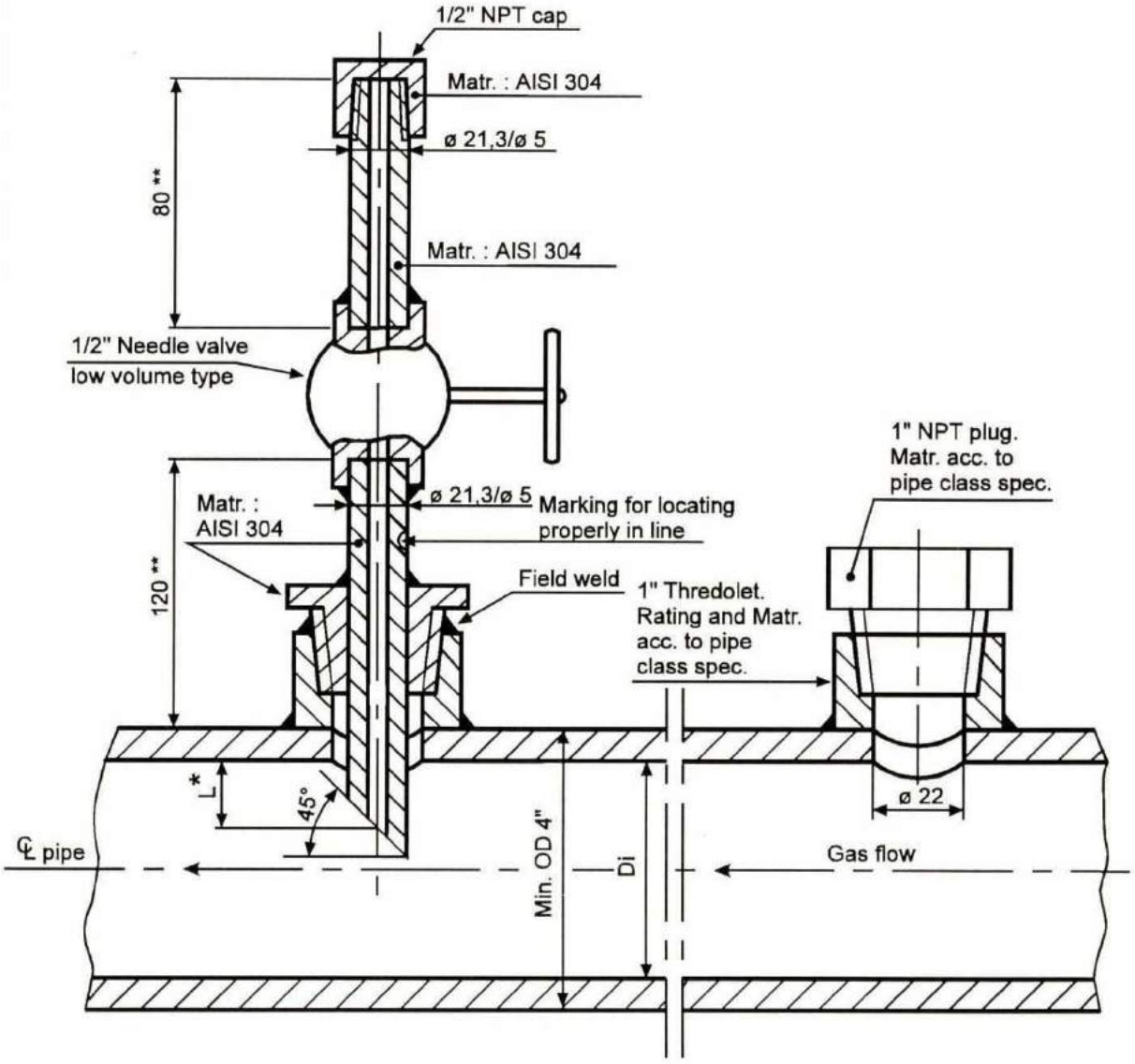


Location of branch in vertical line



All branch fittings and valves to be specified acc. to pipe class.

ANALYSIS CONNECTION WITH PROBE ON PIPE
FOR RATINGS < = CLASS 900



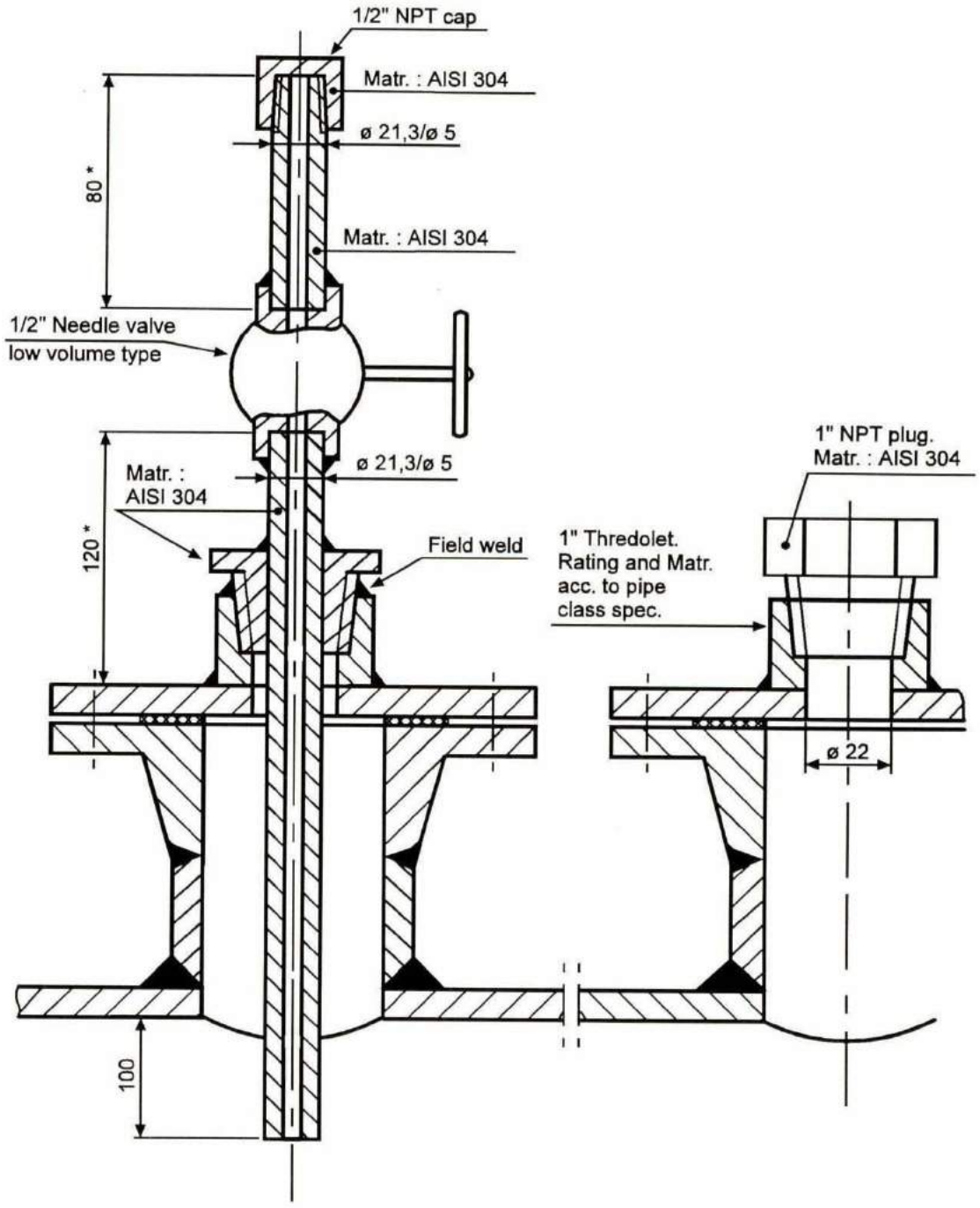
Final execution
Instrumentation supply

During pressure test and cleaning
Piping supply

* For Di > 6", L = 1/3 Di +- 1/6 Di
For Di < = 6", L = 1/2 Di +- 1/6 Di

** Shortest possible

ANALYSIS CONNECTION WITH PROBE ON EQUIPMENT FOR RATINGS < = CLASS 900

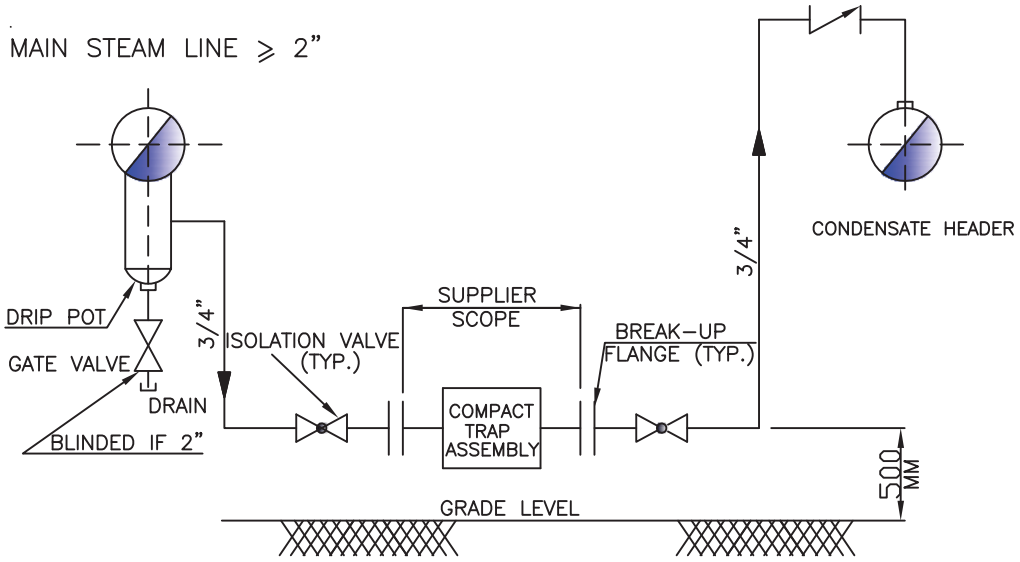


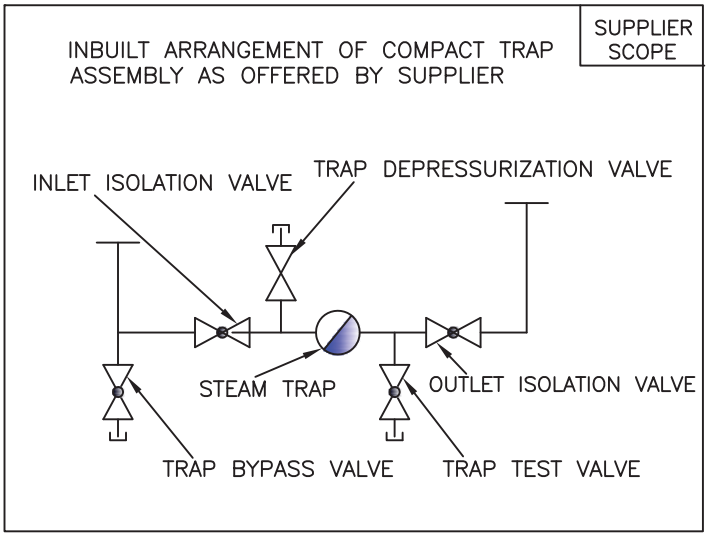
Final execution
Instrumentation supply

During pressure test and cleaning
Piping supply

* Shortest possible

TYPICAL ARRANGEMENT OF DRAIN FOR STEAM LINES AND STEAM TRAP





SECTION VI – 3.2

DESIGN SPECIFICATION – PROCESS

UREA HANDLING & BAGGING PACKAGE

[UREA (NEEM OIL COATED) HANDLING SYSTEM, BULK SILO AND BAGGING SYSTEM INCLUDING FILLED BAGS STACKING/ LOADING TO WAGON & TRUCK]

PLANT: AMMONIA-UREA PLANT BASED ON COAL GASIFICATION

PROJECT: INTEGRATED ROM BASED FERTILISER COMPLEX AT TALCHER, ANGUL DISTRICT, ODISHA (INDIA)

CONTENTS

1.0 GENERAL:

This section covers general requirements & arrangements to be envisaged for removal of neem oil from neem oil coated Urea Dust. For this purpose, 50% solution of Urea shall be prepared & after oil removal shall be sent to Urea Plant for further treatment.

2.0 SCOPE OF WORK:

2.1 TFL, TALCHER

2.1.1 NEEM OIL COATED UREA SOLUTION TANK & OIL REMOVAL: Bidder shall provide One no. underground Urea Solution Tank. Approximately 40MTPD Urea Dust shall be collected and send to this Urea Solution Tank. In this tank 50% solution of urea in Steam Condensate/DM water shall be prepared. Steam Condensate/DM water shall be provided at temperature of 45 Deg C /amb respectively. One No. agitator shall be provided at top of tank to prepare this 50% urea solution. Effective capacity of underground storage tank shall be $50m^3$. Urea Solution shall be pumped by 2 No. (1W+1S) vertical pumps of capacity $10m^3$/hr each to Mechanical Oil Separator & Activated Carbon Filter. Treated recovered Urea Solution from Activated Carbon Filter shall be sent to Urea Plant. Activated Carbon filter shall be Deoiling type. Outlet from Activated Carbon Filter shall contain Oil in traces only. Bidder shall provide necessary arrangement to isolate Mechanical Oil Separator & Activated Carbon filter.

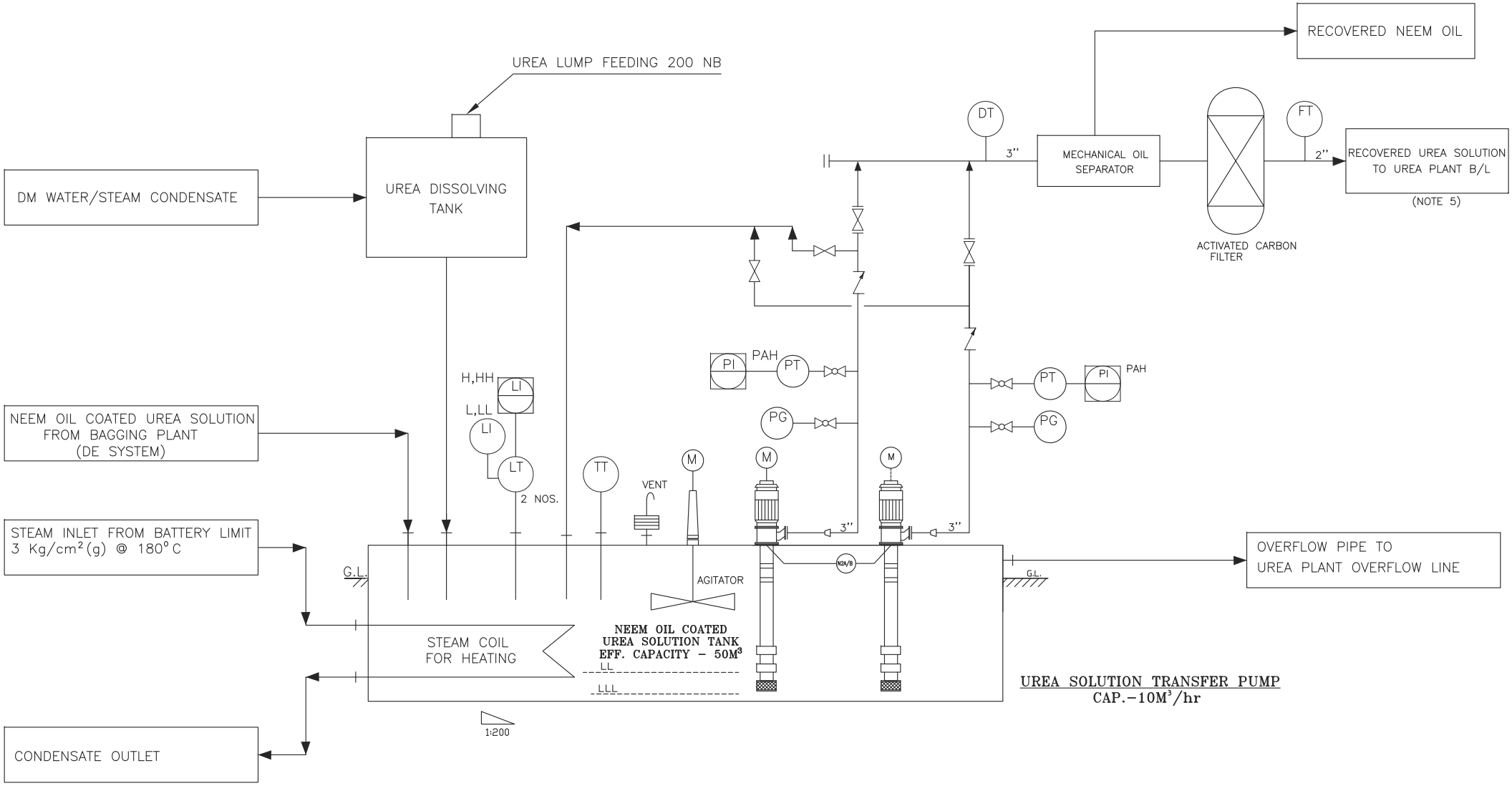
Oil content of Urea Solution to Mechanical Oil Separator shall be 100ppm.

MOC of Urea Solution Tank is SS-316L.

Bidder to connect this recovered Urea solution piping up to the urea plant battery limit. Required pressure at the tie-in point shall be 3.0 kg/cm2g. MOC of the piping shall be SS-316L.

Schematic arrangement for Urea Solution Tank & Oil removal system is shown in Annexure-I.

ANNEXURE–I



NOTE:–

1. PERMANENT EJECTOR SHALL BE PROVIDED ON TANK TO DEWATER THE NEEM OIL COATED UREA SOLUTION TANK.
2. NEEM OIL REMOVAL SYSTEM CONSISTING OF DUAL MEDIA FILTER, COALSCER AND ACTIVATE CARBON FILTER WITH TWIN ARRANGEMENT TO FACILITATE BACK WASHING & REPLACEMENT OF MEDIUM TO BE PROVIDED.
3. TRACING OF ALL THE PIPELINES WITH STEAM TO BE PROVIDED.
4. OIL ANALYZER WITH OFF SPEC RECYCLE ARRANGEMENT TO BE PROVIDED.
5. VENDOR TO CONNECT THIS PIPE UPTO UREA PLANT BATTERY LIMIT, REQUIRED PRESSURE AT THE TIE–IN POINT SHALL BE 3.0 Kg/cm²(g).

REV	DATE	DESCRIPTION	PPD.	CKD.	APPD.
0	27.07.21	ISSUED FOR TENDER	SNS	RS	MN

CLIENT: TALCHER FERTILIZERS LIMITED

PROJECT: INTEGRATED COAL BASED FERTILIZER COMPLEX AT TALCHER, ANGUL DISTRICT, ODISHA (INDIA)

TITLE: SCHEMATIC FOR NEEM OIL SEPERATION SYSTEM

REV. 0 | SHEET 1 OF 1 | SCALE : | DRG. NO. PC183–1312–0046 | FILE:

PROJECTS & DEVELOPMENT INDIA LIMITED
NOIDA

SECTION VI- 3.3

DESIGN PHILOSOPHY- ELECTRICAL

PLANT : UREA HANDLING & BAGGING PACKAGE (UREA HANDLING SYSTEM, BULK SILO AND BAGGING SYSTEM INCLUDING FILLED BAGS STACKING / LOADING TO WAGON & TRUCK)

PROJECT : INTEGRATED COAL BASED FERTILISER COMPLEX, AT TALCHER, ANGUL DISTRICT, ODISHA (INDIA)

CONTENTS

LIST OF ATTACHMENTS

Technical Specification No.	Description
PC183-TS-0802	Uninterrupted Power Supply System
PC183-TS-0803	Power Transformers
PC183-TS-0804	Neutral Earthing Resistor
PC183-TS-0805	Medium Voltage Switch Boards
PC183-TS-0806	High Voltage Switch Boards
PC183-TS-0807	Bus Duct
PC183-TS-0808	Sheet Steel Distribution Boards
PC183-TS-0809	Lighting Sub Distribution Boards
PC183-TS-0810	Induction Motors
PC183-TS-0811	Interlocking Sw. Socket and Plug
PC183-TS-0813	Battery Charger
PC183-TS-0814	Battery
PC183-TS-0815	Cables
PC183-TS-0816	Prefabricated Ladder Type Cable Racks
PC183-TS-0817	Local Control Stations
PC183-TS-0818	Junction Box
PC183-TS-0819	Electricals for Over Head Cranes and Hoists
PC183-TS-0820A	Variable Frequency AC Drives (High Voltage)
PC183-TS-0820B	Variable Frequency AC Drives (Medium Voltage)
PC183-TS-0822	Capacitor Bank & Associated Equipment
PC183-TS-0829	Auxiliary Service Transformer
ES:8028	Electrical erection, testing & commissioning
	Electrical Specification for Bagging & Stitching Machine With Weighing Cum Tipping Machine
	Electrical Specification for Scrapper

--	Conceptual SLD - 11 kV Switchboard (Drg. No. PC183-1231)
--	Conceptual SLD - 3.3 kV Switchboard (Drg. No. PC183-1232)
--	Conceptual SLD - 415V Switchboard (Drg. No. PC183-1233)

Electrical Sketches	Description
PC183-PDS:E 113	Foundation Details of 11/0.433kV Transformers
PC183-PDS:E 114	Foundation Details of 11/3.45kV Transformers
PC183-PDS:E 115	Typical Details of Transformer Room Door
PC183-PDS:E 116	Sump Pit for Transformer Oil
PC183-PDS:E 119	Typical Foundation Arrangement for Panels in Sub-Station
PC183-PDS:E 120	Typical Foundation Details for HT/LT Circuit Breaker Panels
PC183-PDS:E 207	Details of Bracket Arm for Street Lighting Pole
PC183-PDS:E 208	Installation Arrangement Area Lighting Fixtures
PC183-PDS:E 210	Junction Box for Street Lighting Pole
PC183-PDS:E 213	Typical Street Lighting Pole
PC183-PDS:E 510	Details of Concrete Cable Trench
PC183-PDS:E 511	Cable Rack Arrangement in Trenches
PC183-PDS:E 516	Typical Arrangement of Cables buried in slit
PC183-PDS:E 530	Pre-Fabricated Cable Tray Straight Run
PC183-PDS:E 531	Pre-Fabricated Cable Tray Horizontal Tee
PC183-PDS:E 532	Pre-Fabricated Cable Tray Horizontal Cross
PC183-PDS:E 533	Pre-Fabricated Cable Tray 900 Horizontal Bends
PC183-PDS:E 534	Pre-Fabricated Cable Tray 900 Vertical Bend Bending Rad. 1000 mm
PC183-PDS:E 535	Pre-Fabricated Cable Tray 900 Vertical Bend Bending Radius 600 mm
PC183-PDS:E 536	Pre-Fabricated Cable Tray Coupling Arrangement
PC183-PDS:E 537	Pre-Fabricated Cable Tray Fixing Arrangement
PC183-PDS:E 538	Pre-Fabricated Cable Tray Reducing Coupler Plate
PC183-PDS:E 601	General Notes on Earthing and Lightning Protection
PC183-PDS:E 602	Earthing Conductor Details
PC183-PDS:E 603	Arrangement of Connections of Earth Conductors
PC183-PDS:E 604	Typical Details of Connection in Earth Pit
PC183-PDS:E 605	Earth Pit Details
PC183-PDS:E 606	Typical Arrangement of Earthing for Motor and Start Stop Push Button
PC183-PDS:E 611	GI/Al Accessories for Earth Electrode
PC183-PDS:E 613	Earthing of storage tank & vessel
PC183-PDS:E 615	GI Earth Bus
PC183-PDS:E 617	Typical Arrangement for Neutral and Equipment Earthing

1.0 SCOPE

1.1 The scope includes work/service for the complete design, engineering, manufacture, testing at works, Third Party Inspection, supply of all electrical equipment, dispatch, storage, handling, erection, testing at site and commissioning of complete electrical system required for 'Urea Handling & Bagging Package.

Although every item of supply and/ or installation might not have been described, the Contractor shall supply anything and everything to complete the project.

1.2 This specification shall be read in conjunction with all drawing and documents attached and other relevant reference as specified therein.

1.3 The scope of work/ services of Contractor shall comprise complete electrics of the Urea Handling & Bagging Package. The scope of work/ services shall broadly comprise but not limited to the following:

1.3.1 Design & detailed engineering, Coordination, General Services etc

a. Basic as well as detailed engineering.

b. Preparation of drawings/ document/ to suit Project implementation schedule. Preparation of drawings/ documents/ calculations/ formats/ test reports/ test certificates; Erection, Testing & Commission Manuals/ Operations & maintenance Manuals/ Reports/ QAP etc for approval/ Review/ reference/ record and/ or for any other requirement; submission to Owner/ Consultant in requisite sets, getting approval from Owner/ Consultant, making approved copies available to manufacturers, inspectors, erection & commissioning engineers, supervisors, owner/ Consultant etc as required in requisite sets well before those are actually required by them to fulfil their obligations.

c. Design, manufacture, testing of equipment/ cables/ cable trays/ earthing and other erection materials etc at manufacturer's works, submission of documents with manufacturer's test reports/ type test reports to Owner/ Consultant prior to inspection call.

d. Quality Assurance at each stage of manufacture including procurement of raw materials/ bought out items and arranging inspections by Owner/ Consultant/ Third Party.

e. Obtaining dispatch clearance from Owner in writing.

f. Packing, loading, forwarding, delivery at site/ store, loading/ unloading, storage as per manufacturer's recommendation; shifting from stores and handling in store as well as at site for erection.

g. Arrangement of testing/ checking instruments/ kits/ sets/ apparatus with valid calibration certificates issued by duly accredited laboratories/ institutions, to carry out tests stipulated in specification and documents referred therein/ other applicable standards.

h. Deputing electrical contractors, supervisors electricians, cable jointers etc. on full time basis. for carrying out electrical work.

i. Installations of equipment/ cables/ materials.

j. Conducting pre-energisation tests to ensure that installation is fit to be energized.

k. Erection shall not be considered complete unless pre-energisation tests are carried out, results are tabulated & submitted to owner/ consultant and results are found satisfactory.

l. Conducting functional/ pre-commissioning checks/ Cold trial runs; no-load & load tests,

m. Commissioning the installation.

n. Conducting Performance Guarantee tests and taking corrective steps (inclusive of replacement of equipment/ materials if required) till results are satisfactory/ acceptable.

o. Conducting Pre-Acceptance Tests/ checks and tabulating the results/ observations

p. Liquidations of defects/ discrepancies/ observations noted during erection, pre-energisation tests, commissioning, trial runs, performance guarantee tests, Pre-acceptance tests/ checks etc.

q. Submissions of all final/ 'As built' drawings/ documents after incorporation of changes made in soft as well as hard copies, duly certified by Contractor to the effect that those are 'Final' and/ or 'As built'

r. Conducting Final Acceptance Tests/ Checks

s. Co-ordinate with the Owner/ Consultant, other contractors/ agencies working at site as required for proper, smooth and timely execution of work/ implementation of the project

t. Preparation of drawings/ documents, applications for getting the installation inspected and approved by Electrical Inspectorate of state and/ or Central Electricity Authority and all coordination for getting the installation approved for energisation & use. Carrying out all modifications/ alterations required by statutory authorities. All expenses on these activities shall be carried out and borne by Contractor . The obligation of owner shall be limited to

- Signing of application as Owner of installation and
- Payment of fee for inspection of installation.

Approved drawings and certificates shall be submitted to the Owner/Consultants well ahead of schedule so that the actual commissioning of equipment does not get delayed for want of inspection and approval by the Electrical Inspectorate and other statutory bodies. The actual inspection work by the Electrical Inspector shall be arranged by the Contractor and necessary coordination and liaison work in this regard shall be the responsibility of the Contractor .

1.3.2 Manufacture, testing at works, getting inspected by owner and/ or their consultant/ third party, packing, transportation and delivery to site in well packed condition, insurance during transit and till commissioning & handing over, storing at site as per recommendation of manufacturer/ supplier/ direction of supervising engineer of Owner/ Consultant until required for erection, transportation to work place. Erection, testing & commissioning, handing over of complete electrical system of 'Urea Handling & Bagging Package (hereinafter referred as Plant in short) comprising, but not limited to :

a. Bus Ducts

b. Transformers viz.

- 11/3.45 , 11/0.433 kV, 3.3./0.433 V Transformers, as required
- Lighting Transformers

c. Switchgears:

- 11 kV ICOG Panel, as required
- 11 kV Switchgears/ switchboards, as required
- 3.3 kV Switchgears/ switchboards, as required.

- 415 Volt Switchgears/ switchboards including PCCs, PMCCs, MCCs, EPMCCs MLDBs, ASPBs (welding receptacle & other non-plant / non-critical loads are generally feed through ASPBs), LSDB, PDB, Junction boxes etc as required.
- Capacitor Bank with APFC
- Local control Panels, Local Control stations, Switch Sockets .
- Variable Frequency Drive Panels / Soft starters, as required

d. 11kV, 3.3kV, 415V Motors and other special application/ voltage motors as required.

e. All Cables viz

- Power Cables (11kV, 3.3kV and 1.1kV)
- Control Cables,
- Earthing Cable
- Signal cables,
- Optical fibre cables
- Data Cables
- Communication cables
- Special application cables, FO Cables from OUSS to Bagging Substation for interlocking, and Protection.

f. Erection/ installation & all sundry materials for installation, testing & commissioning of equipment/ panels/ fittings/ cables (including jointing & termination of cables) comprising (but not limited to) the following:

- Foundations,
- Chequered Plates
- Brackets, support structures, erection materials & accessories, as required
- Cable trays, racks, pipes, ducts, cable channels etc as required.
- Testing checking kits/ instruments

g. Complete Illumination system - Normal, Emergency and Evacuation Lighting of Urea Handling & Bagging Plant including Substation, MCC Room, Urea Product Handling Building, Urea Silo, Gantries, Transfer Towers, Urea neem oil separator system, Railway Platform shed, associated outdoor area lighting & street lighting etc.

h. Aviation lighting, as required.

i. Neutral Grounding, NER.

j. Complete Earthing & lightning protection of Urea Handling & Bagging Plant including Substation, MCC Room, Urea Product Handling Building, Urea Silo, Gantries, Transfer Towers, Urea neem oil separator system, Railway Platform shed, etc. .

k. 110V DC Batteries, Battery Charger and DC Distribution Boards.

l. 115V AC UPS Panels with batteries & UPS & UPS Power Distribution Boards for Instrument.

m. 240V AC UPS with batteries & UPS & UPS Power Distribution Boards for Electrical.

n. Complete Electrics for Air Conditioning and Ventilation systems of Substation, MCC Room, Control Room etc. .

o. Complete Electrics for EOT Crane, Hoists,

p. Cable trench/Cable tray with supporting structure alongwith anchor fasteners required for fixing of structures / supports, for complete Urea Handling & Bagging Package .

q. Conveyor system with conveyor control panel etc

r. Klaxons/ Hooters, Beacon

s. Steel wire ropes and U clamps

t. Motorised Flappers

u. Brakes.

v. Roller operated limit switch for flow diversion.

w. Safety tripping devices such as stop push buttons, belt sway switches, zero speed limit switches, pull cord switches, gravity take up, chute choking devices, Bunker level indicator etc

x. Complete Electricals system for equipments listed herein but not limited to following :-

- EOT crane
- Air conditioning system for Substation, MCC Room, Bagging Plant Control Room
- Weighing cum tipping machine
- Complete Conveyors system including all other relevant components/parts
- Salt Scraper
- Bagging & Stitching Machine
- Vibrating feeder & screen
- Road weigh bridge
- Delumper/Crusher
- Wagon & truck loader
- Air compressor
- De- Dusting/Dust extraction system at required place including urea solution tank
- Motorised gate bunkers
- Road weigh bridge
- Two way flap gate
- Filled bag diverters
- Check weigh machine
- Urea neem oil separator system
- Bucket elevators
- All Chutes with motorised flap gate/ prism gate wherever applicable
- All diverters (Electric operated)
- Offline check weighers
- Magnetic separators
- All field & control room instrumentation including PLC/DCS, Control Desk, Monitors etc as per Instrumentation specifications.

- All technological structure of equipments.
- Any other items required for the system.

y. The scope shall also include the erection, testing, commissioning of above equipments.

The contractor shall clear the site after commissioning of the equipments / system and obtain the Site Clearance Certificate from owner's Engineer-in-charge

z. Any and all other Materials, Equipment and Services so as to make a totally integrated and functional system together with all accessories and associated equipment, ensuring safety, maintainability and reliability in compliance with all applicable codes, standards, guidelines, statutory regulations and safety requirements in force.

aa. Any other equipment, not specified, but required for safe, proper, trouble free and efficient operation of the system

bb. Contractor shall consider any other requirement which is not covered in this NIT, but required for successful operation of the plant.

cc. Spares & consumables for complete electrics as follows:

- Commissioning Spares (as per Clause No. 16.0 of Design Philosophy-Electrical) and Spares for 2 Years operation (Mandatory/Insurance) for all equipments (as per Section VI-7.0: Spare Parts) shall be supplied by the Contractor as part of LSTK contract.
- Contractor shall recommend 2 years Operational Spares (other than mandatory/ Insurance spare) for all the equipment (item-wise) with recommended quantity & unit price with validity of 2 Years. The same shall not be part of LSTK price.
- Spares and consumables required and first oil fills including short fall during erection, testing, cold trials, commissioning, performance evaluation tests, guarantee tests etc and till handing over of installation.

dd. Tools & Tackles.

ee. Testing Equipments/ instruments

ff. Arranging services of major equipment suppliers during installation and commissioning.

gg. Training of Owner's Personnel for Operation & Maintenance of the Plant.

hh. Any and all other items/ facilities/ services not specifically mentioned but essential/ required for completeness of the systems/ equipments/ facilities.

1.4 Contractor shall consider following additional feeders in their 415 V Switchboards / UPS Distribution Board of Urea Handling & Bagging Package Substation for Owner's use

a) 2 Nos. 125 A Feeders (Indoor Bus) and 3 No. 125A Feeder (Outdoor Bus) in MLDB for Lighting Loads of Owner Use .

b) 2 Nos. 125A power feeders in their 415 V EPMCC for Owner use.

c) 3 nos. 32A feeders in UPS ACDB

Contractor to provide required provision in their transformers, Switchboards and other associated equipments for feeding these loads.

1.5 Separate PMCC and separate EPMCC shall be provided for Urea Handling & Bagging Package with Trivector meter in incomers.

1.6 Normal power supply shall be tapped from 2 Nos. 11KV feeders at Owner's Offsite & Utilities Substation (OUSS) and further distribution shall be in Contractor's scope. For location of OUSS, refer Plot Plan attached elsewhere.

Emergency power supply shall be tapped from 1 Nos. 11KV feeders (Emergency Bus) at Owner's Offsite & Utilities Substation (OUSS) and further distribution shall be in Contractor's scope.

For Silo MCC, power supply shall be tapped from 2 Nos. 415V feeders at Owner's Offsite & Utilities Substation (OUSS) and further distribution shall be in Contractor's scope. For location of OUSS, refer Plot Plan attached elsewhere.

Bidder shall indicate the details of Normal Loads and Emergency Loads in the bid. Tentative Location of Offsite & Utilities Substation (OUSS) is marked in Plot plan.

1.7 This design philosophy contains specifications of the major equipments to indicate the basic requirement and serve as a guideline. However, it shall be the responsibility of the contractor to offer a complete quality electrical system of superior quality, even if the specifications of certain items are not given.. The items for which technical specifications are not indicated herein shall be of IS/IEC standard and specifications of these shall be subject to owner's approval in case of order.

1.8 The bidder shall offer the best and proven most suitable type of energy efficient equipments manufactured by well known reputed manufacturers having proven performance track record of minimum 2 years , as per vendor list appended in this bid package. However for the sake of standardization of the electrical equipment and material used for the electrical installation, the Contractor shall supply all items of a particular type or make for whole plant of the same manufacturing company for ease of maintenance and less spares inventory.

1.9 1 No. 415 V Feeder (125 A) at Existing Substation near 132 KV Switchyard shall be made available by Owner for Construction Power. Tapping of Construction Power (on chargeable basis) from this feeder (including supply & erection of all required materials like structural supports for cable tray, cable trays, power cables, control cables, protection & metering, cable termination etc. as well as underground cabling work) and further distribution shall be in Contractor's scope.

In construction Power, Contractor shall ensure that the minimum power factor of 0.9 shall be maintained at their end by providing suitable power factor improvement devices.

Contractor shall have to distribute construction power with adequately rated distribution and sub distribution boards/feeder pillars, power supply cables and other associated materials for feeding loads to carry out construction and fabrication activities at his own cost.

Bidder shall indicate details of construction power in the bid with month-wise breakup for the entire duration of project.

However during non availability of construction power, Contractor shall have to arrange emergency power, if required, through DG set at their own cost.

1.10 Contractor shall provide adequate area lighting at site of construction, fabrication yards, storage yard and office etc. by means of suitable lighting fixture, lighting masts, flood lighting poles etc. which are to be supplied and maintained by the contractor as per safety aspect.

1.11 Relay Co-ordination & Relay Settings etc. of the entire electrical installation of 'Urea Handling & Bagging Package 'shall be conducted by the Contractor using latest software preferably ETAP at appropriate stage of design-engineering.

All the Electrical equipments shall be designed and selected according to the Short Circuit Study Report.

In case equipment is ordered before studies are completed and revision of rating or design is required as a result of Electrical System Study then inclusion of such revisions shall be in Contractor's scope without any cost and time implication.

1.12 For control, monitoring, load management, data logging and printing of status of all important electrical equipment and feeders, a Programmable Logic Controller (PLC)/RTU based Electrical Control and Monitoring System (ECMS) shall be provided by Electrical Distribution System (EDS) LSTK Contractor . However, Contractor has to provide the required multifunctional dual channel transducers (Only where Current Data is critical and used in process control) , Digital Multi-function Meters, latest version numerical/Communicable type protective relays with non-volatile memory, comprehensive unit providing protection, metering, control & communication with communication port & interlinked with Online Energy/Load Management System and required microprocessor based devices if any in panels , communicable door mounted Motor Protection Relays in all motor feeders of PMCC & MCC, proper communication facility in supplied UPS, Battery Chargers, VFD, Soft starter , MOV and other critical equipment for proper communication with ECMS / DCS system. The interface of electrical equipments with ECMS / DCS shall be through IEC 61850 communication protocol for Numerical relays and IEC 61850/Modbus for Multifunction Digital Meters, Motor Protection Relay (MPR) and other equipment, Ethernet communication module shall also be used. 100% redundancy shall be provided for communication i.e. the relay should have minimum 2 Nos. IEC-61850 communication port in addition to Front Port.

All connection of numerical relays to Ethernet / Network Switch and looping of MFMs inside the switchboards and Network / Ethernet Switches, as required, for interfacing i.e. all connection / wiring from individual switchboards up to the respective Substation ECMS cabinets and Ethernet / FO cables between the switchboards shall be in Contractor s' scope.. However, wiring / connection of Ethernet / FO Cables in I/O Racks shall be in EDS Contractor's scope.

Contractor shall provide separate room for local ECMS equipments (Data Concentrator Panels, OWS, EWS, PC console, chairs, furniture etc.) in Substations of Urea Handling & Bagging Package. Provision of future expansion of Data Concentrator Panels etc. shall also be considered while designing separate room.

1.13 The scope shall also include obtaining all required statutory approvals from all statutory bodies. Contractor shall carry out all modifications/alterations required by statutory bodies.

All approvals for permanent installations shall be obtained in the name of Owner. Approval for equipment & installation for Construction Power shall be in Contractor's name.

1.14 In case of any discrepancies between Design Philosophy – Electrical and Technical Specification of equipment/item/work in respect of description of equipment/ item/work, the details indicated in the Design Philosophy – Electrical shall prevail.

1.15 Final location of equipments as well as route of cable trays shall be finalised during detailed engineering.

1.16 All electrical equipments installed in the areas classified as hazardous shall be certified for such use by a recognized certifying authority such as CIMFR Dhanbad / PESO, Nagpur etc.

1.17 All electrical works associated with the followings but not limited to, shall be considered

a) Cranes, Hoist, elevators
b) Pollution control and monitoring equipment
c) All auxiliary building & associated electrical building/rooms.

1.18 Following Integrations & Interfaces are envisage presently of Contractor ;

- Protection for outgoing feeders of 11 kV Switchboard at Offsite & Utilities Substation (OUSS) to Contractor Switchboard (Inter tripping, Cable Protection etc.)

However, any other interface and Seamless Integration requirement or any other unforeseen which may arise during detailed engineering/ execution stage, same shall also be in the Contractor 's scope without any cost and time implication.

1.19 All the sub stations shall be provided with following equipment :

- CO_2 fire extinguishers (4.5 litre capacity) as per applicable NFPA.
- DCP fire extinguishers for substations and transformer yards as per applicable NFPA.
- Synthetic insulating mats on front and back side of the switchboards. (LV as well as HV) as per latest IS.
- Framed single line diagram in Aluminum frame with glass,
- Do's & Don't chart as per Indian Electricity Rules in Aluminium frame with glass.
- Shock treatment chart written in English and Local language duly framed and approved by engineer-in-charge.
- Caution boards / dangers boards written in ENGLISH & HINDI for all the voltage levels.
- CPR (CARDIO PULMONARY RESUSCITATION) Charts.
- High Voltage / Low Voltage danger signage (Skull & bones).
- Exit Route / Emergency Exit Route Signage.
- Cable Route Marker, wherever cable is in underground.
- Earthing rod.- Minimum 1 No. for each Voltage level.
- Sets of Sand buckets with stand (each with at least 3 sand buckets) for substations and transformer yards.
- HT discharge rod.
- HT and LT hand Gloves (3 Sets each for each substation).
- A Type FRP ladder 3 feet & 8 feet – 2 no each type for each substations.
- First Aid Box

Other requirement or any other unforeseen which may arises during detailed engineering shall also be in Contractor's scope.

1.20 EXCLUSION

Major civil works like Bagging substation building, Bagging MCC room shall be excluded from bidder scope and shall be executed by other vendor/contractor. However bidder to submit the layout drawings substation & Bagging MCC room like equipment layout, cable trench/ tray layout, floor/wall cut out layout etc within 4 week of LOI/PO, duly reviewed/ approved by TFL/PDIL. For making necessary provisions only in respective buildings by other vendor/contractor.

In case the drawings and data for civil works are modified by the bidder after the execution of the civil works, the same shall have to be carried out by the bidder in consultation with TFL/ PDIL without any time and cost implication.

2.0 BASIS OF DESIGN

2.1 General

2.1.1 The electrical installation shall be designed to provide:

- Necessary amount of power
- Flexibility
- Service reliability
- Ease of expansion
- Ease of operation and maintenance & inter changeability of equipment
- Safety of personnel

The design of electrical installation shall ensure provision of a safe, efficient and reliable supply of electricity at all times including adverse system conditions. Safe conditions shall be

ensured under all operating conditions including those associated with start up and shut down of plant as well as those arising out of failure of electrical equipment. The isolation of part of system of electrical equipment due to either maintenance or shut down shall not compromise safety aspects.

2.1.2 The design of electrical installation shall ensure provision of a safe and reliable supply of electricity at all times. Safe conditions shall be ensured under all operating conditions including those associated with start up and shut down of plant as well as those arising out of failure of electrical equipment, climatic conditions like lightning and earthquake etc. The isolation of part of system of electrical equipment due to either maintenance or shut down shall not compromise safety. All electrical equipments shall be of proven design and technology.

System shall be designed considering following aspects in general: -

- To facilitate inspection, cleaning and maintenance with the care to safety in operation and personnel protection.
- To minimize turnaround time.
- To provide safety, reliability and flexibility of service.
- Adequate provision for future extension and modification.
- Maximum inter-changeability of equipment.
- Desired level of operator interface to achieve coordinated efficient and fail-safe operation, data logging and maintenance of the equipment.
- To decide redundancy, stand by, spares and overload capacities to achieve desired reliability and flexibility requirement.
- To get cost effective and techno commercially proven technology. Economic considerations shall cover capital and running costs and an assessment of the reliability of the system.

2.1.3 All the electrical consumers within the battery limit shall be identified and listed to have complete details of rating, efficiency, power factor, operating duty cycle (continuous, intermittent, standby), category of supply required (emergency, normal, critical) etc.

2.1.4 Required redundancy (based on specific process/operating needs) shall be built in substation which feeds power supply to process units/important facilities so that in case of tripping of one feeder, the unit may not be adversely affected and continuity in operation at full capacity is achieved.

2.1.5 While sizing the system necessary consideration shall be given to restrict the system voltage drop within permissible limits during starting of large rated motors. At the same time, the short circuit current shall be kept within limits keeping in view of the market availability of switchgears rating. For this purpose current limiting reactors/unit ratio transformers if required may be used.

2.1.6 Contractor while performing design and engineering activities shall adhere to following guidelines.

a) If any equipment is not covered in this design philosophy but required for successful operation of the project, Contractor shall prepare additional specifications for equipment or bulk material taking reference of Indian/International Codes and good engineering practices prevalent in fertilizer industry and obtain owner's approval for the same.
b) The standard drawings attached with this package define the basic system design and distribution philosophy for the package. This is for guidance purpose only. Contractor shall develop detailed drawings and submit for owner's approval.

c) Contractor shall be responsible to verify the rating and consider providing equipment with adequate rating but not less than the specified rating. Compliance should be without any extra cost and time implications.
d) Contractor shall consider any other requirement which is not covered in this bid package, but required for successful operation of the plants without any extra cost and time implications.
e) Contractor shall obtain approval from all statutory authorities such as Central Electricity Authority (CEA)/Electrical Inspectorate, Chief Controller of Explosives (CCoE), CPCB etc. for all electrical facilities including electrical switchboards & panels supplied and installed by contractor.
f) Contractor shall Liaison and in all interface coordination with contractors of other units of project at construction, erection, testing & commissioning phase for any common facility and for smooth execution.
g) Equipment specification sheet/data sheets for all equipment shall be prepared by the contractor based on relevant codes and Technical specifications/ Data sheets attached as reference. Data sheet shall contain all technical data and information which are essential for review and technical acceptability, detailed engineering, installation, testing, repair and maintenance, replacement etc.
h) Contractor shall clearly specify in their purchase specifications the requirement of conducting special tests/type tests, which are envisaged for various electrical equipment which shall have no impact on cost and time.
i) Bidder shall must visit the site and collect all relevant information required for designing of complete system before quoting. Bidder shall make themselves familiar with the work actually involved and actual site conditions. Failure to do so shall not absolve the Bidder of their responsibilities based on adverse site conditions.
j) All the electrical equipments shall be of proven design and technology.
k) Normal & Emergency Load details (rating of all motor, Lighting, Switch socket etc.) load shall be submitted.
l) Load Summary shall be prepared by Contractor to determine ratings of electrical equipments (transformer, switchgears, cables etc.), to evenly distribute plant loads among the various substations and switchgear, and to evaluate the need for power factor correction. All calculation shall be necessarily reviewed/approved by Owner/Consultant.

Motors, heaters etc. shall be designed as per Section 4.0 : Design Basis of NIT.

The maximum normal running load and the peak load shall be calculated as follows:
Maximum Normal Running Load = (100% of sum of all continuous load) + (40% of sum of all intermittent loads or largest intermittent load, whichever is higher).

Peak Load = (100% of sum of all continuous load) + (40% of sum of all intermittent loads or largest intermittent load, whichever is higher) + (20% of sum of all standby loads or largest standby load, whichever is higher).

Electrical System shall be designed for continuous Peak Load operation.

Note: If electrical motor is stand-by to non-electrical driven equipment (for e.g. turbine driven equipment), then in such case standby motor shall be considered as continuous load.

All the electrical equipments shall be designed / sized considering motor input power (i.e. BKW divided by motor efficiency).

Margin for future requirement shall be as per clause 2.1.6 m over the above.

Line loss of 2% to be considered for equipment sizing.

Minimum P.F. shall be maintained as 0.95 at every voltage level by providing APFC Panel by Contractor.

All the electrical equipments like Transformers, Switchboards etc. shall be suitable for

starting of the largest motor, while other loads are running, considering peak load condition.

m) Electrical equipments to be designed by Contractor i.e. Transformers, Switchgears, MCCs, PCCs etc. shall have capacity for future requirements. The Margin shall be as follows:

i) HV Transformer: 25% is added to the Continuous Peak Load.
LV Transformer: 30% is added to the Continuous Peak Load.

ii) Switchgear: Switchgear bus bar current rating as well as breaker shall be equivalent (nearer or higher standard rating size) to full load current of upstream Transformer.

iii) Switchboards and MCCs fed from other switchboards: Shall be rated for 125% of peak load.

n) The actual fault levels shall be arrived at on the basis of incoming power source, transformers, contribution of motors, etc.

o) Prospective touch and step voltages shall not be adverse to the stipulations of relevant publications of Bureau of Indian Standards / IEC/IEEE-80.

p) Sizing calculations for all the electrical equipments shall be submitted for review/approval, in case of award of order. Owner/Consultant's Comments, if any on the same shall also be considered and modification in any equipment shall be done accordingly, without any time and price implication.

q) Seismic zone as applicable shall be considered for design of all electrical equipment.

2.2 Load Grouping

Electrical consumers shall be classified as 'normal / non-essential, emergency / essential or vital / critical loads as per the concepts defined below:

2.2.1 'Emergency' or 'essential' loads shall be identified on the criteria that, when failing in operation or when failing if called upon, will affect the continuity of operation, the quality or the quantity of product. For such loads, reliable source shall be ensured. Such feeders shall be grouped on a separate bus section in the respective Switchboards/ MCCs / PCCs.

2.2.2 Some of the loads which can be identified as emergency / essential load but not essentially limited to following:

- Electrical loads required for continuous operation of process plants utility in case of normal supply failure.
- Electrical loads required for safe shut down of facilities in case of normal supply failure.
- Emergency lighting & communication facilities.
- Fire Detection and Alarm System (Load Details by Owner during detailed engineering).
- AC & DC UPS / Battery charging equipment.
- Control room AC equipment -Essential ventilation system for offices / Manned areas of other buildings.
- Motorised valves as per process requirement
- PA & Paging system. (Load Details by Owner during detailed engineering).
- AC Emergency Lube Oil Pump
- Any other load (To be indicated by Contractor)

2.2.3 Critical' or 'vital' loads shall be identified on the criteria that, when failing in operation or when called upon, can cause an unsafe condition of the installation, jeopardize life or cause a major damage to the installation. For critical loads if any, UPS shall be provided to facilitate uninterrupted supply. The loads on UPS are AVR / PLC / DCS / Auxiliary supply for drives etc. Critical drives if any shall be provided with DC motors.

2.2.4 Some of the load which can be identified as critical / vital load but not essentially limited to following:

- Loads providing control and protection to plant equipment.
- Loads serving critical equipment for safety of plant, equipment and / or personnel

2.2.5 Non-essential service is a service, which is neither 'essential' nor 'vital'. Hence the non-essential load does not require any special measure such as standby feeder or standby source to safeguard the continuity of service.

2.3 **Statutory requirement Codes and Standards**

2.3.1 The design, installation, testing & commissioning shall conform to compliance of following statutory requirements :

- Indian Electricity Act
- Indian Electricity Rules
- The Indian Factories Act
- The Indian Explosives Act.
- Statutory requirement of Govt of Odisha and Govt. of India.
- Guidelines, instructions, directions issued by Pollution control Boards of state as well as central government. Guidelines, instructions, directions issued by Chief Controller of Explosives (CCoE), CPCB, CMRI, DGMS, CEA etc.
- Guidelines of Tariff Advisory Committee
- Guidelines of Insurance Companies Association.
- Any other applicable Rules/Acts/Regulations.

The design, installation, testing & commissioning shall be in accordance with established codes, good engineering practices and latest versions of following documents valid/ applicable on the date of acceptance of bid. The stipulations in these documents shall be considered as minimum requirements:

- Indian Standard Specification or equivalent IEC Standards
- Publications of IEEE
- API Standards
- National Electrical safety Code(NESC)
- Standards of Underwrites laboratory(UL)
- American Society for Testing Material (ASTM)
- American National Standards Institute (ANSI)
- Other International Standards

Contractor shall be responsible for obtaining necessary statutory approvals from all the statutory bodies/authorities e.g. Electrical Inspectorate, PESO (earlier CCoE) as applicable before commissioning of electrical facilities. The CEA clearance for electrical equipment and components thereof shall be obtained by the contractor.

Contractor shall carry out all modifications / alterations required by all statutory bodies. However, necessary statutory fee shall be deposited by the Owner.

2.4 Some of the bare minimum relevant Indian Standards are as listed below. However, system/equipment design shall be in line with latest edition of all applicable standards.

IS: 325, IEC:60034	Three phase induction motors
IS: 335	New insulating oil for transformers and switchgears
IS: 722	AC electricity meters
IS: 732	Code of practice for electrical wiring installations system voltages not exceeding 650V

IS: 737	Specification for wrought aluminum and aluminum alloys, sheet and strip (for engineering purpose)
IS: 996, IEC:60034	Single phase AC motors
IS:1248	Direct acting analogue electrical measuring instruments and their accessories:
IS: 1367 Part-13	Hot dip galvanised coatings on threaded fasteners.
IS: 1646	Code of practice for fire safety of buildings and electrical installations
IS: 1913	General and safety requirements for Luminaries (Tubular fluorescent Lamp)
IS: 2071	Method of high voltage testing
IS: 2099	High voltage porcelain bushings
IEC:62305	Code of practice for the protection of buildings and allied structures against lightning
IS/IEC60079	Electrical apparatus for Explosive gas atmosphere
IS: 2544	Porcelain post Insulators for system with normal voltage greater than 1000 volts
IS: 2633	Methods of testing uniformity of coating on zinc coated articles
IS: 2705	Current Transformers
IS: 3034	Code of practice for fire safety of industrial buildings, electrical generating distributing stations.
IS: 3043	Code of practice for earthing
IEC 61869-1	Instrument transformers — General requirements
IS: 11171	Specification for dry type transformers.
IEC 61869-2	Additional requirements for current transformers
IEC 61869-3	Additional requirements for inductive voltage transformers
IS: 3177 IEC60034	Crane duty motors
IS: 3347	Dimensions for porcelain transformer bushings
IS: 3637	Gas operated relays
IS: 3639	Fittings and accessories for power transformers
IS: 3646	Interior illumination: Part I & Part II
IS: 3716	Application guide for insulation co-ordination
IS/IEC:60529	Degree of protection provided by enclosure for rotating electrical machinery
IS: 4722	DC motors
IS: 4759	Hot dip zinc coating on structural steel and allied products
IS: 5082	Specification for wrought Aluminum alloys bars, rods, tubes and

	sections for electrical purposes
IS: 5561	Electric power connectors
IS: 5571	Guide for selection of electrical equipment for hazardous areas
IS: 5572	Hazardous areas other than mines for electrical insulations area having flammable gases and vapours
IS: 5578	Guide for marking of insulated conductors (1st rev)
IS: 6362	Designation of methods of cooling of rotating electrical machines
IS: 6600	Guide for loading of oil immersed transformers
IS: 6665	Code of practice for Industrial lighting
IS: 7689	Guide for control of undesirable static electricity
IS: 8084	Interconnecting Bus bars for AC voltage above 1 KV upto and including 36 KV
IS: 9676	Reference ambient temperature for electrical equipment
IS: 10028	Code of practice for selection, installation and maintenance of transformers
IS: 10322-1	Specification for Luminaries,Part-1,General requirements
IS: 11353	Guide for uniform system of marking & identification of conductor & apparatus terminals
IS: 11448	Application Guide for AC electricity meters
IS: 12360	Voltage bands for electrical installations including preferred voltage and Frequency
IS: 12459	Code of practice for fire protection of cable runs
IS: 12615	Energy efficient motors
IS: 13234	Guide for short circuit calculations
IS: 13346	General requirements for electrical apparatus for explosive gas atmosphere.
IS: 13408	Code of practice for the selection, installation and maintenance of electrical apparatus for use in potentially explosive atmospheres
IEC: 60255	Electrical Relays
ISIEC: 60947	Low voltage switchgear and control gear
IS: 60034-5	Degree of protection provided by Integral design of rotating electrical machines
IS: 60079-0	Explosive atmospheres, Equipment General Requirements
IS: 60079-1	Explosive gas atmospheres – Part-1 Equipment protection by Flame proof enclosures “d”.
IS: 60079-7	Equipment protection by increased safety “e”
SP: 30	National Electrical Codes (NEC) - BIS Publication
IS/IEC 62271	HV Switchboard.
IEC 61439-1/2	LV switchboard (PCC/PMCC/MCC) for TOTAL TYPE TESTED (TTA). Type Test Certificates for short circuit withstand of 50kA for 1 sec.

	along with ACB mounted in the Switchboards shall apply.
IEC 61641	Switch Board with INTERNAL ARC CONTAINMENT test.
ANSI C-37:23	Metal enclosed bus
ANSI C-37:24	Effect of Solar radiation on metal enclosed bus.
IEC 60034	Rotating Electrical Machinery
IEC 61131	Programmable controllers
IEC 60871-1 /IS 13925	Shunt Capacitors for AC power Systems Specifications

Any other standard may be followed provided it is equivalent or more stringent than the standards specified above.

2.5 In case of any conflict/deviation amongst various documents the order of precedence shall be as follows:

- Statutory rules/regulation
- Design Philosophy
- Data sheets
- Technical specification/Installation Standards, etc.
- Applicable IS/IES standards

In case of contradiction / conflict among documents and statutory requirement, Contractor shall refer to Owner for clarification. However, most stringent specification shall be followed with Owner's approval. Owner decision shall be considered as final.

2.6 **Site Conditions**

The equipment shall be designed for the following site conditions:-

- Minimum ambient Temperature — 1 deg.C
- Maximum ambient Temperature — 46 deg.C
- Design Reference Temperature — 50 deg.C
- Relative Humidity — 100%
- Altitude above mean sea level — Lower than 1000 Mtrs.
- Atmospheric pollution — Dusty due to presence of Coal Dust & Urea Dust and corrosive due to presence vapours of Ammonia.

Equipment/ cables selected shall be derated for (a) higher ambient temperature, (b) restriction in temperature rise (c) variation in voltage, (d) variation in frequency (e) installation conditions viz. proximity to heat sources, bunching, layering, separation from others/ laying in conduits etc. with respect to the conditions for which it was designed & manufactured. Various de-rating factors considered shall be informed with supporting documents.

Equipment to be installed in MCC rooms/ Electrical Rooms/ Control rooms shall be designed for + 50º C so that in case of failure of Air-conditioning/ ventilation facilities, the operation/ functioning of equipment is not be affected.

3.0 AREA CLASSIFICATION.

3.1 The hazardous zones within the project area shall be classified according to the requirement of IS/IEC. The bidder shall furnish area classification drawing with Technical part of the Bid.

PESO approved Hazardous Area Classification Drawing shall be submitted during detailed engineering.

3.2 All electrical equipments installed in the areas classified as hazardous shall be certified for such use by a recognized international certifying authority such as CIMFR earlier CMRI, Dhanbad. The item shall in addition bear the valid certification from PESO (earlier CCoE) and also the manufacturer shall hold a valid Bureau of Indian Standards (BIS) license.

For those items where overseas OEM vendor will supply the electrical equipment certificate from international authority can be accepted but the certification shall be approved by PESO (earlier CCoE), Nagpur India.

3.3 The electrical equipment for hazardous areas shall be selected as per IS-5571 and petroleum rules and Gas group shall be selected based on the approved hazardous area classification drawing . The minimum requirement is summarized below:

Equipment	Zone-1	Zone-2
MV Motors	Ex-de	Ex-n
HV Motors	Ex-de / Ex-p	Ex-n/Ex-de/Ex-p
Push Button Station	Ex-d	Ex-d
Motor Starters	Ex-d	Ex-d
Plug & Socket	Ex-d	Ex-d
Welding Receptacle	Ex-d	Ex-d
Lighting fitting	Ex-d	Ex-nR
Control Gear Box	Ex-d	Ex-nR/Ex-d
Junction Boxes	Ex-d	Ex-d
Transformer Unit	Ex-d	Ex-d
Break Glass Unit (Fire Alarm System)	Ex-d	Ex-d
Lighting Panel/Power Panel	Ex-d	Ex-d
Transformers	Hermetically sealed with surface temperature not exceeding 200º C	

Notes:
The electrical equipment for hazardous areas shall generally be suitable for gas group IIB and temp classification T3 as applicable to the selected type of explosion protection. In case of hydrogen or hydrocarbon mixtures having more than 30% hydrogen, the gas group to be considered shall be IIC.

As additional safety features, the following requirements for electrical equipment shall be followed :

1. All electric motors for agitators/mixers and metering pumps handling flammable material shall be flameproof type (Ex-de) irrespective of the area being classified as zone-2 or zone-1.
2. All electric motors for vertical sump pumps handling flammable material shall be flameproof type (Exde).
3. Irrespective of the area classification (whether zone-1 or zone-2), all lighting fixtures within the storage areas shall be flameproof type (Ex-d).
4. Irrespective of the area classification (whether zone-1 or zone-2), all motors and lighting fittings within the pump house near the offsite tank farm and within the loading/unloading gantries shall be of flameproof type (Ex-d).
5. All emergency/critical lighting fixtures and associated junction boxes in hazardous areas (whether zone-1 and zone-2) shall be flameproof type (Ex-d).

6. Even though fired heaters in process units are not considered for area classification, all electrical equipments associated with fired heaters in process units shall as a minimum be suitable for installation in Zone-2 area.
7. Where air conditioning system is designed considering ammonia as refrigerant, the room housing air conditioning equipment shall be adequately ventilated to classify it as safe area. For additional safety the following shall be considered:
   - 100% standby system for ventilation
   - Location of MCC/local panels in adjacent separate room.
   - Instrumentation to be flameproof type or hermetically sealed.
   - AC plant room motors with type`e' protection.
   - Lighting in AC plant room suitable for zone-2 area.
8. Building such as Compressor sheds inside the process area shall be designed to allow adequate ventilation to allow area classification as Zone-2.Lighting equipment, EOT crane etc. in the shed shall be flameproof type (Ex-d). All other electrical equipment shall be suitable for Zone-1 or Zone-2 area depending on extent of hazard.
9. All HV motors for hazardous area Zone-1 shall preferably be flameproof type (Ex-de). Pressurised motors may be provided in exceptional cases.
10. Ex-n motors without pre-start ventilation as permitted by Indian Standard unless any other type is specified by Process Licensor , shall be provided, except for the following cases as listed below:
11. - HV motors for Centrifugal compressors (As Ex-n motors are not recommended for use for such applications as per IS/IEC-60079-15 and therefore Ex-de or Ex-p motors shall be provided for these applications)
12. - For motors in Zone-2 areas having frequent start/ stop requirements e.g. EOT cranes/ Elevators, MOV actuators etc., Ex-de motors shall be used.
13. For Zone-2 areas, motors with ratings above 100kW having average starting frequency of more than one per week, Ex-n motors with pre-start ventilation provision or Ex-de or Ex-p motors shall be used.
14. Ex-p motors shall be used for large rating motors where Ex-de or Ex-n motors are not available.

4.0 SYSTEM DETAILS AND UTILIZATION VOLTAGES

4.1 The various voltage levels for in plant power distribution shall be as follows:

A. Normal Power	11KV ± 10%, 50Hz ± 5%, 3Ph, 3 W
B. Emergency Power	Voltage Variation ± 5%, 50Hz ± 3%, 3Ph, 3 W Contractor shall indicate Emergency Power required at OUSS.
C. Distribution Equipment	a) 11KV ± 10%, 50 Hz ± 5%, 3 Ph, 3 W with resistance earthed neutral b) 3.3KV ± 10%, 50 Hz ± 5%, 3 Ph, 3 W with resistance earthed neutral c) 415V±10%, 3 Ph, 4 W/240V ± 10%, 1 Ph, 2W, 50 Hz ± 5% solidly grounded neutral.
Combined variation in voltage & frequency	± 10%
Control Supply for: - 415V motors	AC 240V ± 10%, 50 Hz ± 5%, 1Ph (For contactor controlled motors)- Electrical UPS located in

- Switch Gear Breaker controlled feeders: a. Closing, tripping & spring charging motor b. Auxiliary power	Substation. DC 110V ± 5% (For breaker controlled motors) – Battery Charger DC 110V ± 5%, 2 W - Battery Charger AC 240V ± 10%, 50 Hz ± 5%, 1Ph, 2W
- Instrumentation and Automation, DCS & Auxiliaries	AC 115 V ± 10%, 50 Hz ± 3% 1Ph, 2W – Instrumentation UPS located at Control Room
Voltage Ratings - Motors above 1000 KW - Motors above 150 KW up to 1000 KW. -Motors up to150 KW	 11 KV, 3 Ph AC 3.3 KV, 3 Ph AC 415 V, 3 Ph AC
- Space heaters - Lighting - Panic Lights - Power Sockets/Receptacle	240V, 1 Ph AC 415V/240V AC 110V DC 415V, 3 Ph AC/240V, 1 Ph AC

4.2 The actual fault levels shall be arrived at on the basis of incoming power source, transformers, contribution of motors, etc. and shall be indicated in the Bid.

All switch boards of the same voltage shall be rated for identical fault level. Minimum fault level to be considered for design and selection of equipment shall be as follows:
11 kV Switchgear – 40 kA for 3 Seconds.
3.3 kV Switchgear – 26.24 kA for 3 Seconds.

The fault level for 415V switchboards shall be 50kA for 1 sec.

Impedance of transformers shall be selected suitably (tap position at principal) without comprising voltage drop at receiving end.

11kV/0.433kV or 3.3kV/0.433kV Transformer rating shall not be more than 2000kVA.

Fault level of DC System shall be decided by the Contractor after substantiating the same by calculation.

4.3 **System** Earthing

The neutral of 11 KV and 3.3 KV systems shall be non-effectively earthed through resistance. The earth fault current of 11 KV and 3.3 KV shall be limited to full load current of the transformer or 400 A, whichever is less. Suitable protection system to be designed to have proper sensitive Earth fault protection.

The neutral of 415V supply system shall be solidly earthed.

The DC system shall have positive pole earthed through high impedance. Prospective touch voltage earthing shall comply with the requirements of relevant Indian/IEC standards.

5.0 POWER SUPPLY AND DISTRIBUTION.

5.1 Power supply from 11 KV switch board in Offsite & Utilities Substation(OUSS) of Plant

5.1.1 2 Nos. 11 kV Feeders and 1 No. 11 kV Feeder (Emergency Bus) shall be made available in 11 kV Switchboard at Offsite & Utilities Substation. Tapping of power supply from 11 kV Switchboard at Offsite & Utilities Substation (OUSS) including supply, erection & testing of all required material such as structural supports for cable tray, cable trays, cables, cable terminations at both ends etc. shall be in Contractor's scope. Further distribution to equipment at 11 KV, 3.3 KV, 415/240 V, 115 V (UPS) AC, 240 V (UPS) AC, 110 V DC etc. through proper type and size of cables, their supply, erection, testing and commissioning etc. shall be in Contractor's scope.

Contractor shall consider 11kV/3.45kV, 11kV/0.433kV or 3.3kV/0.433kV transformers for downstream distribution. The supply system shall be designed for maximum power requirement of the plant. Double radial system of power supply, each suitable for 125% of full load shall be followed for entire plants.

Contractor shall indicate details of power requirement and the Rating of 11kV Feeders at offsite & Utilities Substation in the Bid.

For Bagging Electrical consumers for conveyor, Truck loader, wagon loader, weighing machine, lighting (bagging building, platform, conveyor gantry etc) etc from TT-2 to whole urea handling & bagging package shall be proposed to be feed from switchboards located at Bagging Substation.

For Electrical consumers for conveyor, De Dusting system, scrapper, vibrating screen, crusher/delumper, neem oil system, lighting (conveyor gantry etc) etc up to TT-2 shall be proposed to be feed from switchboards located at Silo MCC room. Tentative location of Silo MCC Rom is indicated in Plot Plan.

2 Nos. 415V Feeders shall be made available in 415V Switchboard at Offsite & Utilities Substation(OUSS) for Silo MCC. Tapping of power supply from 415 V Switchboard at Offsite & Utilities Substation (OUSS) including supply, erection & testing of all required material such as structural supports for cable tray, cable trays, cables, cable terminations at both ends etc. shall be in Contractor's scope. Further distribution to equipment at 415/240 V, 115 V (UPS) AC, 240 V (UPS) AC, 110 V DC etc. through proper type and size of cables, their supply, erection, testing and commissioning etc. shall be in Contractor's scope.

5.1.2 In the event of failure of normal power in the plants, the plants shall be brought to safe shut down condition through Emergency power. Emergency power shall cater to the load of emergency lighting, UPS system, battery charger, motorized valves, Fire alarm system, PA & Paging system in addition to the process loads for safe shutdown of the Plant and wherever required as per detail design.

Emergency power supply shall be tapped from 1 numbers of feeders at Owner's Offsite & Utilities Substation and further distribution shall be in Contractor 's scope. However, Bidder shall indicate the details of Emergency Loads in the bid.

5.1.3 The electrical system layout and interconnections (power as well as control) shall be such that the problem in electrical system of one plant should not affect the electrical system of other plant and vice versa.

5.1.4 The insulation system of cable, 11 kV & 3.3 kV equipments shall be based on unearthed system only.

5.1.5 Each incoming feeder shall be sized for 125% load of the switch board. The outgoing feeders shall be sized for the nominal load. Breaker rating of all the outgoing feeders of 11KV switchboards & & 3.3 KV switchboards shall be same considering provision of inter-changeability except Incomer & Bus coupler Circuit Breakers.

5.1.6 Primary connections of transformers shall be provided with cables of suitable size and secondary connections shall be through cable/bus duct. The entry of cables in the switchboards shall be from bottom only.

5.1.7 All switchboards shall be provided with minimum two incoming feeders and one bus tie having auto/manual changeover facility.

5.1.8 It shall be possible to have momentary paralleling of power sources at 11 kV, 3.3 kV switchboards and 415V PMCC /PCC/MCC and trip the desired circuit breakers.

5.1.9 The normal operation of the 11 kV, 3.3 kV Switchgears, Power & Motor Control Centre (PMCC) and Motor Control Centre (MCC) shall be as under:

i. Bus-coupler shall be provided between all the sources. Incomer and Bus-coupler breaker rating shall be same for all the switchboards. Each incoming feeder shall independently feed the loads on respective buses with full rated bus tie breaker open and the load on each bus balanced. In order to ensure maximum degree of reliability and continuity, automatic transfer from one incoming feeder to other shall be possible through auto/manual closing of bus tie breaker in case of sustained loss of power on any bus section.

ii. The bus tie breaker shall be provided with auto/manual selection. The bus tie breaker shall be independent in manual mode. In auto selection mode, the bus tie breaker is electrically interlocked with incoming circuit breakers, so that it cannot be closed unless one of the incoming breakers is open.

iii. When one of the incoming feeder trips, the bus tie breaker is closed automatically based on the philosophy described and the total load is transferred to other healthy incoming feeder which is capable of carrying the entire load. Sufficient switchgear capacity is to be provided. Time for changeover is suitably selected based on downstream system requirement of reacceleration of motors etc.

iv. Auto Change Over scheme shall be provided for incomer feeders and bus coupler feeder of 11kV switchboard, 3.3kV Switchboards and 415V Switchboards. Under normal operating conditions, incomer-1 and incomer-2 breakers shall be closed and bus coupler breaker shall remain open with 'Local-Remote-Off' switch in 'Remote' position. The bus coupler breaker shall close automatically under the following conditions being fulfilled:

- Either of the incoming breaker trips due to under voltage (70% or below).
- Voltage on the healthy bus is more than 80% for the set period.
- Residual voltage on the bus with no power supply comes down to 30% or below.

Required nos. of bus PT, line PT and under voltage relays shall be provided to achieve the desired automatic changeover.

v. Auto transfer shall take place only on sustained loss of power on either of bus sections. Auto transfer shall be blocked in case of fault on either of bus sections or no power on both incomers.

vi. Paralleling of two incoming feeders is not foreseen. However, facility for momentary paralleling shall be provided for intentional changeover without interruption of supply with synchro check relay in Bus Coupler panel. There shall also be provision of selective tripping of one feeder out of three feeders with a Delay (two incoming feeders and one Bus Coupler).

5.1.10 EPMCC shall have 1 Normal and 1 Normal/Emergency incomer feeding critical load of plant whereas PMCC & MCC shall have 2 Nos. Normal Power Incomers feeding non-critical loads. DC Battery Charger, UPS System etc. shall be fed from EPMCC. PMCC shall fed breaker controlled feeders and various power feeders whereas MCC shall fed contactor controlled load and various power feeders. PMCC and MCC shall be separate.

5.1.11 Auxiliary Services Power Board (ASPB) having essential bus (to be fed from Emergency Bus of EPMCC) and nonessential bus (to be fed from Normal Bus of EPMCC) shall be

provided in the plant for supplying power to welding switch sockets, lighting load, EOT crane and other auxiliary loads.

5.1.12 Separate MCCs be provided for air conditioning and ventilation systems.

5.1.13 For the use of the Owner during plant shut down period, each area shall be provided with indoor type feeder pillar, which shall be located in a separate room other than substation building and away from hazardous area. The feeder pillar shall be fed from the 415 V switchboards (PMCC) of the nearby substation. Each feeder pillar shall comprise of 1 No. 630 A 4 P MCCB incomer, 2 Nos. of 250 A TPN MCCB outgoing feeders, 2 Nos. 125 A TPN MCCB outgoing feeders and 4 Nos. 63 A TPN MCCB outgoing feeders. Other construction details shall be as per specification of sheet steel distribution board (PC183-TS-0808).

5.1.14 Location of feeder pillar shall be decided during detailed engineering.

5.2 Instrumentation Power

5.2.1 The power supply for instrument shall be 115V, 1Ph from UPS System.

5.2.2 Provision for 240V, 1 Ph power for lighting of instrument panels shall be provided from LSDB.

5.2.3 All instrument panels shall have two UPS incomer supply (one from different bus of UPS DBs) to avoid any type of power obstruction in case of failure of one supply.

5.2.4 Separate 240VAC UPS System shall be provided to feed MCC control supply, Control Room (to meet 250 lux in case of UPS Supply only)) & Substation lights (30% of total light) , ECMS Equipment, Fire Detection & Alarm System etc. This UPS System along with associated Battery (Ni-Cd) and UPS distribution Board shall be located at Substation.

5.3 Lighting Distribution

5.3.1 In substation / MCC Room Main Lighting Distribution Board (MLDB) shall be in provided. MLDBs shall have two incomers through 415/433 V Lighting Transformers. One Incomer of MLDB shall be feed from PCC/PMCC and One Incomer shall be fed from EPMCC. In other areas the Lighting Distribution Boards shall receive power from MLDB. One third lighting load shall be connected to the emergency power (DG Source) to provide emergency light during failure of normal power. The MLDB Incomers shall have Metering facility with Digital communicable Multi-function Meters

5.3.2 Both the lighting transformers feeding MLDB and their respective circuit breakers shall have same rating. Both the lighting transformers shall be designed for 100% load of MLDB.

33 % of total light of plant excluding Substation & Control Room shall be fed from Emergency Power (DG Power), in case of failure of Normal Power.

10% of light or required Number of lights for safe evacuation, whichever is higher, shall be used as panic light (240V AC), in case of complete shutdown for the plant area excluding Substation & Control Room.

The both normal and emergency section of Main Lighting Distribution Board shall have separate Sections of busbars for indoor and outdoor lighting. Indoor / Outdoor bus Sections shall be connected by means of suitably rated contactor operated through digital clock timer. There shall be provision to Switch ON & OFF Outdoor Type feeders from ECMS in Remote Mode.

5.3.3 Manual by-pass circuit for outdoor lighting shall be wired up to a switch located in Electrical control room / shift office, so that outdoor lighting can be switched ON or OFF manually to bypass the automatic switching.

5.3.4 All outdoor lighting fixtures and outside lighting of Sub-Stations, Offices, Control Rooms etc., shall receive power from outdoor lighting bus.

5.3.5 All Lighting fixtures / electrical equipment in Analyzer room shall be flame proof type.

5.3.6 Main Lighting distribution board shall feed Lighting Sub Distribution board having 63A 4 Pole MCB and ELCB as incomer, 16Amp DP RCBO as outgoing . The outgoing ELCB shall have rating of 300 /100 mA. Six, Nine or Twelve way Lighting Sub Distribution board shall be used having 30 % as spare outgoing RCBO feeder.

5.3.7 Welding outlets shall be fed from ASPB having 3 phase supply for welding connection. All welding outlets shall be provided with CBCT ELCB of 100 mA and Digital Earth Fault Relay with display.

5.4 DC **Power**

5.4.1 110 V DC system shall be provided for control of circuit breaker feeders and panic lighting. It shall be obtained from Ni-Cd batteries.

5.4.2 The battery shall be provided with SCR controlled automatic rectifier-cum battery chargers and shall consist of Main Float cum Load charger, Standby Float cum Load charger and Boost Charger and 2 Nos. Battery Bank each of 60% capacity (of 5 hours backup at 100% capacity) with isolation facility for ease of operation & maintenance.

5.4.3 Each rectifier-cum- battery charger shall have independent power supply to be fed from the emergency source.

5.4.4 110V DCDB shall have 2 sources with auto changeover facility in case of failure of 1 source.

5.4.5 DC Battery Charger, AC UPS and HVAC for control room shall be fed from emergency switchboard.

5.4.6 Battery end cell voltage shall 1.1V. Aging factor shall considered 125% and spare capacity shall have 120%.

5.4.7 For Temperature derating factor shall be based upon Minimum Ambient Temperature i.e. 50C.

5.4.8 Battery Charger shall have at least 20% additional capacity for Owner Use. Battery Charger shall have 110 V DC system.

5.4.9 Separate Rectifier-Cum-Battery Charger with DC Distribution Board and Battery Bank shall be provided for each Substation.

5.4.10 The battery and charger combinations shall be such as to ensure continuity of D.C. supply at load terminals without even momentary interruption.

5.4.11 AC Ammeter and AC Voltmeter on Charger Input; DC Ammeter, DC Voltmeter for charger output/ battery voltage and on demand type Battery Charge / Discharge Ammeter shall be provided.

5.4.12 For all other specifications of Battery Charger , refer PC183-TS-0813.

5.4.13 For all other specifications of Battery Bank, refer PC183-TS-0814.

6.0 SUB-STATION / MCC Room

6.1 Elevated with trays in cable cellar : Yes

6.2 Complete Substation / MCC Room : Air-conditioned

6.3 Roof slab for

a Power transformer : Yes

b Distribution transformer : Yes

6.4 Batteries in substation and control Rooms : Separate room

6.5 Switchgear room : Air-conditioned

6.6 Battery charger in substation : Air conditioned

6.7 UPS Systems : Air conditioned

6.8 Nickel- Cadmium Battery : Separate room (Ventilated)

6.9 Variable speed drive panels : Air-conditioned

6.10 Thyristor controlled panels : Air-conditioned

6.11 Adequate number of Portable Fire Extinguishers of Dry Chemical Powder and Carbon dioxide shall be provided in suitable location in Substation, Transformer bays, Control room building etc. . in addition to sand bucket as per CEA requirement. These extinguishers will be used during the early phase of fire to prevent its spread and costly damage.

All extinguishers shall be supplied with initial charge and accessories as required.

Portable type extinguishers shall be provided with suitable clamps for mounting on walls or columns.

All extinguishers shall be painted with durable enamel paint of fire red colour conforming to relevant Indian Standards.

Dry chemical powder type extinguisher shall conform to IS: 2171.

Carbon Dioxide type extinguisher shall conform to IS: 2878.

6.12 The layout of equipment shall be such that it shall have adequate space for installation, operation, maintenance and future expansion. The clearance of equipment from the walls/other equipment shall be adequate to ensure safety of working personnel. Generally the following norms shall be maintained for 11 kV/3.3 kV/415 V Switchboards:

a) The clear space of 2.5 M at rear side of 11kV/3.3 kV Switchboard.

b) A clear space of 1.5M behind the double front switchboards and 1M for single front.

c) A clear space of 3.0M between the two boards facing each other.

d) A clear space of 2.5M on either side at entrance/exit.

e) A clear space of 2.0M between two boards in same line after future panel space of switchboard.

f) A clear space of 1M in switch room from top of equipment.

6.13 The MCC Room, Substation Switchgear Room, UPS & Battery Charger room, ECMS room, Maintenance Room, Engineer Room, and Shift Office shall be fully air conditioned through HVAC system with proper ducting arrangement for uniform cooling,, however all the equipment shall be suitable for operation under specified ambient condition even on failure of air conditioning system. The substation shall have HVAC system so that the temperature inside the substation is maintained at 25 Deg.C in all conditions. Provision for remote alarm on failure of air conditioning system shall be provided. Indication of substation and control room temperature shall be provided. Heat load to be calculated on the basis of heat generation in the substation during peak summer period. Fire damper to be provided in the ventilation duct of the HVAC. There should be a separate room for installation of the HVAC Units located at ground floor.

6.14 The battery room shall form a part of the sub-station. Battery room shall be provided with minimum two flameproof exhaust fans and louvered opening in opposite wall/door. A sink with water tap shall be provided with water connection. Eye wash shower shall also be provided. Floor of the battery room and walls up to 2 M height shall have acid/alkali resistant protective epoxy coating. Light fittings, exhaust fan, on/off switches etc. in this room shall be chemical resistant type and flame proof type.

6.15 Location of battery charger shall be nearer to battery room.

6.16 To the extent possible Bus duct shall be in straight position. Bending of bus duct shall be avoided.

6.17 The Sub-stations shall also have an emergency door opening outwards.

6.18 The sub-station shall house all the electrical power, control and monitoring equipment except those required for operation in the field. The equipment shall broadly include the following: -

- Transformers located in separate Bay/Room.
- High Voltage Switch Boards
- Power Control Centres
- Power & Motor control centres
- Emergency Power & Motor control centres
- Motor Control Centres
- Auxiliary Service Panel Boards
- Lighting Transformer (Indoor / Outdoor as per requirement)
- Main Light Distribution Board
- Lighting Distribution Boards
- Lighting Sub-Distribution Boards
- Battery Sets
- Rectifier-Cum-Battery Charger
- Cell Booster
- DC Distribution Boards
- Rectifier-inverter Sets
- UPS System alongwith UPS distribution board.
- Neutral Earthling Resistors (Indoor / Outdoor as per requirement)
- Input / Output Panels
- VFD System
- HVAC system
- Any other equipment required

6.19 All static devices such as Rectifier-Cum-Battery Chargers, Variable Speed Drive Panels, Soft Starter etc., shall be housed in a separate room. Heat load for panel to be taken by panel manufacturer.

6.20 Separation walls between transformers in all substations and safe inter transformer distances for switchyard transformers shall be provided.

6.21 Transformers shall be located in bays adjacent to the sub-station building. All bays shall have oil drained floor, surfaced with gravel or other suitable material.

6.22 In order to prevent leaking oil from reaching and polluting the water bearing stratum, transformers shall have the following provisions, depending on the oil capacity of the transformer.

Oil Capacity up to 2,000 litres:
Transformers installed adjacent to sub-station shall be provided with oil soak pit with a layer of pebbles of about 40 mm granulation.

Oil Capacity exceeding 2,000 litres:
Transformers installed adjacent to sub-station shall be provided with oil collection pit and sump pit as per Drg. No. PC183-PDS:E 114 for draining away of any oil, which may escape or leak from the tanks, to a waste oil tank.

6.23 A clear space of at least 1.5 meter shall be maintained all around the transformers after HVWS system etc. High Velocity Water Spray (HVWS) System shall be provided for transformers fire protection having oil capacity more than 2000 Liters and rating upto 20MVA.

6.24 Heat load for panel to be taken by panel manufacturer.

6.25 Separate common oil pits are required for Transformers.

The volume of common oil pit will be 125% of the volume of oil of the transformer, which contains the largest volume of oil in transformers.

The oil pit will be closed type of water-proof concrete construction.

The oil pit will be connected to individual pit under each transformer and drain line of each transformer will be at least 150 mm dia pipe with a minimum slope of 1:96 as per TAC Regulation.

Transformer fire/drainage of oil will be considered for only one transformer at a time.

Level of pit will be so selected that there would not be accumulation of oil/water/oil-water mixture in the pit under each transformer.

Pit shall be provided with 2 x 100% sump pump for common oil sump.1 No. Portable sump pump shall also be provided.

Oil Pit under Transformer and its Cooler Bank: Gravel filled open oil pit will be provided under each transformer and its cooler bank. The pit shall be such that it can take oil/water surge of 20% of the volume of the transformer oil. Level of pit shall be such that there will not be accumulation of oil/water in the pit. The gravel size will be 60 mm. Each pit will be connected to the drain line leading to new common oil pit.

6.26 In all substations / MCC Rooms, space for future extension of switchboards shall be provided. Two panel extension space on each side (for each bus section) shall be provided for all HV Switchboards, PCCs. One panel extension space on each side (for each bus section) or two panel extension space on one side (in exceptional cases) shall be provided for all PMCCs, MCCs and ASPBs.

The HV switch boards and power control centres shall have sufficient number of spare feeders to the extent of 20% or 1 No., whichever is higher for each type & rating.

For other boards (PMCCs, MCCs, MLDBs, ASPBs, DCDBs etc.) sufficient number of spare feeders to the extent of 20% or 1 No., whichever is higher, for each type & rating shall be provided.

6.27 Fire protection for substations shall be provided to comply with requirements of relevant BIS (Bureau of Indian Standards) and other Indian/ International standards, as applicable. In case Indian standards are not available for any equipment, standards issued by IEC/ BS/ VDE/ IEEE/ NEMA/NFPA or equivalent agency shall be applicable.

In case of contradiction / conflict, most stringent specification shall be followed.

Substations shall be provided with smoke detectors and fire alarm system as specified elsewhere in the ITB and as per relevant Indian Standard.

6.28 Fire barriers shall be provided at cable/bus-duct entry/exit point. Cable shall have fire protection paint for 1 m length at building entry points for above ground cables.

7.0 PROTECTION & METERING

7.1 Selection and co-ordination of protection and metering system shall be such as to ensure:

- Selective, sensitive and reliable protection of equipment against damage due to internal or external faults or atmospheric discharge.
- Isolation of fault in the shortest possible time.
- Simplicity of the scheme with maximum protection.
- Uninterrupted operation of healthy system.
- Personnel & plant safety.

7.2 Protective relays shall be of latest version, numerical / communicable type with non-volatile memory, comprehensive unit providing protection, metering, control and communicable with communication port for interlinking with online energy/Load Management System. 100% redundancy shall be provided for communication i.e. the Relay should have

minimum 2 Nos. IEC-61850 communication port in addition to Front Port.. Numerical Relay shall have communication on IEC-61850 protocol in redundant mode and meters shall have communication on MODBUS protocol. Relay shall have 4 CT input for O/C and E/F protection. There should be option for derivation of E/F internally.

Relay shall meet the requirement for withstanding electromagnetic interference according to relevant parts of IEC 60255 / IEC 61850. Failure of single component within the equipment shall neither cause unwanted operation nor lead to a complete system breakdown.

The relay should support (tested for) IEC 61850 Edition 2 with parallel redundancy protocol as per IEC 62439-3 with two nos. of port and one additional port at front for local communication. Use of any type of converter is not acceptable.

7.3 The Numerical relay shall be provided with integral (no separate unit) arc flash protection system based on both current & light detection method. Relay should have provision of 3 nos. arc sensor, each for cable chamber, busbar chamber & circuit breaker chamber. Sensor shall cover any flash over occurring in the respective chambers. Facility should be there to adapt selective logic schemes for tripping only respective breaker or Incomer breaker.

7.4 The relay should support (tested for) IEC 61850 Edition 2 with parallel redundancy protocol as per IEC 62439-3 with two nos. of port and one additional port at front for local communication. Use of any type of converter is not acceptable.

7.5 Numerical relay shall indicate MWH, MVAR, MVA, V, A, Hz, PF. It shall have future provision for connecting with substation HMI. Separate multifunction meter with communication (for centralized energy monitoring) shall be used and shall not be part of protective device.

7.6 Relays shall support features like remote relay parameterization, disturbance recorder etc. It shall be possible to set/operate the relay from the front facia. Lock out relay shall be conventional type with hand reset facility.

7.7 Contractor shall supply licensed (lifetime) software along with required communication cables for Parameterization and viewing of disturbances, events, etc. through Laptop for all Make and models of Numerical relays. 1 No. Laptop complete (Minimun 8GB RAM, 1 TB hard Disk, latest processor) with all required software and accessories complete in all respect shall also be provided.

7.8 Special protection if required for any feeder such as differential, restricted earth fault, directional distance power relays etc. shall also be through numerical relay having serial port for monitoring.

7.9 In general all protection shall be through microprocessor based numerical relay. However high speed tripping relay shall be separate.

7.10 All Auto-changeover logic to be built in Numerical Relay. Numerical Relays shall have sufficient I/O to cater the same and there should be minimum 10 % spare I/O for future use. External I/O Card/ Module are not acceptable.

7.11 All Process Stop and other important Parameters shall be routed through Numerical relays for recording and Time-stamping. Hardware Annunciator is not required. Common Audio Visual Alarm for each Bus section of Switchboard shall be provided through Numerical relays.

7.12 Bare minimum protection for power distribution system shall be as indicated below. However, Contractor shall provide any other necessary protection required for complete protection of system:.

7.13 Protection devices for power distribution system shall be as indicated below (Figure inside bracket refers to note below) (YES – Applicable)

Sl. No.	Relay Description	Relay No.	HV Tr. Fdr. Sec Wdg. Volt=>	HV Tr. Fdr. Sec Wdg. Volt<	HV /LV Motor Fdr., HV Breaker controlled contactor	O/G Bkr. HV Plant Fdr.	O/G Bkr. MV PMCC	I/C HV	I/C MV PMCC

			3.3 KV	3.3 KV	controlled				
1.	IDMTL Over-Current Relay	51	YES	YES	-------	YES	YES	YES (2)	YES
2.	IDMTL Earth-Fault Relay	51N	YES (4)	YES	-------	YES	YES	YES (2)	YES
3.	Standby / Backup Earth Fault Relay (earthed neutral)	51G (11)	YES (24)	YES (24)	-------	-------	-------	-------	-------
4.	Motor Protection Relay with (50, 50N, 46, 49, 50L/R, 95)	99	-------	-------	YES	-------	YES	-------	-------
5.	Instantaneous Restricted Earth Fault Relay (Earthed side)	64R (11)	-------	-------	-------	-------	-------	YES (25)	YES
6.	Instantaneous Over current Relay	50	YES	YES	-------	-------	-------	-------	-------
7.	Instantaneous Earth Fault Relay	50N	YES (5)	YES	-------	-------	-------	-------	-------
8.	Differential Protection Relay	87	YES (6)	-------	YES (7)	YES (8)	-------	-------	-------
9.	High speed tripping relay	86 (20)	YES	YES	YES	YES	YES	YES	YES
10.	Trip Circuit Supervision Relay	95 (20)	YES	YES	YES	YES	YES	YES	YES
11.	Transformer Auxiliary Relay	63	YES	YES	-------	-------	-------	-------	-------
12.	Under Voltage Relay with timer	27 / 2	-------	-------	YES	-------	-------	YES (9)	YES (9)
13.	Check Synchronisation Relay	25	-------	-------	-------	-------	-------	YES (10)	YES (10)
14.									

Notes for Relay Protection Philosophy

1. All the numerical relays shall be of communicable type and connected to ECMS on IEC 61850 (Ethernet based) communication protocol with time stamping and time synchronization.
2. In case of HV switchboards with continuous parallel operation of incomers, following additional relays shall be provided:
    a. One set of 87B (Bus differential) and 95 B (Bus wire supervision) for each bus section.
    b. 32 (Directional IDMTL over current and earth fault) relays for the incomers.
3. In case of grid power supply EHV incomer following additional relays shall also be provided:
    a. Relay 21 for distance protection, Relay 59 for overvoltage protection with timer, Relay 67 for directional over current protection, Relay 67N for directional earth fault protection, Relay 81 for under frequency / df/dt protection and Relay 98 as dead bus charging relay.
    b. Minimum protection relays for EHV Transformer shall be 50, 50N, 51, 51G, 51N, 63TX, 64R, 86, 87T, 87F & 95.
4. Instantaneous earth fault (50N) shall be provided only for transformer with delta primary.
5. Directional IDMTL earth fault (67N) shall be provided for transformer with star primary.
6. For transformers rated 5 MVA and above.
7. For motors rated 1500 kW and above, excluding VFD fed motors.
8. .
9. Wherever auto-transfer feature is provided.
10. For switchgears where continuous or momentary paralleling of Incomers is envisaged, check synchronizing relay shall be provided.

11. 51G and 64R relays for input transformer of VFD system shall be decided by VFD Manufacturer.
12. The bus tie feeders in HV switchboards shall be provided with 51, 51N, 86 and 95 relays.
13. HV capacitor bank feeders shall be provided with 51, 51N, 59 (over voltage), 60 (Neutral displacement), 86 and 95 relays.
14. The following feeders shall be provided with timers for delayed tripping on bus under voltage while the under voltage relay shall be common for the bus
    a. HV and MV capacitor feeders.
    b. HV and MV breaker controlled motor feeders.
    c. Contactor controlled motor feeders with DC control supply.

    Numerical relays where ever provided for motor and capacitor feeders shall use in built under voltage relay and timer for delayed tripping on bus under voltage.
15. One no. DC supply supervision relay (80) shall be provided for each incoming DC supply to the switchboard.
16. .
17. In case of numerical relays, all relays shall be comprehensive units including all protection, metering and control.
18. Under voltage and over voltage function along with associated timer shall be part of the numerical relays.
19. Auto changeover scheme control & logic between Incomers and bus coupler shall be built in the numerical relay.
20. Tripping relays (86) shall be separate relay. There shall be two nos. high speed tripping relay for motor feeder. One for electrical fault and one for process fault. Electrical fault relay shall be hand reset type and process fault relay shall be self reset.
21. Breaker control switch shall be hardwired type.
22. Stand by earth fault relay 51G shall be provided in the incomer of switchboard fed from transformers where transformer & switchboard both are located remotely from HV substation as well as in same HV substation.
23. For transformers located remotely away from HV Substation, a local power isolating device in the form of breaker panel without any protection relay shall be provided before transformer. A local emergency stop push button (Lockable) shall also be provided in transformer bay for tripping remote breaker.
24. Restricted earth fault relay 64R shall be provided for transformer rating >= 1 MVA in the incomer of switchboard fed from transformers having secondary winding star connected. This shall trip the HV side breaker.
25. .
26. Relay 87 and 64R shall be separate numerical relay. Hence shall not be part of main comprehensive numerical relay. CT for 87 and 64R can be clubbed, as two core of single CT.
27. Accuracy class of the current transformers shall be
    - Class PS for differential and special requirements.
    - Class 0.5 / 0.2 S for metering purpose.
    - Class 5P20 for protection purpose

    All the CTs shall have rated burden of minimum 15 VA and secondary rated current of 1 A.
28. Accuracy class of the potential / voltage transformers shall be
    - Class 5P for protection purpose.
    - Class 0.5 / 0.2 S for metering purpose.

    All the PTs shall have secondary voltage 110 V or 110 V / sqrt.3 and rated burden of minimum 50 VA per phase for both metering and protection core.
29. All the incoming, outgoing and tie breaker feeders of any HV & MV Switchboard shall be provided with numerical relays only with communication facility as protection devices. Releases shall not be acceptable in any case.
30. Numerical relays in all HV motor feeders shall be suitable for RTD / BTD inputs.

31. Each bus section shall be provided with separate under voltage relays.
32. Multifunction meter shall be provided to keep a record of power consumption and supervision of all concerned parameters like current, voltage, power, frequency, power factor etc. as specified. All the metering instruments shall be flush mounted.
33. Separate Communicable Digital Multifunctional meters shall be provided in all feeders with Numerical Relays for communication with ECMS system.
34. Motors shall also be provided with Unbalanced (-Ve) Sequence Protection Relay (46), as required.
35. Numerical under voltage relays (27) with time delay relay including VT fuse failure relay shall be provided for Bus VTs.
36. All Motor feeders of PMCC & MCC (irrespective of Rating) shall have door mounted communicable (Modbus / Profibus) type Motor Protection relay (MPR) with display.
37. No Meters, transducers or measuring equipments to be installed in the Protection CT circuit.
38. Cable Differential relays for both the end to be supplied by Downstream user contractor i.e. Contractor. Cable Differential relay will be of Fiber Optic Cable based communication only.
39. All required Alarms and Trips shall be incorporated in the Numerical relays. Sufficient LED shall be available in the Relays.
40. Trip Circuit Supervision relay shall be part of Numerical relay.
41. All Motors above 5.5KW and Outgoing Feeders above 100A shall Earth Fault protection with CBCT and Digital Earth Fault Relay with display.
42. Capacitor Feeder : 59, 27,50, 51, 50N, 51N, 60, CBFP etc.

7.14 Metering instruments shall be provided to keep record of power consumption and supervision of all concerned parameters like current, voltage, power (Active, Apparent and Reactive), frequency, power factor, Energy (Active & Reactive) etc. All the instruments shall be flush mounted. All meters shall be digital multifunctional meters with communication port for Load management at remote location. Additionally digital type ammeter, voltmeter and Hour Meter shall be provided separately for various feeders as indicated below :

The metering devices in HV and MV switchboards shall be as below:

- Type of metering: Analogue/As part of the Numerical relay

(Figure inside bracket refers to note below) (YES - Applicable)

Sl. No.	Feeder type	A	V	Hz	PF	MW	MWH	HM	MVAR	MVAH	MVA
1.	HV Incomer	YES	YES	YES	YES	YES	YES	----	YES	YES	YES (1)
2.	HV Bus Tie	YES	----	----	----	----	----	----	----	----	----
3.	HV Transformer	YES	----	----	----	YES	YES	----	----	----	----
4.	HV Bus PT	----	YES	----	----	----	----	----	----	----	----
5.	HV Plant Feeder	YES	----	----	----	----	YES	----	----	----	----
6.	HV Motor	YES	----	----	----	----	YES (kWh)	YES	----	----	----
7.	HV Capacitor	YES	YES	----	----	----	----	----	YES	----	----
8.	PMCC Incomer	YES	YES	----	YES	----	YES (kWh)	----	----	----	----
9.	PMCC Bus Tie	YES	----	----	----	----	----	----	----	----	----
10.	PMCC Bus PT	----	YES	----	----	----	----	----	----	----	----
11.	ACB Outgoing (Non Motor)	YES	----	----	----	----	YES (kWh)	----	----	----	----
12.	MV Motor (>55 KW)	YES	----	----	----	----	----	----	----	----	----
13.	MCC / ASB Incomer	YES	YES	----	----	----	----	----	----	----	----
14.	MCCB O/G	YES	----	----	----	----	YES	----	----	----	----

	(250A and above)						(kWh)				
15.	MLDB Incomer	YES	YES	----	----	----	YES (kWh)	----	----	----	----

Notes for Metering:-

1. MVA meter in external power supply incomers shall include maximum demand indication also.
2. Separate analogue type voltmeters with voltmeter selector switch and analogue type ammeters with ammeter selector switch shall be provided for incomers of all switchboards.
3. Ammeter (size 48mm x 48mm) shall be provided in space heater circuit of breaker fed HV & MV motors.
4. Apart from metering which shall be part of the numerical relays, Communicable digital multi-function meters of Accuracy Class 0.5/ 0.2(for Incomers only with suitable Metering CT shall be provided in all the breaker feeders of HV & MV Switchboard i.e. in incomers, bus coupler, outgoing plant feeders, transformer feeders, motor feeders, capacitor bank feeders, etc.
5. Multi function meters with serial communication over RS-485 or fiber optic cable, preferably with IEC protocol shall be provided in all the breaker feeders.
6. Power factor meter shall be provided for synchronous motors in addition to the metering provided for induction motors.
7. For current feedback to DCS/PLC and VFD feeders motor current transducers shall be provided and mounted in switchgear panel.
8. CT operated Ammeter for all motor feeders above 5.5 KW, all MOV and LOPs shall be provided at both LCS and feeder end of switchboard.
9. All ammeters for LV motors shall be connected through CT. Only HV motors shall have 3 ammeters or ammeter selector switch or Voltmeter and Voltmeter Selector Switch.
10. Hour run meter shall be provided in all breaker controlled motor feeder.

8.0 CONTROL AND MONITORING

The following provision shall be made for control and monitoring of following electrical equipments.

8.1 Transformers

- TNC switch in primary & secondary side of switchgear.
- Emergency trip from secondary side for tripping primary side of transformer.
- VCB with all required protection to be considered in all the 11kV & 3.3kV switchboards. .
- Lockable ‘OFF’ push button in transformer room to trip sending end switchgear.
- Indication lamp for ‘ON’ ‘OFF’ ‘Auto-trip, ‘Non-trip’ and ‘Trip Circuit Healthy’, ’Ready to Close’ , ‘Ready for Service’, ‘Test’, ‘Service’, ‘Space Heater ON’.
- Ammeter and voltmeter on both primary and secondary side.
- Load break switch with Earthing Switch on transformer primary side (only where primary side circuit breaker is not located in the same sub-station).

8.2 Motors Controlled Through Circuit Breakers

- TNC switch, L/R Switch with Ammeter on LCS

- Current monitoring at DCS/PLC through Dual Channel Current Transducer with Display facility installed at switchgear end, where required from process point of view.
- Indication Lamps in switchgear for 'ON', 'OFF', 'Auto-trip' and 'Trip Circuit Healthy', 'Ready to Start', 'Ready for Service', 'Test', 'Service', 'Space Heater ON, 'Space Heater ON for Motors'.
- Emergency trip in switchgear.
- Winding and bearing temperatures of motors shall be available at DCS in control room.
- Process interlock in CCR, where required.
- Control and Feedback for Motor Start & Stop command, Trip Indication, ON Indication, OFF Indication, Local / Remote Indication and Ready to Start Indication in remote (DCS/PLC etc.)
- Motors controlled through Circuit breakers should also be provided with ammeter, KVAh, KWH and running hour counter. Theses shall be incorporated in Numerical relay Or Multi-function Meter.

8.3 Medium Voltage Motors Controlled Through Contactors

- Start & Stop Push Button (Mushroom Stay Put Type) with Ammeter, Local/Remote switch on LCS
- Current monitoring in DCS, where required from process/Instrument point of view.
- Emergency Trip in PCC/MCC.
- Process interlock in CCR, where required shall be wired through separate auxiliary relay.
- Indication lamp for 'ON', 'OFF', 'Ready to Start' and 'Fault' in switchgear.
- Control and Feedback for Motor Start & Stop command, Trip Indication, ON Indication, OFF Indication, Local / Remote Indication and Ready to Start Indication in remote (DCS/PLC etc.)
- Motor space heater & Panel board space heater shall be provided with Ammeter & LED in
- Switchgear.
- All Motor feeders of PMCC & MCC (irrespective of Rating) shall have door mounted communicable (Modbus / Profibus) type Motor Protection relay (MPR) with Earth fault protection and display.

9.0 EQUIPMENT SPECIFICATION

9.1 General Features

9.1.1 The equipment shall be suitable for tropical climate conditions and corrosive and saline atmosphere.

All electrical equipment accessories and wiring shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

Fine mesh screen of corrosion resistant material preferably SS shall be furnish on all ventilating openings to prevent entry of insects.

9.1.2 The equipment to be installed in indoor plant area shall be enclosed in dust, damp and vermin proof enclosure equivalent to IP 54 as per relevant Indian Standards/IEC.

9.1.3 The equipment excluding motors to be installed in outdoor plant area shall have IP 65 enclosure. Motors of plant shall have IP 55 enclosure.

9.1.4 4 mm FRP (fire retardant and UV stabilized) canopies shall be provided for all outdoor equipments like motors, starters, LCS, SDBs, sw. sockets etc. PA stations shall have acoustic hood.

9.1.5 The switch boards, to be installed inside the building shall have enclosure IP 4X for HV switchgear, for LV switchgear degree of protection shall be IP 52 up to 1600A rating and IP-4X above 1600A rating. Equipment requiring ventilation opening such as battery charger/UPS etc. located in air conditioning room may have IP 43 enclosure however, opening for the ventilation shall be covered with fine wire mesh.

9.1.6 Creepage distance shall be 31mm/kV (for highest system voltage) for all equipment.

9.1.7 All the electrical equipment shall be provided with rolled aluminium/stainless steel heavy duty double compression type cable glands and crimping lugs for the cable terminations

9.1.8 The outside surface of all equipment shall be painted after suitable pre-treatment by the application of two coats of anti-rust and corrosion resisting epoxy based paints.

9.1.9 All similar equipment (viz. HV Switchboard, LV Switchboard – PCC, PMCC, MCC, EPMCC, ASB, LDB, DCDB, Transformers, Numerical relays, UPS, Battery Chargers, Motors, etc.) supplied against a package should be of single Make only – for ease of O&M and spare management.

9.2 **Power Transformers**

9.2.1 The transformers shall be double wound, copper conductor, and Dyn11 type. Transformers shall rated for 11/3.45 kV, 11/0.433 kV, 3.3./0.433 kV, as required. Transformer with 3.45 KV Secondary winding shall be considered for the substation only, where 3.3 KV switchboard is to be installed for feeding 3.3 KV motors.

9.2.2 The rating of power transformers shall be selected on the basis of load and future load growth. For future load growth the following provision shall be made:-

- 25% spare capacity in HV transformers above continuous peak load.
- 30% spare capacity in LV transformers above continuous peak load.

9.2.3 The rating of power transformers shall be selected keeping following into considerations:

(a) Duty : Continuous

(b) Outdoor type : ONAN (ONAN rating shall have 25% spare capacity above continuous peak load)

(c) Indoor type : Dry Type

Epoxy cast resin/ resin encapsulated type

(d) Maximum loading : 80% when one of the transformers is out of service

(e) Peak efficiency at : 35% - 40% of load

(f) Class of Insulation : B or better for oil filled

: F or better for dry type

9.2.4 Maximum temperature rise over ambient of 50 Degree Celsius shall be limited to:

(a) Outdoor transformers:

Top oil (measured by thermometer) : 50 ^{0} C

Winding (measured by resistance) : 55 ^{0} C

(b) Indoor transformers:

Winding (by resistance method) : 90 ^{0} C or lower as permissible for class

of insulation offered

9.2.5 Special consideration shall be given in specifying the percentage impedance of the transformers to suit the switchgear short-circuit capacity available..

9.2.6 Transformers generally up to 10 MVA shall have ONAN cooling, while ratings above 10 MVA shall be ONAN/ONAF cooled. Bare minimum protection devices for transformer have been as indicated below; however Contractor shall provide any other necessary protection relays required for complete protection of system.

Primary Side.

IDMTL Over Current, IDMTL Earth Fault, High Set Over Current, Instantaneous Earth Fault, Standby Earth Fault, Restricted Earth Fault , Differential (for sizes of 5 MVA and above), *Buchholz Alarm and Trip,*Winding Temperature Alarm,* Trip, *Oil Temperature Alarm, *Oil Level Alarm & Trip, *Trip for Winding Temperature and Oil Temperature. All protection except REF shall be provided on secondary side, if the primary side circuit breaker is located in other sub-station. REF protection shall trip the primary Inter-tripping of primary and secondary circuit breaker of transformer shall be provided for all faults through lockout relays.

CT for Restricted Earth Fault protection shall be provided in the transformer.

9.2.7 High Velocity Water Spray (HVWS) System shall be provided for transformers fire protection having oil capacity more than 2000 Liters and rating upto 20MVA.

9.2.8 Following Push buttons shall be provided for transformers :

- Lockable ‘OFF’ push button in transformer room to trip the breakers on primary side.
- Push button shall be provided on breaker on secondary side for permission to close breaker on primary side
- Emergency trip PB on breaker on secondary side for tripping breaker on primary side of transformer.

9.2.9 The instruments such as OTI/WTI, Buchholz relay and MOG shall have Magnetic Reed Switches. The mercury switch contacts are not acceptable.

9.2.10 For all transformers, conservators shall be provided with Magnetic Oil Gauge (MOG) having 1NO contact activated on Low oil level. For transformers above 2000KVA Air cell shall be provided in the conservator.

9.2.11 Transformer rooms shall have slab and shall be under shed.

9.2.12 All Routine Tests shall be performed in compliance with B.S.171, IEC publication No.60076, IS 2026 (parts I to V), CBIP and IS: 2026 (Part III) before dispatch from Manufacturer’s works and at erection site during commissioning or latest editions or any other authoritative standard. Certificates for Type Tests on similar type Transformers shall be submitted.

9.2.13 All Power transformers above 5 MVA shall have facility for Remote display (in ECMS) of Oil Temperature, Winding temperature, Conservator Oil Level and moisture ppm of Oil through 4-20 mA signal / Modbus communication.

9.2.14 For all other specification refer PC183-TS-0803.

9.3 **Neutral Earthing Resistor (NER)**

9.3.1 The NER shall be provided to earth the neutral of 11 kV and 3.3 kV systems. Neutral of 415V supply system shall be solidly earthed.

9.3.2 Neutral earthing resistor shall be outdoor type made of AISI 304/406 punched stainless steel grid element. . The earth fault current of 11 kV & 3.3 kV shall be limited to full load current of transformer or 400 A, whichever is less.

9.3.3 All NER not requiring operation shall be provided with isolator.

9.3.4 For all other specification refer PC183-TS-0804.

9.4 **Switchboards**

9.4.1 General

9.4.1.1. There shall be three positions for Breaker/Contactor trolley: - Service, Test and Isolate. In service position, the power connections shall be made; but in test and isolate mode, the power connection of bus bars shall be automatically removed.

ACB feeder for PCC, PMCC & MCC shall be single front for ease of operation & maintenance. Non-ACB feeders for motors or power may be double front type.

Breaker duty cycle shall be O-0.3sec-CO-3min-CO.

Separate CT shall be provided for differential/REF protection.

LV circuit breaker shall be 4 Pole type except for outgoing motor feeders which shall be 3 Pole type.

9.4.1.2. Suitable shutter arrangement shall be provided to protect the person from accidental contact with live bus in trolley chamber.

9.4.1.3. The degree of protection shall be IP 4X for HV switchboards and IP 52 for LV Switchboard up to 1600A rating and IP-4X for LV switchboards above 1600A rating.

9.4.1.4. All HV, MV & LV Switchboards shall be LOTO compliance.

9.4.1.5. 11 kV & 3.3 kV Switchboard shall conforms to IS/IEC 62271-200, IAC-A FLR-50KA/40KA 1 Sec, PM, LSC 2B which means that the switchgear panels shall be four side internal arc tested, shall have metal partitions and shall confirm to loss of service continuity. LV switchboard shall conform to IEC 60947. All 3 compartments (Busbars, Circuit breaker & Cable compartment) shall be tested for Internal arc for the said rating.

9.4.1.6. Each HV compartment should have individual exhaust channel / pressure relief flaps to let out over-pressurized hot gases at the top of the switchboard in case of an internal fault. Suitable factory fitted arc duct arrangement shall be provided for vending out the arc out of the switchgear room.

9.4.1.7. The switchgear shall have integral making type earth switch with proper Mechanical & Electrical interlock.

9.4.1.8. The observation window on the CB compartment door shall be made of special toughened/ laminated glass substantiated in type test reports as proving it arc proof. Observation window shall be of same material and construction as the type tested design/construction as specified in IEC.

9.4.1.9. Each cubicle shall be equipped with anti-condensation heater controlled by thermostat.

9.4.1.10. LV switchboard (EPMCC/PMCC/MCC) shall be TOTAL TYPE TESTED (TTA) design as per IEC 61439-1/2. Type Test Certificates for short circuit withstand of 50kA for 1 sec along with ACB mounted in the Switchboards shall be provided.

9.4.1.11. LV switchboard (EPMCC/PMCC/MCC) shall comply with Internal Arc Containment test as per IEC 61641.

9.4.1.12. The busbars and connection shall be made of electrolytic grade copper only. Aluminium busbars are not acceptable. All busbars of 11kV & 3.3kV switchgear including bus duct shall have Raychem sleeving.

9.4.1.13. Front access doors with single action operator will be provided to the HV circuit breaker compartment and LT Relay compartment. Bolted type CB door locking arrangement shall not be accepted.

9.4.1.14. An electro-mechanical device shall be provided to ensure the auxiliary circuits have been securely connected between the fixed and moving portions of the switchgear, before allowing closing operation of the circuit breaker. The voltage rating of the device shall be the same as the voltage used for the closing circuit.

9.4.1.15. Tripping and closing coils shall be of continuous rated type to ensure longer life. All Feeders of 11 KV shall have Double Trip coil for safety.

9.4.1.16. Circuit breakers shall be provided with a mechanically operated visual indicating device to display the circuit breaker switching state and a mechanical operation counter

9.4.1.17. The circuit breaker operations of closing and opening shall be possible with the circuit breaker compartment door closed.

9.4.1.18. It shall be possible to trip the circuit breaker locally by mechanical means. Voltage Transformer (VT) shall be cast-resin with built-in primary fuses, VT's shall be draw out type.

9.4.1.19. Voltage transformer shall be independent of circuit breaker carriage

9.4.1.20. Electrical interlocks and castle key interlocks shall be provided between Bus-bar Earthing Switches and all Bus-bar Isolators of each Bus-bar Section in such a way that Bus-bar Earthing Switches can not be closed when the Bus-bar Isolator of any circuit in the section is closed.

9.4.1.21. Bus VT Miniature Circuit Breaker (MCB) ON auxiliary contacts and under voltage relay contacts shall be monitored in the interlocking scheme to confirm the dead bus condition.

9.4.1.22. All CT & PT must be suitable for continuous operation of min. 20 % overload and for service under all rated and fault conditions.

9.4.1.23. Current transformers shall be in accordance with IEC 61869-1 & 61869-2. The rated output shall match the requirements of the equipment connected. The secondary current rating shall be 1 A, .Unless otherwise specified, cores for measuring instruments shall have accuracy classes of not more than 0.5 % and saturation factors less than 5.

9.4.1.24. Secondary terminals of current transformers shall be wired up to a terminal block with short-circuiting links, located at an accessible place. At this terminal block one side of each transformer shall be connected to earth.

9.4.1.25. The CT rating plate and the terminals must be accessible after the Power cables have been installed.

9.4.1.26. The busbars and connection shall be made of electrolytic grade copper only. Aluminium busbars are not acceptable. All busbars of 11kV & 3.3kV switchgear including bus duct shall have Raychem sleeving suitable for Line to line voltage . Proper shroud to be provided in the joints.

9.4.1.27. Tripping and closing coils shall be of continuous rating type.

9.4.1.28. Clearance between gland plate to cable termination point in all switchboards shall be adequate but not less than 300mm to ensure proper cable termination.

9.4.1.29. FRP supports shall be used for bus bars with adequate clearances and creepage distance to prevent flash over due to effect of dust moisture.

9.4.1.30. Protective relays shall be mounted on the front of the switchgear panel.

9.4.1.31. All logic like, Auto/Manual changeover etc. shall be built in the Numerical relay. Adequate number of I/Os shall be provided to meet the requirement. 10% spare I/Os shall also be provided. External I/O Card/ Module is not acceptable.

9.4.1.32. All relays used for protection shall be microprocessor based numerical type only with latest communication protocol IEC-61850 and shall have large graphical display. All relays shall have coating for protection against harsh environment conditions. All

numerical relays shall be of one make only. Selected models of numerical relays shall have metering, control, status and protective functions. It shall be possible to save minimum 5 records of each event. Important functions and features, in addition to the fault measuring capabilities, shall include:

- Programmable scheme logic,
- Remote communication interface for setting / interrogation from ECMS,
- Local communication interface (HMI-keypad and / or serial PC communication),
- Time-tagged events, fault and disturbance records,
- Display of measured/processed quantities,
- Self-monitoring (Hardware / Software),
- Inter-protection communication,
- Electronic transducer communication.

9.4.1.33. All protection relays shall be provided with test plugs and all CT, VT wiring shall be wired through the test plugs in HV, MV & LV Switchboards.

9.4.1.34. The protection scheme(s) shall include all hardware and software to permit remote setting / interrogation / fault evaluation from the ECMS (engineering) workstation or from the computer monitoring system.

9.4.1.35. All protection relays shall be equipped with communication port using IEC protocols to work as an integrated part of the ECMS hierarchy. Should the relay schemes be offered from multiple Bidders / Contractors, all third party user interface software products shall be supplied to the ECMS platform to bring together all types of protective relaying into a unified control system hierarchy.

9.4.1.36. Completely separate and isolated circuits shall be used for Switchgear control, tripping / protection, alarms, and auxiliary devices. These circuits shall have separate control power buses and feeders, suitably protected, for each power bus section.

9.4.1.37. Each control circuit shall be protected by a two-pole miniature circuit breaker with auxiliary N/C contact. The auxiliary contacts of all MCB's of the same circuit type, e.g. circuit breaker motor control, disconnector switch motor control, alarm, space heater, trip, etc., shall be wired in series to a group / common alarm terminal.

9.4.1.38. Each 11kV & 3.3kV outgoing/incoming and transformer feeder control panel shall include voltage detectors to indicate phases "ALIVE". The voltage detectors shall be connected to each phase on the cable side.

9.4.1.39. Contractor shall supply minimum 1 No. laptops with licensed software for communication & configuration of all make & Type of Numerical Relays.

9.4.1.40. GPS system and associated hardware & software shall be provided for synchronisation of clocks of numerical relay and metering LA & ECMS

9.4.1.41. All meters shall be digital multifunctional meters with backlight LCD display and communication port. Additionally digital type ammeter, voltmeter and Hour Meter shall be provided separately for various feeders as indicated above.

9.4.1.42. All the motor / capacitor feeders controlled through vacuum circuit breakers shall be provided with surge arrestors. Lightning Arrestor (LA) shall be provided on each bus of 11KV Switchboard.

9.4.1.43. A continuous ground bus shall be provided at the bottom of the switchgear and in cable connection side for grounding the switchgear, breaker trolley as well as to ground the cable glands.

9.4.1.44. 11KV & 3.3KV Breaker shall be with Integral Earthing switch system with proper interlocks.

9.4.1.45. Control supply bus and space heater supply bus-bars (Copper) of adequate rating shall be provided throughout the length of switchboards with as many sections as sections in power bus-bars.

9.4.1.46. Control supply shall be tapped from control bus in each cubicle/ panel itself through DP MCB of suitable rating.

9.4.1.47. The minimum thickness of sheet steel used in HV and LV switchgear including charger, UPS, ASPB etc. shall be as under:-

a) Base Channel minimum 3.0 mm

b) Load Bearing Members minimum 2.0 mm

c) Doors and covers minimum 1.6 mm

9.4.1.48. A bottom channel of not less than 100 mm shall be provided.

9.4.1.49. The maximum height of the switchboard and other control panels shall be limited to 2200 MM. Maximum height of component requiring operation shall be limited to 1800MM.

9.4.1.50. The switchboards shall have adequate short-circuit ratings and be suitably sized for the load and spare capacity foreseen. The short time rating of bus bar shall be 3 seconds for HV switch boards and 1 second for other boards.

9.4.1.51. The HV switch boards and power control centres shall normally have four spare circuit breaker panel (size shall be as per largest outgoing feeder breaker), two on each side of bus-section.

9.4.1.52. For other boards (PMCCs, MCCs, MLDBs, ASPBs, DCDBs etc.) sufficient number of spare feeders to the extent of min. 20% for each type & rating shall be provided.

9.4.1.53. The 415V switch boards shall have PVC insulated bus bar system suitable for rated voltage. At joints of these bus bars removable shrouds shall be provided.

9.4.1.54. All HV & LV Switchgear, UPS, Battery Charger etc. shall have designated space in each Bus section for Network Switches and other communication equipments.

9.4.1.55. For interfacing with DCS system, separate marshalling panels (with 20% spare terminals) shall be provided on each bus section in all HV & MV switchboards in the same panel line-up. The marshalling panels shall be of full height same as that of switchboards. The horizontal bus bar chamber at the top shall be continuous through this marshalling panel also, for future extension of the MV switchboard. All critical control signals for DCS interface shall be hardwired between substations and DCS. Other non-critical data of Electrical system will be sent to DCS with redundant communication facility between DCS and ECMS.

Hardwired signals (with minimum requirement specified below) from various Motor feeders of a bus section for DCS interface shall be wired and terminated in the marshalling cabinet:

- DCS Start permissive
- Process Start command (Auto)
- Remote Start command (Manual)
- Process Stop command
- Process Trip command (for breaker controlled motor feeder)
- Breaker/Contactor ‘ON’ indication
- Breaker/Contactor ‘OFF’ indication
- Ready to Start indication
- Electrical Fault Trip indication

9.4.1.56. Following monitoring signals, as a minimum, shall be taken from substation to DCS interface, through redundant MODBUS SERIAL LINK communication from ECMS system.

- Load Data viz. KW, PF, A, etc.
- L/R indication
- Process Trip indication
- Electrical Fault Trip indication
- Trip Details

9.4.1.57. Auto changeover scheme shall be provided for incomers and bus couplers on all 11 KV switch boards, 3.3 KV switch boards and PMCCs/PCCs/ MCCs. Under normal operating conditions, incomer-1 and incomer-2 breakers would be closed and bus coupler breaker would remain open with 'auto-manual' switch in 'auto' position. The bus coupler switch would close automatically under the following condition being fulfilled:-

i. Either of the incoming breaker trips due to under voltage (70% or below).

ii. Voltage on the healthy bus is more than 80% for the set period.

iii. Residual voltage on the bus with no power supply comes down to 30%.

iv. Auto change over shall be locked on loss of power on both the incomers.

Auto changeover shall also be provided on switchboards catering to emergency loads.

9.4.1.58. Paralleling of two incoming feeders is not foreseen. However, facility for momentary paralleling shall be provided for intentional changeover without interruption of supply.

9.4.1.59. Every enclosure door that provides access to live parts operating at 240 V AC and above shall be mechanically interlocked with a circuit interrupting device on the supply side such that when the door is open, the equipment is de energised.

9.4.1.60. Separate redundant AC and DC control supply shall be provided for each Switchboard.

9.4.1.61. Control supply for motor feeders having MCCB in PMCC/MCC/ASB etc. and VFD panels etc. shall be feed from 240V UPS (Electrical) and motor controlled with breaker shall have 110 V DC control supply irrespective of its being HV or LV.

9.4.1.62. For motors with auto-starting provision, trip of a running motor shall start standby motor automatically.

9.4.1.63. All the HV/LV switchgear shall be fed through two separate transformers, each transformer having capability to take care of 100% load of the associated switchgear and shall have the facility of auto changeover in case of failure of one transformer as well as option of manual changeover for maintenance purpose.

9.4.1.64. Max. 3 runs of 400 sq.mm power HV cable shall be terminated in single panel. For more than 3 runs of cable complete dummy/adaptor panel shall be provided.

9.4.1.65. The CB ON and OFF lamp shall be provided at rear and front side of 11kV/3.3kV switchboards.

9.4.1.66. All breakers service ON/OFF contact multiplier contactors shall be mechanically latched type and independent of control supply. Loss of supply and restoring the supply shall not affect the status of the relay/ contactor.

9.4.1.67. All breakers shall be electrically operable and mechanical operation from the breaker shall be possible locally. Manual breakers are not acceptable.

9.4.1.68. Separate Ammeter shall be provided for panel and motor feeder Space heater circuit for each panel.

9.4.1.69. The terminal strips used shall be of stud and nut type and control wiring shall be done with ring tong lugs only.

9.4.1.70. Dual channel output with display type current transducer for all HV and LV switchboard feeder shall be provided requiring Ammeter at control panel.

9.4.1.71. All motor (HV/LV) power feeders shall have separate earth fault protection through CBCT and earth fault relay. LV motor (above 5.5. KW) and power feeder above 100A shall have CBCT and Digital earth leakage relay with display.

9.4.1.72. All external hardware shall be of stainless steel only.

9.4.1.73. The control compartment and power compartment shall be separate.

9.4.1.74. All HV and LV breakers shall have remote switching facility as well as ON/OFF/TRIP indication at ECMS.

9.4.1.75. Following Set of accessories as detailed below shall be provided for each 11kV/3.3 kV Switchboard :

a) Breaker handling trolley – 2 Nos.

Following Set of accessories as listed below shall be provided for each 415 V Switchboard :

a) Breaker lifting and handling trolley : Minimum 2 nos.
b) Test cabinet with coupling cables for testing the breaker in draw out position : Minimum 1 No.
c) Racking in/out handle for breakers : Minimum 4 nos.
d) Racking in/out handle for draw out MCC modules : Minimum 2 for each MCC

9.4.1.76. Alarm relays with reverse flag shall be provided to annunciate failure of main incoming A.C. and D.C. power supplies and annunciation D.C. supply in each panel. Lamp indications shall be provided individually for main D.C. supply-1 fail, main D.C. supply-2 fail, and panel annunciation D.C. supply fail. A common A.C. electric bell shall be provided to give an audible alarm in case of failure of D.C. supply-1/D.C. supply-2/annunciation D.C. supply in any panel. A common push-button shall also be provided for cancellation of lamp indications and audible alarm.

9.4.1.77. Gland plate for single core cables shall be non-magnetic.

9.4.1.78. For all other specifications, refer PC183-TS-0805, PC183-TS-0806, PC183-TS- 0808 and PC183-TS-0809.

9.4.1.79. Separate panel shall be considered for incomer Line PT & Bus PT (11 kV & 3.3 kV Switchboards) and PT shall be draw out type. 4 pole MCB shall be provided on LV side of Bus & Line PT.

9.4.1.80. Inspection window shall be provided for HV termination in the switchboard for carrying out thermography, provided internal arc test certificates for this design is available with the bidder.

9.4.1.81. All Incomers and bus couplers shall be provided with synchronising facility. Synchrocheck relay shall be provided in each bus PT & contacts shall be multiplied and wired in each outgoing feeders of each bus section.

9.4.1.82. All 11kV, 3.3. kV and 415 V Switchboards shall preferably be of same make for ease of operation & maintenance.

9.4.1.83. Supervision of installation, testing and commissioning including testing of Relays of all switchboards shall be done through OEM only.

9.4.1.84. All Cable Differential Relays shall be FO Cable type only. Supply & termination of the FO cable & associated HDPE duct, as required, for feeder differential protection shall be included in Contractor ’s scope.

9.4.1.85. All Numerical Relays shall be of same Make and Model (series).

9.4.1.86. 11kV & 3.3kV Circuit Breaker shall have integrated earth Switch with proper Mechanical & Electrical Interlocks& Electrical Interlocks.

9.4.1.87. 11kV & 3.3kV Breaker rack in rack out facility should be operable when breaker panel door is closed position.

9.4.1.88. LV Switchgear design shall be such that the feeder doors should not open in locked out tagged out condition .

9.4.1.89. Current transformers shall be in accordance with IEC 61869-1 & 61869-2. The rated output shall match the requirements of the equipment connected. The secondary current rating shall be 1 A. Unless otherwise specified, cores for measuring instruments shall have accuracy classes of not more than 0.5 % and saturation factors less than 5.

9.4.2 11 KV Switchboard

9.4.2.1 The 11 KV switchboard shall be indoor, metal enclosed, draw out type, equipped with VCBs, stored energy mechanism working on 110 V DC and shall feed power to the various substations through transformers and other outgoing feeders.

9.4.2.2 Degree of protection shall be IP4X as per IS/IEC 60529,IEC 60298. Switchgear sizes and configuration shall be rationalized to minimum spare holding.

9.4.2.3 A study shall be conducted by contractor to determine the rated short circuit capacity for the selection of equipment. However, Rated short circuit breaking capacity shall be as determined by the study or 40 KA for 3 sec, whichever is higher. HV Switchboard shall be suitable for Internal Arc (AFLR) withstand current of “rated short circuit current” for 1 sec.

9.4.2.4 Incoming, bus coupler and outgoing feeders shall be provided with ON, OFF, Trip, Trip Circuit Healthy indications. Process trip lamp/annunciator window to be provided wherever applicable.

9.4.2.5 Control supply shall be 110 V DC.

9.4.2.6 Extra anti-condensing space heater shall be provided in Bus –Bar and Cable chamber of 11KV Switchboard.

9.4.3 3.3 KV Switchboard.

9.4.3.1 The 3.3 KV switchboard shall be indoor, metal enclosed, draw out type, equipped with Vacuum Circuit Breakers (VCBs), stored energy mechanism working on 110 V DC. for all feeders.

9.4.3.2 The minimum degree of protection shall be IP4X as per IS/IEC 60529,IEC 60298. Switchgear sizes and configuration shall be rationalized to minimum spare holding.

9.4.3.3 A study shall be conducted by contractor to determine the rated short circuit capacity for the selection of equipment. However, rated short circuit breaking capacity shall be as determined by the study or 26.24kA for 3 sec, whichever is higher. HV Switchboard shall be suitable for Internal Arc (AFLR) withstand current of “rated short circuit current” for 1 sec.

9.4.3.4 Incoming, bus coupler and outgoing feeders shall be provided with ON, OFF, Trip, Trip Circuit Healthy, Spring Charged indications. Process trip lamp/annunciator window to be provided wherever applicable.

9.4.3.5 Control supply shall be 110 V DC.

9.4.3.6 Extra anti-condensing space heater shall be provided in Bus –Bar and Cable chamber of 3.3KV Switchboard.

9.4.4 Low Voltage Switchgears

9.4.4.1 415 V switchboards shall include the following:

a) Power Control Centres (PCCs)

b) Power-cum-Motor Control Centres (PMCCs)

c) Emergency Power-cum-Motor Control Centres (EPMCCs)

d) Motor Control Centres (MCCs)

e) Main Lighting Distribution Boards (MLDBs)

f) Auxiliary Services Power Boards (ASPBs)

g) Emergency Power Distribution Boards

EPMCC shall be separate from PMCC.

9.4.4.2 Low voltage switchboards shall be metal clad, arranged with self supporting units and assembled together in a row.

9.4.4.3 Internal physical separation / segregation of 415 V Switchboards shall be 3 B for Non-ACB feeders and 4 B for ACB feeders.

9.4.4.4 The switchboards shall be suitable for extension at both the ends.

9.4.4.5 Bus bars shall be of uniform cross section and supported on non-hydroscopic FRP insulators with adequate clearances and creepage distance to prevent flash over due to effect of dust/moisture.

9.4.4.6 The horizontal busbars as well as vertical droppers of LV switchboards shall have heat shrinkable insulated sleeves.

9.4.4.7 Sufficient bus supports shall be given to give adequate mechanical strength during short circuits.

9.4.4.8 A continuous ground bus shall be provided at the bottom in the PCC/ PMCC/ EPMCC /MCC for grounding the PCC/PMCC/MCC.

9.4.4.9 Rated short circuit breaking capacity shall be 50 KA for 1 sec.

9.4.4.10 The PMCC,EPMCC, MCC, Main lighting distribution board and auxiliary services power board shall be provided with withdraw able air circuit breakers for incoming feeders and bus ties.

9.4.4.11 All feeders of 415 V switchboards shall be provided with MCCB except feeder rated more than 400A, for which ACB shall be provided. All outgoing feeders shall be draw-out type in all the switchboards.

9.4.4.12 All ACBs shall be electrically operated- EDO type only. Manual breakers are not acceptable. Each electrically operated breaker shall be provided with antipumping (94), Breaker fail (52BF) and trip free feature, trip annunciation (30) and lockout (86) relays. Lockout relay shall be hand reset type.

9.4.4.13 All ACBs shall be without any internal releases. The required protections shall be wired by means of external numerical relays.

9.4.4.14 Motor feeders below 75 KW rating shall be contactor controlled and 75 KW & above, these shall be ACB controlled with combined motor protection relay. All other feeders of 415 V switchboards shall be provided with MCCB except feeder rated more than 400A, for which ACB shall be provided. All outgoing feeders shall be draw-out type in all the switchboards.

9.4.4.15 Switchboards shall be provided with thermostatically controlled anti-condensation heaters.

9.4.4.16 All units in the MCC shall be completely accessible and removable from front. Both power and control connections shall be stab-in type.

9.4.4.17 Bus bar clearances shall conform to relevant Indian Standard/IEC for equipment voltages up to and including 500 V AC.

9.4.4.18 The switchboards shall be compartmentalized and individual feeder modules shall be draw-out type. Fixed type modules shall not be acceptable.

9.4.4.19 The draw out modules shall be standardized and it shall be possible to interchange any module with a module of same size. The components to control the equipment like MCCB, starter, auxiliary relay etc. shall be wired as a unit on the individual module. Safety shutter shall be provided to prevent direct access to live parts when the chassis is removed.

9.4.4.20 The entire draw out construction should be designed for safe operation during placement or removal of chassis. An earthing arrangement shall be provided which will make contact first before the power contacts are made and break last. Each module shall control one motor in general.

9.4.4.21 The door shall be interlocked so that it cannot be opened unless the isolating switch on that module is OFF. However, it shall be provided with a door defect mechanism for intentional opening when on line for testing and inspection purpose.

9.4.4.22 Control switches for breaker control shall be provided in each breaker cubicle. Circuit breaker shall be interlocked to prevent withdrawal of a closed breaker or insertion of a closed breaker. Each breaker shall be provided with anti pumping device.

9.4.4.23 Provisions shall be made to manually close/trip circuit breakers on loss of control voltage.

9.4.4.24 LV motor and power feeder above 100A shall have CBCT and Digital earth leakage relay.

9.4.4.25 All external hardware shall be of stainless steel only.

9.4.4.26 The control compartment and power compartment shall be separate.

9.4.4.27 The LV PMCC/MCC/PCC control supply shall be 240VAC, 50Hz UPS supply fed from UPS Distribution Board of Separate 240 V AC UPS System dedicated for MCC control supply; Control Room & Substation lights, ECMS Equipment, Fire Detection & Alarm System etc. Breaker control supply shall be 110V DC.

9.4.4.28 All low voltage switchboards shall be provided with 20% spare outgoing feeders or minimum 1 No. of each rating & type (fully wired) and with all the components The timers shall be electronic type only. Pneumatic or synchronous type timers are not acceptable.

9.4.4.29 Each outgoing motor feeder shall consist of a number of components mounted in a module duly wired. In general outgoing feeder rated below 75 KW shall consist of:

a) MCCB.

b) Control supply On/Off switch and fuse

c) Power Contactor

d) Electronic Digital Motor Protection Relay with built-in Earth Fault, Overload, Stalling, Single phase protection, etc. Thermal Overload Relay are not acceptable.

e) C.T for metering

f) Overload reset button.

g) Process Trip / ON / OFF indicating lamp with separate indicator fuse.

h) Auxiliary contactors for multiplication / control.

i) Test position limit switch and test PB

j) CT operated Ammeter for all motor feeders above1.5 KW, all MOV and LOPs at both LCS and Feeder end.

k) Selector switches as per requirement.

9.4.4.30 Provision for indication of minimum following electrical parameters in 415V PCC / PMCC/ MCC shall be made:

a) ON OFF, TRIP, TRIP CIRCUIT HEALTHY, TEST, SERVICE Position, Ready to close indication in ACB feeders.

b) The KWH meters on incomers shall have provisions for sealing for tariff purpose, as required.

c) MCC shall conform to the following as a minimum :

- Motor starters rated for utilisation category AC3 and protection equipment with a minimum of type 2 co-ordination.
- The number of modules per tier shall not exceed 6.
- MCC incomer sizes and configurations rationalised to minimise spares holdings.

9.4.4.31 In PMCC, MCC and EPMCC Non-ACB feeders for motors or power may be double front type. ASDB, UPSDB, DCDB shall be single-front type.

9.4.5 Auxiliary Supply Power Board

The ASPB shall generally be single front, floor mounted draw out type having essential and non-essential bus. Non-essential bus shall be disconnected in case of failure of normal supply through a contactor. Substation station shall have ASPB. Additional 2 Nos.63A Feeders shall be provided for Owner's use.

9.4.6 Lighting Sub Distribution Boards

The Distribution Boards shall be single front, non-draw out wall mounted type.

9.4.7 UPS Distribution Boards

9.4.7.1 The UPS Distribution Boards shall be single front, floor mounted non-drawout type for supply of 115 V AC / 240 V AC and shall have 20% spare outgoing feeders of each rating & Type (fully wired) and with all the components.

9.4.8 Direct Current Distribution Boards

9.4.8.1 The Direct Current Distribution Boards (DCDBs) shall be single front, floor mounted non-drawout type for supply of 110 V DC control power to switchgears and panic lighting. Each Substation station shall have separate DCDB.

9.4.8.2 DCDB shall have 20% spare outgoing feeders of each rating & Type (fully wired) and with all the components

9.4.9 Following potential free contact shall be available for each Motor feeders for indication in ECMS in addition to process requirement:

- Motor ON
- Motor OFF
- Ready to Start
- Motor Process Trip
- Motor Elect Trip

9.5 **Motors**

9.5.1 The rating of LV and HV motors shall be selected from the sizes as recommended in relevant Indian Standard/IEC.

9.5.2 All electric motors shall meet the standard IEC 60034-30-1.

9.5.3 The margin between the installed power and absorbed power shall be as recommended by the driven machine supplier but shall not be less than the following:-

Motor Rating	Margin above Driven M/C Absorbed Power
Less than 22 KW	25%
22 KW to 55 KW	15%
75 KW and above	10%

9.5.4 Voltage Ratings:

Voltage rating for the motors of different ratings shall be as below:

Upto 150 KW: 415 V, 3-phase, 50 Hz AC

Above 150 KW - 1000 KW: 3.3 KV, 3-phase, 50 Hz AC

Above 1000 KW: 11 KV, 3-phase, 50 Hz AC

All motors shall be designed for 3-Phase supply only.

9.5.5 The motors shall have maximum continuous rated duty S1 as per relevant Indian Standard/IEC. Rated duty for special duty motors wherever required e.g. cranes etc. Shall be considered as per driven equipment requirement.

9.5.6 All LV motors shall be TEFC type as per relevant Indian Standards/IEC while HV motors shall be TEFC/CACA type. All motors shall be Class-F insulated with temperature rise limited to that of Class-B.

9.5.7 Normally the motors shall be suitable for DOL starting. However, motors started through VFD shall be suitable to run at 30% to 100% of rated speed and compatible with the VFD.

9.5.8 All motors 30 KW and above shall have space heater provision.

9.5.9 All HV motors shall have winding, hot air and bearing RTDs. All the temperature signals shall be terminated to DCS as well as ECMS.

9.5.10 All LV motors shall be of efficiency class 'IE3' as per latest applicable version of IS: 12615. All HV Motors shall be of high efficient and high power factor type.

9.5.11 The starting current i.e. breakaway current of 415 V Motors shall not exceed the values indicated in IS: 12615. Also there shall be no further positive tolerance on the values of of breakaway of current.

9.5.12 The starting current of 11 KV & 3.3 KV motors shall not exceed 550% of FLC. No positive tolerance is acceptable over 550% FLC.

9.5.13 Type test certificate of similar motor for use in specified hazardous area (if applicable) shall be furnished.

9.5.14 The duty cycle of the motor shall meet the process and driven machine requirement.

9.5.15 In case of 11 KV & 3.3 KV motor, the terminal box shall be suitably designed for proper termination of XLPE insulated Aluminium cables through heat shrink termination kit.

9.5.16 The mechanical parameters such as duty, mounting type, shaft extension, direction of rotation, starting torque requirements etc. shall be adequate for the application. Sleeve or anti friction type bearings shall be used. Vertical motors shall have thrust bearings suitable for the load imposed by the driven machinery. Motors with sleeve bearings may require proximity probes to measure shaft vibration adjacent and relative to the bearings.

9.5.17 Motor rated above 30 KW shall have on line greasing provision and for motor rated above 45 KW, grease outlet feature shall be provided.

9.5.18 All HV motors shall have safety factor not less than 1.1.

9.5.19 Motors rated 1000 kW and above shall have suitable measures to prevent flow of shaft currents and shall have 2 sets (i.e. 6 nos.) of PS class CTs for differential protection.

9.5.20 The motor shall be capable of withstanding the electro dynamic stress and heating imposed if it is started along with the driven equipment at voltage of 110% of the rated value.

9.5.21 During starting of large motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment, while running, shall successfully ride over such period without affecting system performance.

9.5.22 D.C. motor provided for emergency service shall be shunt/compound wound type. Motor shall be sized for operation with fixed resistance starter for maximum reliability.

DC starters shall be complete with MCCB, contactors, resistors, relays, meters, push-buttons, lamps, etc. DC contactor shall be Class I – Category DC3. Switch Duty shall be DC22. The resistor enclosure shall be provided with ventilating louvers and wire mesh guard and shall have a degree of protection IP-23.

9.5.23 The motor may be subjected to sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage. The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics.

9.5.24 Shaft voltage shall be limited to 200 mV.

9.5.25 For all other specifications, refer PC183-TS-0810.

9.6 **Rectifier-cum-Battery Charger**

9.6.1 The Rectifier-Cum-Battery Charger shall be fully automatic using silicon controlled rectifier and shall consist of units as described below:-

i) Main Float cum Load charger: To supply continuous load and keep the battery in healthy state.

ii) Standby Float cum Load charger: To supply continuous load & keep the battery in healthy state in case any abnormality in Main charger.

iii) Boost charger: To charge the battery set initially and recharge (after meeting emergency or sudden application of heavy loads.)

9.6.2 Battery Charger shall have at least 20% extra capacity for future load requirement. Battery Charger shall have 110 V DC system.

9.6.3 Substation shall be provided with redundant battery charger with 2x100% battery banks and connected to each Charger.

9.6.4 The battery and charger combinations shall be such as to ensure continuity of D.C. supply at load terminals without even momentary interruption.

9.6.5 AC Ammeter and AC Voltmeter on Charger Input; DC Ammeter, DC Voltmeter for charger output/ battery voltage and on demand type Battery Charge / Discharge Ammeter shall be provided.

9.6.6 Following analog signals through suitable transducer shall also be provided for hook-up in ECMS:

- Status of charging current (float & boost charging)
- Battery current
- Incoming voltage

9.6.7 Following potential free contacts shall also be provided for hook-up in ECMS

- DC under voltage
- DC overvoltage
- DC earth leakage
- AC incoming power supply failure
- AC input fuse blown-off
- Thyristor/ diode failure
- DC output fuse blown-off
- DC battery fuse blown-off
- Filter Capacitor fuse blown-off

- Load on Battery (using current direction sensing with time delay)
- Battery undervoltage/ Disconnected during discharge (using zero current sensing)
- Cubicle fan failure/ cubicle temperature high (for chargers with forced cooling).

9.6.8 For all other specifications, refer PC183-TS-0813.

9.7 **Battery Sets.**

9.7.1 These shall be Ni-Cd Battery Sets shall be rated to meet the total DC power requirement for 5 hour after complete power failure.

9.7.2 Spare capacity of 20% for future use shall be considered.

9.7.3 Battery shall be designed with minimum temperature as 50C.

9.7.4 Load Test of all Battery to be done at site. Battery will be accepted based on load test only.

9.7.5 For all other specifications, refer PC183-TS-0814.

9.8 **Uninterruptible Power Supply System (UPS)**

9.8.1 115 V AC UPS System with UPS Distribution Board shall be provided to feed 115 V AC, 50 Hz, 1Phase power supply to the instrumentation system, DCS etc. This UPS System along with associated Battery and UPS distribution Board shall be located at Control Room.

Separate 240VAC UPS System with UPS Distribution Board shall be provided to feed PMCC & MCC control supply, Control Room & Substation lights, ECMS Equipment, Fire Detection & Alarm System etc. This UPS System along with associated Battery and UPS distribution Board shall be located at Substation. Block Diagram of 115 V UPS System shall be followed but with 240 V in place of 115 V

Both 115 V AC UPS System and 240 V AC UPS System complete with Battery, UPS Distribution Board etc. shall be separate.

Both the UPS i.e. 240V AC and 115 V AC shall have with 20% margin for future use.

9.8.2 Additional 2 KVA rating of 240 V AC UPS shall be considered for Owner's use while designing UPS System.

9.8.3 Both 115 V AC UPS with UPS Distribution Board and Battery Bank and 240 V AC UPS with UPS Distribution Board and Battery Bank shall be provided for each Substation.

9.8.4 The UPS System shall have IGBT type with touch screen LCD display and shall be backed up by nickel cadmium (Ni-Cd) battery rated for 2 hour at rated capacity of the UPS. Battery (100% Capacity) shall be separate for each Inverter.

9.8.5 UPS system construction shall be such that each charger, inverter module can be made fully isolated for maintenance. No common devices/wiring shall be installed. Further there shall be no common device between main & redundant units (e.g. master oscillators etc.) in order to ensure that the failure of the same does not cause shutdown of more than one unit.

9.8.6 UPS system shall have facility for built in Online battery bank monitoring & testing facility for displaying/calculating expected battery bank back-up time (during testing if battery bank does not have sufficient back up time, test shall be terminated & load shall be shifted to charger automatically).

9.8.7 UPS shall be suitable for 100% step load.

9.8.8 Battery Load cycle test shall be carried out by the vendor at site .

9.8.9 The UPS rating shall be such that in any case the load on the individual UPS shall not exceed 70% (after considering 20% future margin) of the rated capacity.

9.8.10 UPS Configuration shall be as per attached Block Diagram.

9.8.11 The over load capacity of UPS shall be 200% for 10 cycles, 150% for 60sec & 125% for 10min.

9.8.12 All four sections, i.e. Rectifier-I, Rectifier-II, Bypass – I and Bypass - II shall be fed through four separate feeders of emergency bus of PMCC.

9.8.13 UPS shall be PWM based using IGBT. Each charger and SCVS shall have isolating transformer at the input.

9.8.14 The salient features of the UPS shall be as under:

a) High Efficiency

b) Compatible to feed nonlinear, high crest factor loads

c) Microprocessor based monitoring system for UPS status and fault indications

d) High transient performance

e) Low audible noise

9.8.15 Each UPS shall be provided with SNMP software so that all the parameters of UPS and alarms/faults can be viewed into the remote computer. These logs/trends of load can later be printed. Web based parameter and status monitoring shall be used. It shall be hooked to ECMS and DCS System.

9.8.16 The transfer time of UPS from inverter to bypass, in case of failure of both inverters, shall be so selected that during this transition period, instrumentation/DCS etc. which leads to tripping of plant shall not fail. Typically, it shall be as below :

In synchronism : No break transfer i.e. within 6 milliseconds (Maximum)

In asynchronous mode : Within 16 milliseconds (Maximum).

9.8.17 The technical parameters of UPS shall be as under:

Input

a) Rated Voltage 415 V ± 10%

b) Rated Frequency 50 Hz ± 5%

Output

a) Rated Voltage 115 V AC / 240 V AC

Voltage regulation:

Static (0-100% load) ±1%

Dynamic for 100% load change: ±5%

9.8.18 Following potential free contacts shall be made available on the UPS,

- Rectifier ON
- Inverter ON
- Battery CBB ON
- Load on Inverter
- Inverter fail
- Rectifier Fail
- Inverter O/P undervoltage
- Inverter Sync.
- Load on battery
- Bypass Fail
- Load on bypass
- Load transferred. etc

Note: A separate common potential free contact for all the faults/alarms (in UPS / SCVS) shall be made available

9.8.19 Operation Philosophy of UPS:

- 2 sets of rectifiers and inverter shall be provided. Under normal conditions, when AC mains power is available, both the rectifiers shall operate in parallel and supply DC power for float/rapid charging the 2X50% batteries and simultaneously to inverters. In case of failure in one rectifier, the other rectifier shall feed the complete load and the batteries without any interruption.
- In case of Incoming supply failure or failure of both rectifiers the 2X50% batteries shall feed the inverters without any interruption. Each rectifier shall be designed for simultaneously feeding complete inverter load and float/rapid charging of the 2X50% batteries to its rapid capacity. Each rectifier shall be equipped with " On Line" automatic as well as manual charging facility.
- Normally both the inverters will be synchronised with each other and with stabilised bypass supply. Both inverters shall operate in parallel and share the load equally.
- The load sharing controls shall not be subject to common mode failure and any failure of the load sharing controls shall not result in the loss of the vital power.
- When a disturbance/fault occurs in any of the inverters, the faulty unit shall automatically get disconnected and the entire load shall be fed from the other inverter without interruption.
- In case both the inverters develop a fault, the complete load shall be transferred to stabilized bypass supply through the static switches and retransfer of the load from the stabilized bypass supply to the inverter shall be possible in auto as well as in manual mode without interruption.

9.8.20 All alarms & status of UPS shall be communicable through Modbus / Ethernet protocol to ECMS.

Following minimum shall be considered:

- Load on Inverter
- Load on Bypass
- Load on Battery
- Battery on float/ boost charging mode.
- Charger failure.
- Inverter failure
- AC mains failure
- DC under voltage
- DC Over voltage
- Automatic retransfer of load to inverter inhibited.
- Fan failure
- AC Voltage , current & frequency of each inverter
- AC incoming power supply Voltage & voltage.
- DC current at each rectifier output.

9.8.21 For all other specifications, refer PC183-TS-0802.

9.9 **Variable Speed Drives (VSD/VFD)**

9.9.1 Microprocessor based variable speed drive shall be communicable type and shall be able to communicate with ECMS/DCS. It shall be possible to set speed from process DCS for optimum performance through 4-20 mA signal. Speed/current/status feedback to DCS shall be provided. Drive will run at preset speed in the event of loss of signal from DCS.

9.9.2 System shall be highly reliable, efficient and shall provide high power factor, low harmonic distortion, low noise level etc.

9.9.3 System shall be provided with complete by pass circuit to ensure the power supply reliability in case of VSD/VFD failure. It shall be possible to start the motor in DOL mode through by-pass system in case there is any problem/fault in the VFD. The Electrical system and the process should be capable to operate the Motor in fixed speed (without VFD).

9.9.4 The system shall be suitable for load characteristics, continuous speed control. Drive shall be able to accelerate the load over the full speed range (0 – 100 %) with incoming line voltage regulation of 10%.

9.9.5 The system shall be designed for 150% over current withstand for 1 minute. The system shall be equipped with an automatic restart facility which will restart the system in case of voltage dip over 20% or power interruptions less than 4 seconds and recovery of voltage to 95% with a facility to block the automatic restart.

9.9.6 The system shall be suitably designed with due care for long length of cables, output filters, chokes, motor insulation, cable voltage grades etc.

9.9.7 The VSD panel shall be located in the clean air conditioned room in the substation. Required local control equipment shall have start, stop speed raise and lower push buttons, ammeter, speed indicator, ON/OFF/READY status selector switches as required and shall be installed near the motor.

9.9.8 The VFD shall be provided with Input and Output transformer. To prevent harmonics in the station supply 12 pulse rectifier shall be deployed at Input of the VFD.

9.9.9 "Auto Restart" facility for drive system within preset time, typically 0-15 seconds, in case of supply system dip or complete loss of power shall be provided.

9.9.10 Preferably screened type cables or cables as recommended by VSD/VFD vendors shall be used for VSD/VFD systems.

9.9.11 The VSD/VFD panels to be supplied shall be of proven model.

9.9.12 Training of VSD/VFD shall be provided to owner personnel.

9.9.13 For all other specifications, refer PC183-TS-0820A and PC183-TS-0820B.

9.10 **Conveyor Control Panel (PLC Based)**

9.10.1 The conveyor control panel (CCP) is required to perform the various control operation to obtain the material flow in the desired patterns. Bidder/Vendor to develop control schematic diagram, trip/interlock logics and furnish the same for the safe & proper operation of all conveyor motors. Also refer instrumentation design philosophy for the same.

9.10.2 The conveyor control panel shall generally comprise of the following items.

- 415/240V single phase, 50Hz, double wound, air cooled control transformer of suitable rating with secondary leg earthed.
- Stabilized power supply units in 1+1 configuration.
- 2 pole rotary switch of suitable rating to control incoming supply.
- H.R.C. fuses.
- Individual and group selector switches. Group selector switches to be used in interlock conditions.
- Test interlock switches.
- Start stop push buttons.
- Bypass arrangements for safety devices.
- Input, output and logic cards.
- Remote alarm intimating/acknowledgement Push Button Selector Switch (PBSS) of illuminated type.

- Fault annunciation window with type of fault & equipment, card no. inscribed.
- Alarm acceptance & testing, facilities.
- Lamp testing facilities.
- Indication lamp for :
  - Equipment on
  - Equipment off
  - Equipment tripped
  - Thermal overload operation
  - Zero speed switch operation
  - Belt sway switch operation
  - Gravity takes up switch operation
  - Bunker level probe operation
  - Any other as per system requirement
- Space heater of adequate capacity.
- Double Compression type Stainless steel cable glands.
- Pressure clamp type terminals of Elemex make.
- Bag counters / totalizers.

9.11 **Vibrating Screen**

9.11.1 This shall include electromagnetic drive unit, transformer rectifier unit, control panel, local control station etc. and complete in all respects.

9.11.2 The drive unit shall consist of a stator, mounted suitably on the main frame housing a powerful electromagnetic coil, an oscillating armature separated from the stator by an air gap and supported on springs or fastened by clamps.

9.11.3 The frequency of the vibration shall be in synchronization with the supply frequency.

9.11.4 The rate of discharge shall be controlled by the pull of the magnetic coil which can varied by changing the input voltage to the coil. This variation should be possible from zero to the maximum rate.

9.11.5 The control panels & local panels shall be fabricated from 2mm cold rolled sheet steel, dust and vermin proof type (minimum IP55 degree of protection). Necessary stop push button and On indication lamp shall be provided as a minimum along with control switch on local panels.

9.12 **MOTORISED FLAP GATES**

9.12.1 Flap gates shall be of robust construction and actuated by means of a suitable geared motor. The geared motor shall be capable of providing the thrust required to operate the gate against the falling material load.

9.12.2 The equipment shall be capable of being operated manually by means of a suitable chain-link mechanism, when the motor is under repair.

9.12.3 Suitable platform with access ladders and handrail shall be provided to approach for normal & maintenance purpose.

9.13 **EOT crane & hoists**

9.13.1 Electrical system of EOT crane shall include supply, installation, testing & commissioning of following items

- Squirrel cage induction motors of duty suitable for required crane application
- Power control panel

- Control stations
- Limit switches
- Electromagnetic brakes
- Power & control cables with accessories
- Earthing
- Any other items, not specified, but required for safe and proper operation.

9.13.2 The bidder shall provide one no. 415V feeder from their PMCC/EPMCC for each crane / hoist based on the power requirement (running and peak) of EOT crane, and terminate the feeder cable in an isolator located at one end of the bay at a height of 1.5m from the operating floor. Moreover further distribution of power from this isolator to respective loads of EOT crane system shall also be in bidder scope.

9.13.3 Electrical equipments located indoor shall have minimum IP-54 degree of protection, while outdoor equipments shall have minimum IP-55 degree of protection.

9.13.4 The minimum clearance and creepage distance of M.V. equipment shall be 20 and 28 mm respectively and shall be positively maintained after connections.

9.13.5 Enclosure for limit switches, pendant push button, junction boxes and magnets etc. shall be of cast aluminium. Enclosure for control panel, transformer etc may be of sheet steel. The thickness of the sheet steel for the enclosure shall not be less than 2.5 mm. All enclosures shall be suitably painted to withstand atmospheric pollution.

9.13.6 The power rating of the motors shall be 25% higher than the design requirement of the driven equipment, under the specified service and duty conditions.

9.13.7 All motors shall be of squirrel cage type and so designed that smooth acceleration or deceleration of the load is possible without any jerks. Further a maximum displacement of 2 mm when starting and stopping the motor in quick succession shall be guaranteed.

9.13.8 The motors for main hoist and micro hoist shall be suitable for intermittent duty type S4 with 60% C.D.E. and 300 starts / stops per hour. The motors for long travel and cross travel shall be suitable for S2 duty for 60 minutes.

9.13.9 Brakes for main and micro hoist motor shall be suitable for S4 duty, while for long and cross travel hoist motor shall be suitable for S2 duty.

9.13.10 For other specifications refer ES:8208 and relevant mechanical specifications enclosed elsewhere in ITB

9.14 **Local Control Stations**

9.14.1 Local Control Stations shall be provided for all motors for testing and maintenance purpose when the selection is made is "LOCAL MODE" Operation. The essential features of the LCS shall be as given below:

9.14.2 LCS shall be pressure die cast aluminium housing (preferably),, dust & vermin proof, weatherproof, suitable for wall or pedestal mounting with equipment mounted on a base plate inside and behind a front cover (bolted type).

9.14.3 LCS Enclosure shall be certified for use in hazardous areas.

9.14.4 Provision for pad locking in OFF position shall be provided.

9.14.5 Local control stations for breaker controlled HV and LV motors shall be provided with T-N-C switch, Ready to Start Indication, ON indication, Space Heater ON Indication, Trip Indication, Local-OFF-Remote Control switch and ammeter. Moreover, space heater ON indication lamp, trip indication lamp shall also be provided at the switchgear panel.

9.14.6 Local control stations for contactor controlled LV motors shall be provided with start/stop push buttons, ammeters and Space Heater ON Indication (for motor rated 30KW and

above), ON indication, Local-Remote switch (as required) for the motors having rating 5.5 KW and above. If required from process point of view, ammeter shall be provided for motors below 5.5 KW also.

9.14.7 Each element for start and stop shall be provided with 1 NO + 1 NC contact. The push button construction shall be such to avoid mal-operation due to vibrations.

9.14.8 All local control stations shall have weather proof IP-65 enclosure and be suitable for installation in relevant hazardous area, gas group and temperature class. Canopies of suitable size shall be provided with all local control stations.

9.14.9 All components shall be completely wired up to terminal block and also provided with earthing terminals.

9.14.10 Inscriptions on corrosion resistant metal strips giving drive description, mechanism number and functional requirement shall be provided.

9.14.11 Two numbers of LCS shall be provided for the motors, which are installed at elevated platforms. One shall be installed at ground level and the other near the motor.

9.14.12 The ammeter shall be flush mounting, moving iron spring controlled type, of accuracy class 1.5 as per IS: 1248, with square face of minimum size 72 mm × 72 mm having scale range 0-90 degree. The ammeter shall be provided with uniform scale up to CT primary current and compressed end scale up to the 8 times the C.T. primary current. Adjustable red pointer shall be provided to indicate the full load current of the motors. Zero adjusters shall be provided for operation from the front of the meter. All ammeters shall be operated through 1 Amp. CTs only.

9.14.13 Complete Push Button along with its actuator mounted on the cover with wiring done through flexible cables with proper protection.

9.14.14 Preferably Ring Type lug and suitable TB to be used for connection, to avoid loose connection.

9.14.15 All spare hole to be plugged with suitable metal plugs.

9.14.16 For all other specifications, refer PC183-TS-0817.

9.15 **Switch Sockets**

9.15.1 Sufficient number of inter-locked type 125A/63A, 415V, 3 Ph and 16A, 240V, 1 Ph switch sockets shall be provided in various plant locations as per hazardous area classification to facilitate the maintenance work. Supply to switch-sockets shall be taken from ASPB through suitably rated RCCB.

9.15.2 Both 3 Phase switch sockets and 1 Phase switch sockets shall be provided at Min. 20 M interval. Maximum 2 Nos. 63A switch sockets and 2 Nos. 16A switch sockets shall be connected in one circuit.

9.15.3 Sufficient no of Switch socket of (minimum 1 no.) 125A , 415V, TPN to be provided near Transformer bay for use of Transformer oil filtration machine .

9.15.4 Following minimum cable sizes to be considered for individual switch sockets, however actual sizes shall be subject to approval satisfying the current and voltage drop criteria.

i) For 25A Sw. Sockets

Switch sockets: 3Cx25 sq.mm A2XFY cable for incoming and outgoing

Plug: 4Cx2.5 sq.mm. flexible copper conductor cable

ii) For 63A Sw. Sockets

Switch sockets: 3.5Cx50 sq.mm A2XFY cable for incoming and outgoing

Plug: 4Cx2.5 sq.mm. flexible copper conductor cable

iii) For 250A Sw. Sockets

Switch sockets: 3.5Cx240 sq.mm A2XFY cable for incoming and outgoing

Plug: 4Cx95 sq.mm. flexible copper conductor cable

9.15.5 For all Other Specifications, Refer PC183-TS-0811.

9.16 **Conduits**

9.16.1 Conduits shall be of heavy gauge with minimum wall thickness of 1.4 mm (upto 25 mm dia) and 2 mm (above 25 mm dia) rigid steel, hot-dip galvanized, cut square, reamed, threaded and screwed tight at all joints.

9.16.2 Conduits entrances to pull boxes and switches shall have double lock nuts & insulating bushings. No running thread shall be used.

9.16.3 Flexible metallic conduit shall be used for connection to equipment which are subject to vibration and also for connection to level /limit/pressure switches. Conduit runs shall be supported at an interval of 750 mm for vertical run and 1000 mm for horizontal run.

Conduits shall be sized so that conduit fill (ratio of total cable area to conduit area) shall not exceed the following :
One Cable : 53%
Two Cable : 31%
Three Cables & Up : 40%

9.17 **Bus-Duct**

9.17.1 The bus bars and connection shall be made of electrolytic grade copper only. Aluminium busbars are not acceptable. All busbars shall be insulated with Raychem sleeving.

9.17.2 It shall be suitably supported at regular intervals and both bus bars and supports shall be adequately sized and clamped to withstand rated short circuit current without permanent deformation.

9.17.3 The bus bar insulators shall be non-hygroscopic, non-inflammable material. Earth bus shall run along the full length of bus duct without any break.

9.17.4 Outdoor bus-duct shall be weatherproof to IP-65 and shall be provided with canopy, silica gel breather. Construction of outdoor Bus duct shall be such that water gets drain off easily. Extra thickness shall be provided at the corners where water accumulation is likely to happen.

9.17.5 Bus duct shall be supplied with bus bar flexible links for connection at both the ends and expansion joints for every 3M of bus-duct and bus duct support materials.

9.17.6 Openings with cover at suitable locations shall be provided on bus duct for accessing the bus bars for maintenance.

9.17.7 Silica-gel breather shall be provided on both indoor and outdoor portions of the busduct. (shall not be required for pressurized busduct).

9.17.8 Proper sealing shall be done between Outdoor & Indoor section of the Bus Duct.

9.17.9 For all other specifications refer, PC183-TS-0807.

9.18 **EMERGENCY SAFETY DEVICES**

a) Following emergency safety device shall be provided at the specified intervals to trip the conveyor under abnormal operating conditions:-

i. Pull cord switch
ii. Belt sway switch
iii. Zero speed switch
iv. Emergency stop push button

v. Gravity take up switch
vi. Chute choking device
vii. Bunker level indicating device

In addition status of all safety switches on CCP also to be also provided.

PULL CORD SWITCH

a) The pull card switch shall be installed only on the normal walk way side of each conveyor at an interval of 20 m with a minimum of one for each conveyor for tripping the conveyor under emergency.

b) The switch shall be heavy duty type pedestal mounted, enclosed in a dust proof cast aluminium IP-65 enclosure/stainless steel IP-65 enclosure with removable cover, complete with rope clamping arrangement and a set of normally open/normally close contacts rated or open on the operation of deriving shaft through the lever which shall be actuated by pulling the flexible steel wire rope of about 5 mm dia.

c) The operating position of the switch shall have latches for safety purpose and resetting of the latch shall only possible by local manual operation. The lever shall operate on either side of its normal vertical axis.

d) The switch shall be provided with sturdy terminal spring to take the tension of 100 meters long steel wire rope. An arrangement for the adjusting the angle of lever on the shaft shall be provided. The switch shall be complete with 1 no. of earthing terminal, double compression type brass nickel coated cable glands, terminal blocks and cable lugs etc. for termination of 3X2.5 sq.mm XLPE insulated armoured and PVC sheathed copper conductor FRLS cable. The complete details, of limit switch and assembly sketches shall be furnished.

BELT SWAY SWITCH

a) The belt sway switches shall be provided along with timer (range 2 min. to 15 min.) to stop the conveyor in case of excessive sway in the belt on either side. These shall be mounted on the both side of the conveyor at an interval of 50 meters or minimum one pair for shorter length of conveyor. The switch shall be heavy duty type, enclosed in dust and weather proof cast aluminium IP-65 enclosure/stainless steel IP-65 enclosure.

b) The switch shall comprise of horizontally mounted spring return type vertical lever which shall be suitable for operation on its neutral vertical axis, a roller fitted on the lever which is suitable to rotate around its vertical axis. The resetting of the switch shall be possible by local manual operation. The switch shall be complete with a set of normally open/normally close contacts rated for 10A, 240V AC 1 no. earthing terminal, compression type cable glands suitable for 3x2.5 sq.mm (Cu) control cable, cable lugs, terminal block etc. The complete details of switch and assembly sketch shall be furnished.

ZERO SPEED SWITCH

a) 240V UPS power to be provide to all zero speed switch.

b) The zero speed switch with timer of suitable range shall be required to provide adequate protection to conveyor against the following:-

- Excessive belt slip and belt under speed.
- Belt breakage or snapping

c) The switches shall be provided one per conveyor. The switches shall be heavy duty type enclosed in dust and weather proof cast aluminium IP-65 enclosure/stainless steel IP65 enclosure. The switch shall be turn on mounted type having centrifugal switch chamber on one side and extended rotating spindle with pulley at other end.

d) The pulley mounted on the spindle shall be so designed that it shall be able to rotate with the friction against the belt surface with as minimum slip as possible. The arrangement shall be provided to adjust the belt speed within the desired limits. This shall be mounted on the tail end side of the conveyor.

e) The switch shall be complete with a set of normally open/normally close contacts rated for 10A, 240V AC, and 1 no. earthing terminals, cable glands, suitable for 3CX2.5 sq.mm copper conductor control cable, cable lugs, terminal block etc. The complete details of the switch and assembly sketches shall be furnished.

EMERGENCY STOP PUSH BUTTON

a) The stop push button shall be provided in staggered manner at an interval of 20 m with a minimum of one on each side of conveyor for tripping the conveyor under emergency.

b) The push button shall be heavy duty type enclosed in dust and whether proof cast aluminium enclosure/ SS enclosure and shall be suitable for wall/structure mounting.

c) The push button shall be red colour, un-shrouded type having a set of normally open/ normally closed contact rated for 10A, 240V AC and shall have padlocking facility. The push button shall be complete with 1 no. earthing terminal cable glands suitable for 3CX2.5 sq.mm copper conductor control cable, cable lugs and terminal block etc.

STEEL WIRE ROPE & 'U' CLAMPS

a) Galvanized steel wire rope shall be 6/19 construction, ordinary right hand lay, 5 mm dia. conforming to IS-3459 and provided with PVC sleeve of suitable thickness.

b) The steel wire shall be provided all along with conveyor with one end tied to 'U' clamp and other end to lever of pull cord switch as per drawing no. **PDS/E-025** attached.

c) Steel 'U' clamp fabricated out of 50X7 flats, complete with all nuts & bolts for fixing 5 mm dia. galvanized steel wire rope as per drg. No. **PDE/E-025**. The 'U' clamp shall be duly painted to withstand the corrosive chemical atmosphere prevailing inside the conveyor gantries due to urea dust.

Klaxon

a) Electric Klaxon, heavy duty type, enclosed in a dust and weather proof cast aluminium epoxy painted enclosure, suitable for still air range of 250 meters and rated for half hour at 240V single phase 50Hz AC supply.

b) The Klaxon and beacon shall be provided all along with conveyor at an interval of 100 meters apart with a minimum of 1 per conveyor and 1 per transfer tower and at any convenient location to sound the alarm before the start up of plant and any abnormal operation in conveyor system.

9.19 Electrical Control & Monitoring System (ECMS)

9.19.1 Electrical Control & Monitoring System (ECMS) shall be provided for Supervision, control, monitoring, data acquisition, data logging & printing of status of all important electrical equipment& feeders and Load Shedding Scheme as per the recommendations of the system study report as per process requirement and in consultation with Owner/Consultant for entire fertilizer complex, by EDS LSTK Contractor.

Data concentrator Panel and other ECMS System Equipments including PC console, chairs, furniture etc. for Urea Handling & Bagging Package shall be in EDS LSTK Contractor's scope. However, Contractor has to consider space for same in separate room in Substations, as per NIT.

Contractor shall provide multifunctional dual channel transducers in all the breaker feeders as well as contactor feeders of all important & critical Loads. Also, supply &

installation of Network Switches and extend all signals up to Network Switches shall be in the scope of Contractor . Network Switch shall have 20 % spare ports.

Minimum Inputs and Outputs to be considered for ECMS for proper operation/control, effective monitoring and load management shall be inclusive of but not limited to the following:

a. **Transformers:**

Oil Temperature, Winding temperature, Conservator Oil Level and moisture ppm of Oil through 4-20 mA signal / Modbus communication and status of Buchholz Relay.

b. **Incomer /Bus coupler/ Feeder (Power/Motor)**

KW, KVA, KVAR, KWh, PF, VOLTAGE, CURRENT

ON, OFF, TEST, SERVICE, TRIP ON FAULT, TRIP CIRCUIT HEALTHY, CONTROL SUPPLY ON, RELAY WATCH DOG, FAULT DETAILS, DISTURBANCES RECORDER.

Remote ON & OFF Control from ECMS.

c. **LT motor feeder of breaker controlled motors in EPMC/PMCC/MCC**

KW, KVA, KVAR, KWh, PF, VOLTAGE, CURRENT

ON, OFF, TEST, SERVICE, TRIP ON FAULT, TRIP CIRCUIT HEALTHY, READY TO START, PROCESS TRIP, EMERGENCY STOP, LOCAL/REMOTE selection on LCS, CONTROL SUPPLY ON, RELAY WATCH DOG, FAULT DETAILS, DISTURBANCES RECORDER.

Remote ON & OFF Control from ECMS.

d. **LT motor feeder of Contractor controlled motors in EPMC/PMCC/MCC**

ON, OFF, TRIP ON FAULT, READY TO START, PROCESS TRIP.

e. **Breaker Controlled Power feeder in PCC/MCC/ASPB**

KW, KVA, KVAR, KWh, PF, VOLTAGE, CURRENT

ON, OFF, TEST, SERVICE, TRIP ON FAULT, TRIP CIRCUIT HEALTHY, CONTROL SUPPLY ON, RELAY WATCH DOG, FAULT DETAILS, DISTURBANCES RECORDER.

Remote ON & OFF Control from ECMS.

f. **UPS**

Load on Inverter, Load on Bypass, Load on Battery, Battery on float/ boost charging mode , Charger failure , Inverter failure ,AC mains failure, DC under voltage, DC Over voltage ,Automatic retransfer of load to inverter inhibited ,

Fan failure ,AC Voltage , current & frequency of each inverter , AC incoming power supply Voltage & voltage , DC current at each rectifier output.

g. **Battery & Battery Charger**

Status of charging current (float & boost charging) , Battery current ,Incoming voltage, Load Voltage DC, Load current DC, DC under voltage

DC overvoltage , DC earth leakage ,AC incoming power supply failure ,AC input fuse blown-off ,Thyristor/ diode failure ,DC output fuse blown-off ,DC battery fuse blown-off ,Filter Capacitor fuse blown-off ,Load on Battery (using current direction sensing with time delay) ,Battery under voltage/ Disconnected during discharge (using zero current sensing) ,Cubicle fan failure/ cubicle temperature high (for chargers with forced cooling).

h. **VFD**

KW, KVA, KVAR, KWh, PF, VOLTAGE, CURRENT, SPEED , SPEED REFERANCE.

ON, OFF, TRIP ON FAULT, TRIP CIRCUIT HEALTHY, FAULT DETAILS

Remote ON & OFF Control from ECMS.

All Multi-function Meters of all HT, LT Switchboard , LDB, etc. to be connected with ECMS.

All connection/ wiring up to I/O Rack shall be in the scope of Contractor. Connection/wiring from Network Switch to Data Concentrator Panel & Centralized ECMS shall be in Owner's scope. However, cable tray, support for cable trays etc. for Cables from Network Switch to Data concentrator Panel & Centralized ECMS System (within battery limit of Urea Handling & Bagging Package) shall be in Contractor's scope.

Redundant Power Supply from 240 V UPS Distribution Board to all ECMS equipment, OWSs, EWSs etc. (up to termination to I/O Racks, OWSs, EWSs etc.) shall be in Contractor's scope.

9.20 All relays and energy meters shall have communication facility for serial communication (Relays on IEC-61850 protocol and Meters on MODBUS protocol).

9.21 **Heaters**

The type, rating, duty, control and configuration shall meet the process requirement.

The design and specification of heaters with its associated control panel shall conform to the requirements laid down in technical specifications and relevant IS.

9.22 **Junction Boxes**

9.22.1 Junction boxes shall be provided on the machine body, where the terminal block of electrical equipment is not adequate for the termination of aluminium cables or to terminate an external multi-core control cable.

9.22.2 Separate junction boxes shall be provided for power and control cables. These shall be mounted at convenient and easily accessible locations.

9.22.3 These shall be of cast aluminium enclosure having IP65 degree of protection and adequately sized, with terminal blocks, cable lugs and cable glands as required.

9.22.4 The cabling between these junction boxes and electrical equipment shall be in vendor's scope of work.

10.0 CABLING

10.1 **Cables**

10.1.1 All HV & LV power and control cables for HV/LV switchgear shall be supplied and laid by the contractor. Terminations at switchgear end and at the equipment end shall be in contractor's scope. Supporting and laying of these cables shall also be in contractor's scope. Termination of HV/LV cables at HV/LV motor end and HV switch gear end including supply of heat shrink type termination kit for HV cables shall be in contractor's scope. Supply and execution of heat shrink type straight through jointing kits for HV cables shall be in the scope of the Contractor (if required).

10.1.2 Cables shall be sized considering the following factors.

- Maximum continuous load current
- Voltage drop
- System voltage
- Laying conditions

- De rating due to ambient air temperature, ground temperature, grouping and proximity of cables with each other, thermal resistivity of soil etc. shall be taken into account
- Short circuit withstand criteria.

10.1.3 All HV power cables shall be made of stranded aluminium conductor with XLPE insulation, PVC inner sheathed FRLS type, armoured, PVC outer sheathed FRLS type, conductor screen, insulation screen and construction as per IS: 7098 (Part 2). HV cables shall be of unearthed type.

Single core HV Power cable shall be of aluminium conductor. The construction of same shall be as per above.

10.1.4 All LV power cables shall be with stranded aluminium/copper conductor with XLPE insulation, PVC inner sheathed FRLS type , armoured, PVC outer sheathed FRLS type and construction as per IS: 7098 (Part 1). Power cables with conductor size upto and including 16 sq. mm shall be with copper conductor, conductor size 35 sq. mm and above shall be aluminium conductor.

Single core LV Power cable shall be of aluminium conductor. The construction of same shall be as per above

10.1.5 All control cables shall be with 2.5 sq. mm, stranded copper conductor with XLPE insulation, PVC inner sheathed FRLS type, armoured, PVC outer sheathed FRLS type and construction as per IS: 7098 (Part 1). Control cables shall be twisted pair or shielded wherever electro-magnetic/electrostatic interference is anticipated.

10.1.6 All control cables shall have 20 % spare cores. All cores shall be identified with numerical core numbers printed on core in addition to colour coding.

10.1.7 All cables shall be armoured and shall have extruded inner and outer sheath.

10.1.8 Cables connected in parallel shall be of the same type, cross section and terminations.

10.1.9 All power and control cables shall be in continuous lengths (except for very long feeders) without any joints. The cables used for lighting and wires in conduits shall have appropriate junction boxes with adequately sized terminals. Cable joints in hazardous areas shall not be permitted.

10.1.10 In case of length of any control cables comes out to be more than 400 Meters, FO cable with suitable accessories for proper connectivity shall be provided

10.1.11 Cable Reel Drum (Motor operated) shall be provided for Wagon Loader and all other places where the cable travel distance is more than 50 mtrs. .

10.1.12 The maximum voltage drops in various sections of the electrical system shall be within limits stated in the following table:

Sl.No.	System Element	Maximum Permissible Voltage Drop
a)	High voltage cables for general distribution	1 %
b)	Bus duct / Cable between transformer secondary and Switchboards	0.5%
c)	Cable between PMCC and MCC or auxiliary switchboard i) MCC / Auxiliary Switchboard near PMCC ii) MCC / Auxiliary Switchboard situated remote from PMCC	 0.5% Note-3b 2 to 2.5% Note-3a
d)	Cables between HV Switchboard and HV Motor (during running)	3%

e)	Cable between PMCC and motor (during running)	5%
f)	Cable between MCC (situated near PMCC) and motors	5%
g)	Cable between MCC (situated remote from PMCC) and motors	3%
h)	Cable between Auxiliary Switchboard / MLDB and Lighting Panel / Power Panel	1 to 1.5% (Note-2)
i)	Circuit between lighting panels and lighting points	4% (Note-2)
j)	DC Supply Circuit (electrical Controls)	5% and/or as per instrumentation requirement
k)	DCDB to Control Room	2% (Note-1)
l)	UPS outgoing circuit	5% (Note-1)

Note-1

Minimum voltage available across any instrument in the field / control room / satellite rack room shall be as per instrumentation design basis. Distribution system for instrumentation supplies shall be designed accordingly. In case of any conflict between electrical equipment specification sheet and instrumentation design basis report, the latter shall govern regarding instrumentation power supplies.

Note-2

In case of difficulty in achieving specified voltage drops in cables up to lighting panel, 5% drop from Auxiliary Switchboard / MLDB up to lighting points may be permitted.

Note-3

a) Higher voltage drop may be permitted between PMCC and remote mounted MCC / ASB; if overall voltage drop up to motor (from PMCC) is limited within 5.5%.

b) For large substations 1% drop may be permitted.

The maximum voltage drop at various buses during start-up of large motor and / or motor reacceleration conditions shall be within the limits stated below:-

Sl. No.	System Element	Operating Condition	Maximum Permissible Voltage Drop
a)	At the bus bars of the worst affected Switchboard	Start-up of the large HV motor with other loads on the bus or reacceleration of a group of HV motors (Simultaneous start-up or group reacceleration of HV motors is not envisaged)	10%
b)	At the bus bars of the worst affected MV Switchboard (PMCC / MCC)	Start-up of large MV motor with other loads on the bus, or reacceleration of a group of MV motors.	10%
c)	Cables between HV Switchboard and motor	Motor start-up or reacceleration	5% (Note-a)
d)	Cable between MV Switchboard (PMCC / MCC) and motor	Motor start-up or reacceleration	10% (Note-a)

Notes:

a) Higher voltage drop in motor cables may be permitted, in case the conditions given in Note b), c) and d) are complied.

b) The voltage available at the motor terminals during start-up must be sufficient to ensure positive starting or reacceleration of the motor (even with the motor fully loaded, if required), without causing any damage to the motor.

c) For medium voltage motors, the voltage available at the motor terminals must not be less than 80% of the rated value during start-up or reacceleration.

d) For high voltage motors, the voltage available at the motor terminals must not be less than 85% of the rated value during start-up or reacceleration.

e) Soft Starter / VFD Starter shall be considered for starting large HV motors if essential / unavoidable as per system design requirement / equipment design limitation. For cases other than starting limitation, requirement of soft starter / VFD for any drive shall be confirmed by Process Department.

f) Unless otherwise specified as in clause e), all HV motors and MV motors shall be suitable for Direct on Line (DOL) starting.

10.1.13 MINIMUM CABLE SIZES FOR 415V MOTORS

Direct on line (D.O.L) start motors (2/4 pole motors)

MOTOR RATING	CABLE DETAILS			
	NUMBER OF RUNS	NO. OF CORES PER RUN	CONDUCTOR MATERIAL	CONDUCTOR SIZE (MM²)
Below 3.7 KW	1	3	Cu	2.5
3.7 KW	1	3	Cu	4
5.5 KW	1	3	Cu	10
7.5 KW	1	3	Cu	10
9.3 KW	1	3	Cu	16
11 KW	1	3	Cu	16
15 KW	1	3	Cu	16
18.5KW	1	3	Al	35
22 KW	1	3	Al	35
30 KW	1	3	Al	50
37 KW	1	3	Al	70
45 KW	1	3	Al	95
55 KW	1	3	Al	120
75 KW	1	3	Al	185
90 KW	2	3	Al	95
110 KW	2	3	Al	120
125/132 KW	2	3	Al	150
160 KW	2	3	Al	185

- Cables sizes as indicated above are for 2/4 poles motors fed from MCCs located near PCCs and PMCCs.
- Cable sizes for motors not confirming to above table (e.g. for 2/4 poles motors rated up to 150kw & motors with high starting pf), extended distance, reduced voltage starting, low speed motors, VFD driven etc. shall be worked out on case to case basis.
- However cable sizing calculation shall be submitted for approval.

10.1.14 Design Criteria for Cables/Bus Duct & Short Circuit Withstand Time:

a) Design criteria for cables/bus duct

Sr. No.	Design Criteria	3.3 kV / 11 kV	415 V
1.	Loads beyond 1000A rating and located near the transformer	Bus Duct / 1-core cable	Bus Duct / 1-core cable
2.	Loads located up to 200 M	Cable	Cable
3.	Loads located 200 - 1000 M	1-core cable / 3-core cable	1-core cable / 3.5-core cable
4.	Loads located beyond 1 KM	Cable	Cable
5.	Recommended limiting size of multi-core cable (sq.mm) / Single Core (sqmm)	3 Core x 400 / 1 Core x 630	3.5 Core x 300 / 1 Core x 630
6.	Insulation voltage grade	3.3 kV / 11 kV Unearthed	1100 V Earthed
6.	Type of cable insulation	XLPE	Power: XLPE Control: XLPE
7.	Power, Control & Earthing Cables	Armoured	Armoured

For breaker control motor circuits the selection of size will be made ensuring that the cable shall withstand a short circuit fault directly for 0.2 sec.
Suitable derating factors based on the site ambient conditions, method of laying and the no. of cables laid together shall also be applied.

b) Short circuit withstand time (seconds) shall be as follows for Breaker controlled feeders.

Bus duct	1 Sec.
Feeders to motors and transformer	0.25 sec
Feeders from PCC/PMCC to MCC	0.6 sec
Main 11 KV primary distribution feeders	0.7 sec
11 KV cable from transformer to switch board	1 sec
Incomer from other switchboard	0.6 sec

10.1.15 The minimum size of power cables shall be 2.5 sq. mm (Cu).

10.1.16 The control cables shall be 2.5 sq. mm (Cu). However, wiring in the panel/switch boards may be by means of 1.5 sq. mm (Cu) cables except for CT wiring which shall be 2.5 sq. mm. All the control and power wiring shall be carried by using FRLS wires only.

10.1.17 In case of length of any control cables comes out to be more than 400 Meters, FO cable shall be provided.

10.1.18 For all other specifications, refer PC183-TS-0815.

10.2 **Cable Laying**

10.2.1 The cables shall generally be laid on overhead racks. Pipe racks where available, shall be used to support the cable racks.

HV power cable shall be laid on cable tray in single layer having 1D spacing between the cables. LV power shall be laid on cable tray in touching formation in single layer. Control cable shall be laid on cable tray in touching formation.

HV Power, LV Power and Control shall be on separate trays. Instrument and electrical cable trays shall be separate.

Cables shall be clamped properly on the cable rack in such a way that position and layout of a particular cable shall not change throughout the rack so that it can be easily traced during maintenance jobs.

Walkway fo 750 MM to be considered for access to Electrical / Instrument cables on pipe rack.

From substations to various electrical consumers, cable shall be laid overhead. However, wherever overhead cable routing is not feasible Contractor can go for cable trench / slit (Refer PDS attached with the NIT) as per the site requirement.

Wherever, pipe rack is not available and space for overhead cable laying is possible then dedicated structure for cable shall be made for cable laying and shall be in scope of Contractor

10.2.2 The cable racks shall be ladder type, pre-fabricated from suitable hot dip galvanised steel. Maximum cable tray size shall be 600mm wide. Maximum supporting span shall be 2 Mtrs. Cable trays shall be designed considering 25% margin for future use.

All cable racks must be provided with GI flat strip of size 75mm X12 mm as running earth all along the tray.

10.2.3 All FO cable shall be laid through HDPE pipe with all accessories(Connecting arrangement).

10.2.4 All cables shall be terminated using suitable cable lugs.

10.2.5 All HV terminations and joints shall be of RAYCHEM make only.

10.2.6 Bimetallic lugs shall be provided, as required.

10.2.7 In Control Room (excluding false ceiling) and Substation, lighting cable shall be laid in concealed conduit.

10.2.8 For all other specification of cable racks, refer PC183-TS-0816 & PDS attached.

11.0 ILLUMINATION SYSTEM

11.1 General

11.1.1 LED type lighting shall be provided. The average illumination levels in the various sections of the plants shall be as indicated in Annexure-I. All the plants and area lighting shall be energy efficient.

11.1.2 All Lighting fixtures shall be corrosion proof and weather proof and shall be in scope of Contractor.

11.1.3 LED type lighting shall be provided for all areas. The minimum illumination levels in the various sections of the plants shall be as indicated in Annexure-I.

LED shall conform to the following types and standards:-

Product Type	Safety Standard	Performance Standard
Self ballasted LED lamps for general lighting services > 50 V	IEC 62560 Latest Edition	IEC 62612 / PAS Publicly available specification
Control gear for LED modules	IEC 61347-2-13 Latest Edition	IEC 62384 Latest Edition
LED modules for general lighting	IEC 62031 Latest Edition	IEC / PAS 62717 Latest Edition
LED luminaries	IEC 60598-1 Latest Edition	IEC / PAS 62722-2-1 Latest Edition Luminaries performance – Part 2-1: particular requirements for LED
LEDs and LED modules	IEC TS 62504 Terms and Definitions for LEDs and LED modules in general lighting.	

Maintenance factor for indoor lighting shall be considered as 0.7 and for Outdoor lighting 0.6.

The colour rendering index shall not be less than 90%.

The LED lights shall work satisfactorily at the design temperature of 50 Degree Celsius.

All the LED fittings shall be selected in accordance with Hazardous Area Classification.

The life assessment of LEDs shall include control gears/ driver as well.

11.1.4 The specified illumination level shall be maintained after considering maintenance factor 0.5 for Coal Dust Area , 0.6 for plant & outdoor areas (other than Coal Dust Area) & 0.7 for indoor areas and utilisation factor as per manufacturer catalogues for size of room & type of fixture.

11.1.5 Separate area wise panic lights, fed from 110 V DCDB, shall be provided at strategic locations for safe evacuation of operation personnel. These shall be switched 'ON' automatically on failure of power supply to main lighting board and shall switch 'OFF' automatically on resumption of mains or after 1 hour of power failure to avoid draining of the battery. Location of these lights shall be judiciously decided from safety considerations. The outdoor lighting shall be photocell/timer controlled.

11.1.6 Voltage drop at the fixture from the MLDB bus shall not exceed 3%.

11.1.7 Aviation lights shall be provided on tall structures and all isolated structures. . Aviation Lighting shall be in accordance with International Civil Aviation Organization (ICAO) Publication Annexure 14 and to Indian Standards, together with the approval of local aviation authority..

LED type Low Intensity Aviation Obstruction Light suitable for 240V, 50 Hz supply. It shall be covered under Indian patent act (Govt of India) No. 188995. Degree of protection shall be IP-65.

The illumination intensity of aviation lights and mounting height shall be considered based on vicinity of civilian air terminal within 1 kM radius. Aviation lights at each location shall be fed from two separate and distinct DBs (one fed from normal bus and another fed from emergency bus of MLDB). Incase aviation lights are not switched ON for any reason, whatsoever, a signal shall be sent to control room which will sound buzzer and also result in flashing of red light. On acknowledgement, buzzer shall stop but flasher will continue unless aviation lights are turned ON.

The fixtures shall have body of corrosion resistant aluminium alloy casting and shall be suitable for outdoor use and mounting on 40 mm NB G.I. pipe. Necessary electrical threading shall be tapped in the fixture for mounting.

11.1.8 Plant lighting circuits shall be single phase (Phase & Neutral) rated 240 V AC. Each circuit shall be rated to 16A but not loaded more than 8A. A minimum of 25% of MCBs of each board shall be left as spares. The load on one lighting sub-circuit of lighting sub-distribution board and junction box shall be limited to 1000W approx.

11.1.9 The lighting sub-distribution board for control of lighting shall be standardized as 18-way, 15-way, 12-way, 9-way and 6-way type.

11.1.10 In plant office rooms, wall mounting boards shall be installed to control the lighting. These boards shall include switches for lights, fans, 15A/5A plug sockets and fan regulators etc.

11.1.11 15A plug sockets shall be fed through separate circuit of lighting sub-distribution boards/junction box having ELCB of 30mA.

11.1.12 16A plug sockets shall be fed through separate circuit of lighting sub-distribution boards/junction box.

11.1.13 Illuminated exit sign shall be provided in substation / Control Room .

11.1.14 Power factor of complete fitting shall be 0.95 min. at 230 V.

11.1.15 Lights from LED's shall be soothing to eye and without any bright spots on the floor/objects illuminated by the luminaries.

11.1.16 The driver shall be mounted internally and be replaceable with the aid of commonly available hand tools.

11.1.17 The LED module or array shall be designed in such a way that the failure of one LED shall not affect additional LED's.

11.1.18 Life expectancy of LED Luminaries shall be minimum of 50000 hrs with greater than 70% of rated lumen output.

11.1.19 Min. efficiency of LED driver: The minimum efficiency of LED driver shall be 85% for driver power output rating <=40W and 87% for driver power output rating> 40W.

11.1.20 Short circuit protection /Open load protection shall be required for LED fixtures.

11.1.21 Surge Protection for minimum 2kV for indoor and minimum 3kV for Outdoor LED systems shall be provided. However, if a site is prone to lightning and surges 10kV surge protection shall be required. In case of outdoor luminaries, the Surge Protection Device (SPD) should be series type with fail safe.

11.1.22 Color temperature of LED Luminaries: 5700K

11.1.23 Cover type for outdoor type fittings shall be Toughened glass or UV stabilized polycarbonate whereas, whereas, for indoor and non-weather proof items, UV stabilized Poly Carbonate can be used.

11.1.24 For more details, refer PDS attached.

11.1.25 For lighting fixtures and 16 Amp plug socket circuits, 3 core 2.5 sq. mm (Cu) cable shall be used.

11.2 LED Tube Lighting Fixtures (inside Substations)

a) High quality LED fluorescent tube twin batten type complete with 2 X 20W tube eco friendly, no UV radiation as per the specification tabulated below:

Sl. No.	Parameter	Technical Specification
1.	Degree of Protection	IP-20
2.	Lumen output per Lamp	≥ 2000
3.	CCT	6500K
4.	Luminous efficacy	≥ 100 lm/watt
5.	CRI	>80
6.	Guaranteed Life	≥ 50000 burning hours
7.	PF	>0.95
8.	THD	<10%

11.3 **Street Lighting And Security Lighting**

11.3.1 63A TPN outlet from outdoor lighting bus of main lighting board shall be taken direct to the TPN junction box to be mounted on pole through cable and looped from pole to pole.

11.3.2 FRP poles of suitable mounting height shall be used for street light and plant lighting (platforms/ structures/ access ways/ walk ways/ pump house/ pump bay etc.) steel tubular poles of suitable mounting height shall be used

The poles shall be subjected to min. following tests:

- Thickness of galvanising
- Drop test as per IS: 2713.

Deflection test as per IS: 2713

11.3.3 Hot dip galvanized octagonal high mast lighting shall be used for yard and general area lighting. LED type fittings may be used.

11.3.4 LED Street Lighting Fixtures

a) LED Street Light Fitting with cool white light in Pressure Die Cast Aluminium Housing with UV Stabilized Poly Carbonate Cover with in-built power unit of 3500 lumen suitable for 240V, 50 Hz, System shall be used.

b) Lighting fixture shall have 50000 hrs. Life Time, CRI>75, IP-65.

12.0 EARTHING AND LIGHTNING PROTECTION

12.1 Earthing

12.1.1 Complete earthing installation shall be done as per IS: 3043, IEEE-80, IE Rules and IEC recommendations. The earthing system shall be designed to:

(a) Provide a permanent & continuous path from equipment and conductor enclosures to earth from circuits for flow of fault current.

(b) Provide sufficient current carrying capacity to conduct safely any current liable to be imposed on it.

(c) Provide sufficient low resistance to earth to limit the potential between metalwork and earth within safe limits.

(d) Provide equal distribution of potential and minimum potential difference for safety of personnel.

(e) Ensure sufficient current in case of fault to facilitate the operation of relays, over current devices, fuses etc. provided in the circuit.

12.1.2 Common underground earthing grid shall be provided covering sub-stations and plants which is further connected to overall Earthing Grid. The overall earth resistance (dry) shall be limited to 1 ohm.

12.1.3 Earthing rings shall be provided around sub-stations and plants which in turn shall be connected to the common earthing grid. Minimum size of main grid shall be 75mm×12mm.

12.1.4 Anti-corrosive bituminous paint shall be provided at each joint of earth flat after necessary finishing and priming treatment .

12.1.5 Earth pit shall be maintenance free type (chemical earth pit) considered.

12.1.6 Chemical earth pits shall be considered instead of conventional earth pits in view of faster dissipation of lightning surges and fault currents, easy installation and maintenance free feature. Enhanced high quality UL certified 17.2 mm copper bonded (250 micron) earthing electrode/ rod along with 22.6 KG graphite based (non-bentonite) as a ground enhancing material with stainless steel clamp for connecting copper bonded rod with horizontal flat strip shall be used.

12.1.7 Backfill shall be permanent and maintenance free. (No re- charging with salts or any other chemicals) and shall maintain its earth resistance with time. Backfill shall confirm IEEE 80-2000Clause No.14.5 (d). Backfill in its set form shall have a resistivity of not more than 0.12 ohm-m. Backfill shall comply the requirements and all applicable tests as per part-7 of IEC 62561.

12.1.8 Earthing grid/ring shall comprise of buried GI earth strips and GI pipes/electrodes.

12.1.9 Separate earth electrodes shall be provided for system neutral earthing. For equipment earthing, minimum two numbers of electrodes shall be provided around each plant/section. However, all these earth electrodes shall be interconnected.

12.1.10 Inter-connecting pits having an earth bus in an enclosed brick chamber without earth electrode shall be provided in the common underground earthing grid for convenience of taking earth conductors inside the plants.

12.1.11 As far as possible, the reinforcement rods inside concrete column shall be connected to the earthing grid/ring to reduce the overall earth resistance.

12.1.12 Individual electrical equipment shall be earthed by GI strip/GI wire/Cu/Al cable. Earth buses shall be provided in plants for earthing groups of electrical/non-electrical equipment to earthing grid/rings.

12.1.13 Size of earthing grid/ring and earth conductors of equipment for generating station and sub-stations shall be as per relevant standards. The fault current magnitude shall be decided based on system fault level. The time duration shall be taken as 1 second for voltage level above 66 kV and 3 seconds for voltage upto 66 kV as per IS -3043.

12.1.14 All equipment rated above 250 V shall have two external earth connections and those rated up to 250 V shall have one external earth connection. However, for lighting fixtures, earthing shall be done through 3rd core of the cable in safe as well as in hazardous area.

12.1.15 Flameproof equipment, in addition, shall have one internal earth connection. This means that 4 core cables to be used for all the flameproof equipments and 3.5 core cables to be used for all flameproof motors located at hazardous area.

12.1.16 All steel structures, tanks, vessels, pipes, pipe joints, valves etc. shall be earthed against static charge accumulation by 50x6 mm GI strip. The no. of earth connections shall be as follows:

Equipment having diameter	Hazardous area	Non hazardous area
30 M	2	2
More than 30 M	3	2

12.1.17 Wherever process equipments are mounted on steel structures, the structures shall be earthed instead of earthing the individual equipment.

12.1.18 The pipe structures shall be earthed at not more than 25M apart.

12.1.19 For all equipment in hazardous area, in addition to external earthing one internal earthing shall be provided.

12.1.20 Minimum sizes of earth conductors to be used shall be as given below.

Sl.No.	Equipment	GI conductor size	Al conductor Size
1.	HV/LV switch board, transformers, HV motors	50mm×8mm	150 sq. mm
2.	Motors rated 75 KW and above	50mm×6mm	150 sq. mm
3.	Motors rated 30 KW to less than 75 KW and vessel earthing	35mm×6mm	95 sq. mm
4.	Motors rated 5.5 KW to less than 30 KW	25mm×6mm	25 sq. mm
5.	Motors less than 5.5 KW	8 SWG	6 sq. mm
6.	All minor equipment rated 250V & above.	10 SWG	6 sq. mm
7.	Earth Grid	75mm x 12 mm.	-

Vendor to calculate the actual size. However, higher size of calculated one or above-mentioned size shall be provided.

All GI conductors shall meet the galvanizing requirement as per IS.

12.1.21 The main ground grid shall be buried in earth at a minimum depth of 1000 mm below finished grade level unless stated otherwise

12.2 Lightning Protection

12.2.1 All structure shall be protected against lightning strokes by suitable lightning protection system to be designed and installed as per IS/IEC-62305.

12.2.2 The number of down conductors shall be minimum two.

12.2.3 Bare metallic structures shall not have any air termination rods at the top. The earth connections shall be welded to the bottom of structure at 300 mm above floor level. However, tall metallic columns with insulation at top shall be provided with air termination rods. Separate earth electrodes shall be provided for each down conductor of lightning protection. However, these shall be inter-connected with the other electrodes in main grid.

12.2.4 Air Terminal

The vertical air terminal rods shall be installed at the roof of buildings to protect these objects from lightning strokes.

The vertical air terminal shall be made of 20 mm dia galvanized steel rod. The projected length of the rod shall be as required to protect the object (on which the rod is fixed) from lightning stroke.

The air terminal rod shall be properly fixed on the top of the building/structure to withstand very high wind pressure. In case the air terminal rod is embedded at the top of roof of building: the portion embedded inside the concrete shall not touch the reinforcement bars and shall be duly insulated from them.

All the vertical air terminal rods shall be electrically connected together by means of horizontal conductors of size 50 x 6 mm galvanized steel flats.

The shielding angle for one vertical air termination shall be 45 degrees. For more than one rod, shielding angle between the rods shall be taken as 60 degrees.

Horizontal air termination (i.e. G.S. Flat conductor) shall be so laid that no part of the rood will be more than nine (9) metres from the nearest roof conductor.

12.2.5 Shielding Masts

The shielding mast for lightning protection shall be installed at the top of steel columns cap plates of power house main building.

The shielding mast shall be made of galvanized steel pipe and the height of the same shall be decided considering the zones to be protected.

Each shielding mast shall be connected to grounding grid by a down conductor 50 x 6 mm. Galvanized steel flat run along the building column. In addition all power house building columns joints shall be electrically bonded.

12.2.6 Down Conductors

The down conductors shall be 50 x 6 mm galvanized steel flats. The connection between each down conductor and earth electrode shall be made via test link located at approximately 1500 mm above ground level.

13.0 CABLE TRAYS

13.1 The cable trays and risers shall be of aluminium alloy ladder type.

13.2 Aluminium prefabricated cable racks and accessories such as coupler plates, tees, elbows etc shall be fabricated from 4 mm thick aluminium 19000 H2 alloy sheet extrusion conforming to designation no. 64430 and condition WP as per IS:733.

13.3 For Al fabricated ladder trays, the rung spacing shall be 300 mm.

13.4 In paved areas/near the equipment, if required, the cables shall be laid in buried G.I. pipes. Protection shall be provided for rising cable with G.I. pipe for a minimum height of 300 mm above floor level.

13.5 All cables shall have their run nos. marked close to the termination as well as at intervals for proper identification.

13.6 All cables shall be terminated at the equipment by means of rolled aluminium/stainless steel heavy duty double compression type cable glands and crimping type lugs.

13.7 The cable racks shall be designed to avoid any sharp bends in the cable. The corners of cable racks shall be smooth with radius not exceeding six meters.

13.8 In case provision of inserts, grouting pockets and openings are required in floors, ceiling, and walls, the same shall be indicated by the vendor within four week of the placement of order. But in case it is necessary to cut modify these requirements or to furnish requirement beyond the above stipulated time, these shall have to carried out by the vendor at the site without any extra cast.

13.9 All the cable shall be properly laid and suitably clamped at regular interval. All cable racks/riser shall have 50% extra space for owner's future use.

13.10 The width of cable trays shall preferably be 150, 300, 450, 600 mm.

13.11 The no of tiers may be decided keeping a clear head clearance of 2.5 m inside the rooms, 6 m while crossing the main roads and 3 m while crossing the branch road. For multiplier racks the minimum gap between the two tiers and between top tier and ceiling shall be 300 mm.

13.12 The minimum sizes of various structural members used for supporting of cable racks shall be as follows:-

Members	Size of structural member Channel angle	Maximum separating distance
Support 100x50	75X75X8	1.5 m.
Runner	50x50x6/75X75X8	As per requirement

13.13 Each straight length and bed shall be supplied with two coupling plates fitted at each side channel at one end. The couplings plates shall be complete with bolts, nuts and washers fitted at other four holes for fixing to adjoining member. Coupling plate shall be designed to permit longitudinal adjustment up to ±10 mm and skew up to 10˚.

14.0 CAPACITOR BANKS (APFC)

14.1 The Contractor shall ensure that the power factor remains minimum 0.95 lag (inductive) in all the Bus of HV, MV& LV Switchboards.

Suitable capacitor bank shall be designed and installed at 415 V voltage level in the substation.

Capacitor bank at 3.3 kV or 11 kV may also be considered, if required.

The capacitor bank shall utilize the Automatic Power Factor Controllers to maintain the power factor of individual plant. Under no circumstances power factor shall become leading (capacitive) and all necessary protections to avoid this shall be used.

14.2 For all other specifications, refer PC183-TS-0822.

15.0 MOUNTING STRUCTURES

Switch sockets, cable trays, DBs etc shall be mounted / supported on suitable structure fabricated out of standard sections of mild steel, i.e. channels, angels, flats etc conforming to IS: 2066.

16.0 **SPARES**

16.1 Commissioning Spares

Contractor shall recommend list of commissioning spares for all the equipments, as required. The commissioning spares shall form an integral part of the scope of supply. Contractor shall be responsible for the quantification of the commissioning spares for the smooth commissioning start up of the plant/ package system. Item wise list of commissioning spares with recommended quantity shall be furnished for information. The same shall be Part of contractor Price.

16.2 Mandatory/Insurance spares

Contractor shall supply Mandatory / Insurance spares for all equipments as per Section 10.0: Spare Parts of this bid package. The same shall be Part of Contractor Price.

16.3 2 Years Bidder's Recommended Operational Spares (Other than Mandatory/ Insurance spare))

Bidder shall recommend 2 years Operational Spares (other than mandatory/ Insurance spare) for all the equipment (item-wise) with recommended quantity and unit price. The item-wise price shall be with validity of 2 Years.

The same shall not be part of Contractor price.

16.4 All spare parts shall be identical to the parts used in the equipments.

16.5 Any other spare parts or special tools not specified, but required, shall also be quoted along with the offer.

17.0 **VENDORS' SERVICES**

17.1 The Contractor shall consider the services of major equipment suppliers during installation, testing and commissioning in their scope as required.

17.2 The services of engineers of following equipments' (OEM)manufacturers are envisaged and required during installation, Testing and commissioning. Contractor shall arrange for the same without any additional cost implication:

- AC UPS
- Variable Speed Drives
- Numerical relay
- Power Transformer
- HV & LV Switchboard

17.3 Site Testing, parameterization and commissioning of the Numerical relays shall be done by OEM expert only.

18.0 **TESTING & INSPECTION**

18.1 Testing of all electrical equipments shall be done in accordance with relevant IEC/BIS codes in presence of owner's representative at manufacturer's works before despatch / at site before installation. All such tests shall be arranged by the contractor and testing charges, if any, shall be borne by the contractor.

18.2 The Contractor shall submit the certificates of type tests performed on identical equipment as evidence of the compliance of the equipment with the type tests. All Type Test Certificates shall not be older more than 5 years.

18.3 The Contractor shall submit the certificates of routine and acceptance tests conducted on the purchased equipments.

18.4 All the routine/acceptance tests shall be performed at the manufacturer's works in the presence of owner's representative.

18.5 Stage Inspection of Electrical Equipment shall be considered. The owner or their representative shall be allowed to visit the manufacturing works for stage inspection during manufacturing stage.

18.6 The equipment shall be dispatched from works only after receipt of Owner written approval of the test reports.

18.7 The Contractor shall intimate the owner 4 weeks in advance of the tests and submit the detailed schedule of tests.

18.8 In addition, the equipment shall be inspected at site for final acceptance.

18.9 Certified reports of all the tests carried out at the works shall be furnished in six (6) copies for approval of the Owner.

18.10 Electrical installation work shall be subjected to inspection by owner / his authorized representative, statutory bodies like Electrical Inspector, Factory Inspector and where applicable by equipment supplier's engineer. The contractor shall carry out without extra cost to owner rectifications / modifications desired by the above authorities to make the installation conforming to I.E. Rules etc.

18.11 The owner may reject any portion of the work considered defective or of poor workmanship and the contractor shall make good these defects without extra cost to owner.

19.0 **DOCUMENTATION**

19.1 The Contractor shall submit the documents for electrical equipments (MS-word, MS-excel and AutoCAD) as per the drawing and documentation schedule as given in this bid package.

19.2 Sizing of Electrical system and Equipments shall be submitted during detailed engineering stage.

19.3 A dedicated PC with licensed copy of documentation software shall be included in the scope of Contractor for documentation of Electrical Engineering.

19.4 The software shall be used for preparing and updating the various documents such as general arrangement drawings, cable schedules, single line diagrams, control system drawings and equipment specifications etc.

19.5 The documentation software shall be same which is used by the Contractor for electrical documentation.

19.6 The details of the documentation software shall be furnished in the technical offer.

19.7 Contractor shall ensure that following shall be mentioned in each sheet of drawings/ documents in the order mentioned below:

(a) Logo and Name of the client

(b) Logo and Name of the consultant

(c) Logo and Name of the contractor (Contractor)

(d) Logo and Name of the Manufacturer on the drawings prepared by manufacturer, if applicable

(e) Name of the Project for which drawings are applicable

(f) Title of the drawing (Title shall indicate the details shown in the drawing)

(g) Drawing/ document number with sheet number and number of total sheets in the drawing (Drawings having different title shall be assigned different drawing number)

(h) All sheets of each drawing shall bear same title, same document number and same revision number

19.8 At the time of handing over of the installation, Contractor shall supply as built drawings taking into consideration the actual execution carried out at site.

19.9 Erection, testing/ checking (inclusive of calibration check) prior to energisation/ after energisation and commissioning Manuals shall be in bound book format and shall give step by step procedure for:

(a) Storage, Handling and Erection

(b) Checking/ testing after erection and before energisation.

(c) Pre-commissioning tests/ checks and cold trials

(d) Commissioning

(e) Drawings relevant for erection, operation, maintenance and repair of the equipment.

(f) List of instruments/ testing kits/ sets, measuring instruments etc. required for testing/ checking with specification, ratings, ranges etc.

19.10 Operation & Maintenance Manuals for each of the equipment/ system being shall be in bound book format and shall be supplied alongwith dispatch of equipment and inclusive of following:

(a) Log sheets indicating daily/ hourly recordings of parameters to be noted down by customer's operating personnel.

(b) Procedure for shut down and energisation.

(c) Preventive maintenance schedule.

(d) Safety procedures for safe operation of equipment and complete system.

(e) Specification of equipment installed. Manufacturer’s catalogues operation and maintenance manuals for all types of relays/components used.

(f) Test procedures for site tests/ checks.

(g) Spares list for each equipment/ system for 2 years operation and maintenance.

(h) Relevant calculations and protection relay setting table for the equipment/ system being supplied by him

(i) Instructions for Diagnostic trouble shooting / fault location charts

(j) Tests for checking of proper functioning/ Operation.

(k) Storage and re-conservation Manual

(l) Safety Manual

(m) Drawings relevant for operation, maintenance and repair of the equipment

(n) Instructions for Maintenance and Repair

(o) List of spare parts with ordering specifications and manufacturer's catalogues.

(p) List of consumables with specifications, brand names and annual consumption figures.

(q) Manufacturer’s catalogues with ordering specification for all items

(r) List of special tools and tackles

(s) QAP, Internal Test Certificates and Inspection Certificates

(t) Procedure for ordering spares.

(u) All as built drawings.

19.11 Drawings/ documents to be submitted with inspection call of equipment:

(a) Type test certificate for identical equipment

(b) Sub-supplier's/ vendor's catalogue/technical literature

(c) Test reports for internal inspection

(d) Test certificates of components

(e) Technical specification & data sheets of equipment

(f) All drawings as applicable of category 'Approved', 'Approved with comments' and drawings 'For information/ Reference' including comments thereon

19.12 The details of equipment layout and cable routing will be designed by the Contractor during detail engineering stage and these shall be subject to approval by Owner/Consultant. Changes as required to achieve a neat layout with adequate working space all around, for better aesthetics as well as to meet statutory regulation and codes shall be done without any time and cost implication.

20.0 TOOLS & TACKLES

The Contractor shall supply at least one set of all special tools for each substation required for maintenance of the equipment supplied by them and price shall be included in the offer. List of tools & tackles with quantities shall be mentioned in the offer.

21.0 REVIEW OF DRAWINGS & DOCUMENTS BY OWNER/ CONSULTANT

21.1 The successful Bidder (herein after referred as contractor), shall submit within one month of placement of LOI; list of drawings/ documents/ Manuals that would be submitted by them. The list shall mention Serial Number, Title of the drawing/ document/ manual, Category (For Approval, For review, For Reference, etc) and tentative date of submission. The list shall be prepared taking in to account into consideration stipulations in respect of submission of drawings/ documents and scheduled date for completion.

21.2 Template for name plate of drawings, documents and drawing/ document numbering system shall also be submitted by contractor and approval obtained.

21.3 The Contractor shall ensure that all sheets of the drawings/ documents and top sheet of manual prepared by manufacturer/ vendor/ supplier & submitted by him or by his consortium member or by manufacturer or his consultant, are checked by him/ leader of consortium and vetted by Contractor / Leader of consortium before submission with stamp ensuring correctness, completeness, suitability of document for subject work and compliance with stipulations of order

21.4 The responsibility for delay in approval/ review of drawings/ documents due to

a. Submission of incomplete drawings/ documents not meeting the requirement of project/ stipulations of order

b. Non-compliance of comments made earlier

c. Drawings are not submitted in requisite copies;

and consequent delay in project shall be that of contractor.

21.5 The contractor shall ensure that in case any model number is mentioned in the drawing, detailed technical catalogue, literature, explanatory notes to describe the model and its technical details in full are also submitted along with the drawing. Such drawings/ documents should be assigned Drawing/ Document Number, Number of sheets in the drawing, Rev number etc (Unique Identification). Reference of such drawing/ document number should be mentioned in the drawing.

21.6 The drawings/ documents shall be prepared in such sizes that those can be read easily. Size of font in print submitted shall not less than size10 Arial or equivalent.

21.7 The drawings/ documents shall be submitted in sizes in which those are prepared. Photocopies in reduced sizes shall not be accepted.

21.8 The contractor shall leave space on each sheet for stamping the drawing by Owner/ consultant to avoid stamping on contents of drawing making them unreadable. Submission of drawings in A4 size shall be avoided.

21.9 All sheets of a drawing shall be assigned same title and drawing number. Drawings having different title shall be assigned different drawing numbers.

21.10 GA drawings, schematic diagrams, single line diagrams, bill of material, data sheets, characteristics curves, cable schedules and cable termination diagrams shall be assigned separate drawing numbers.

21.11 Revision shall be clearly marked on all subsequent issue of drawings and documents.

21.12 Inability to incorporate some of the comments shall be clearly stated by contractor with reasons and without delay. However, to accept or reject the non-compliance based on the reasons indicated by contractor shall be discretion of Owner/ their consultant.

21.13 In case alterations are considered necessary by the contractor in the drawings already approved, such drawings shall be resubmitted for approval again stating the considerations necessitating changes/ alterations. In case, alterations/ changes proposed by contractor are approved by the consultant/ Owner; all other drawings and data affected by such alterations/ changes shall be duly revised and re-submitted for the approval as stated above.

21.14 Contractor shall depute their concerned engineers (with the engineers of suppliers, if required) shall visit consultant after submissions of drawings for discussion, modification of drawings and approval so that project is not delayed for want of approval of drawings.

21.15 It will be the responsibility of contractor to submit the drawings and obtain approval to meet the project schedule. Delay in approval of drawings due to following shall be the responsibility of contractor:

a. non-submission of drawings/ documents/ well before those are actually required and/ or

b. delay in incorporation of comments and/ or

c. non-incorporation of comments by contractor and/ or

d. submission of drawings without checking and ensuring requirement stipulated in contract/ order

21.16 Contractor shall note that any approval and/ or clearance accorded by Owner or consultant for manufacture and/ or to proceed further given during discussions or recorded in the minutes of the meetings shall be valid only after the drawings showing relevant details are submitted by contractor and clearance/ approval is accorded by Owner/ Consultant by stamping and signing on the relevant drawings.

21.17 Approval of drawings by Owner / his consultant shall not relieve the contractor of his contractual obligations and responsibility for engineering, design, workmanship, materials and performance of the equipment

21.18 Contractor shall furnish, if requested, additional drawings, calculations, information to the Owner/ Consultant to enable him to examine/ study the drawings submitted.

21.19 Contractor shall note that work shall be carried out exactly as indicated in the approved drawings and no alterations shall be made without the written approval of the Owner/ Consultant.

22.0 TRAINING

22.1 Training shall be imparted to owner's personnel at manufacturer's works as under:

a) AC UPS: Two engineers for one week .

b) Variable Speed Drive: Persons for one week.

c) Power Transformer: Two engineers for one week.

d) Numerical relay: Two engineers for one week

e) HV & LV Switchboard : Two engineers for one week

23.0 VENDOR LIST

23.1 Make of all electrical equipment shall be as per Section 15.0: Vendor List attached with this bid package.

23.2 Any other vendor shall be subject to Owner/Consultant's approval.

23.3 Bidder shall indicate the make of all the major equipments in their offer.

23.4 Any other item for which vendors are not mentioned in NIT, Contractor shall furnish list of proven suppliers with PTR subject to Owner's/ Consultant's approval during detailed engineering. Document(PTR) shall be in English language only.

24.0 INSTALLATION, TESTING AND COMMISSIONING

24.1 The Contractor shall undertake installation of all electrical equipment in accordance with latest code of practices, in conformity with recommendation of the respective equipment manufacturers, drawings approved by the owner or owner's representative, direction of engineer-in-charge, statutory regulations and to the entire satisfaction of the owner.

24.2 The Contractor shall arrange all the necessary erection tools and tackles, testing and measuring instruments and shall supply the required erection materials including structural steel.

24.3 Contractor shall furnish field inspection and test data sheets for all equipments for owner's approval.

24.4 The Contractor shall obtain the necessary certificate of compliance/completion certificate with test results from statutory authorities as required. All necessary drawings and test certificates as required by them shall be furnished by the vendor.

24.5 The erection work shall be supervised by competent supervisors holding relevant supervisory license from the Government.

24.6 Installation of Equipment

a. The equipment shall be installed in switchgear rooms, MCC rooms, control rooms and at shop floors.

b. The scope of work of Contractor under installation shall be inclusive of but not limited to the following:

c. Physical inspection and handling

d. Assembly and interconnection of shipping sections, if any, as per manufacturer's instructions. Supply of materials, fabrication and installation of supporting frames/ brackets for proper support of equipment/ panels/ devices/ cable trays etc..

e. Installation on foundation/ supports/ brackets.

f. Alignment, levelling and clamping/ welding/ fixing/ grouting with supports/ foundation bolts as required.

g. Mounting loose supplies and connection of wiring.

h. Conducting pre-energisation tests/ checks to ensure that installation is carried out as per manufacturer's instructions/ direction of supervising engineer and is healthy/ fit for energisation.

24.7 Cable Installation

24.7.1 General

(a) All Cables to be laid in overhead cable tray only. Cable Tray for HV, LV and Control cable should be separate. Underground cable to be avoided, Cables to be laid on racks in underground concrete cable trenches inside the plant only where overhead structure is not possible. Cables may be laid in ground (slit with HDPE conduit) where number of cables to be laid are less and do not justify use of concrete cable trenches.

(b) All the cable tray structures shall be painted with two coats of primer and two coats of final paint after necessary surface preparation.

(c) Cable OD 40 MM and above shall be clamped individually.

(d) Cables shall be clamped only after the cables are neatly arranged, dressed tailored and kept in position. Support of cables on edges of cable trays/ structural steelwork shall be avoided.

(e) Power cables shall be laid in one layer only. Control and other cables may, however, be laid in two layers. More than two layers shall not be permitted.

(f) All the cable tray network shall be earthed by a continuous earth strip.

24.7.2 Cable laying in Trench/ on Racks/ Trays/ Cleated on Wall/ Structure. For proper support, access and neatness of appearance of installation; cables shall be laid on racks or cable trays or cleated on wall and/ or structure taking following into consideration:

(a) Cable racks/ trays shall be 250 mm apart.

(b) Ladder type cable trays shall be used for laying power cables.

(c) Perforated type cable trays shall be used for laying control, signal, and communication etc. cables.

(d) Coaxial cables for data transfer from/ to microprocessor based equipments shall be laid in HDPE conduits with pull boxes fixed to cable supporting racks.

(e) Top tray shall be used/ left vacant for communication, signaling and fire alarm cables.

(f) Cables shall be laid in separate trays according to voltage and noise classification. Fire proof partition shall be provided between HV and LV cables.

(g) Power, control and lighting cables shall be laid in separate cable trays.

(h) Large size cables shall be clamped individually. Small size cables may be bunched together provided that in any bunch all cables have sheath of same material.

(i) Cables in trays shall be clamped at not more than every 1500 mm for horizontal run and 800 mm for vertical run and near bends.

(j) Cable racks/ trays shall be planned in such a way so that at least 20 % or one rack/ tray (whichever is more) can be added in future and at least 20 % free space shall be left in each cable tray for cable laying in future..

(k) Support to cable trays shall be provided at intervals as required for proper support but at interval not more than 1000 mm.

(l) Support to trays shall also be provided at each joint of tray irrespective of it's distance from adjacent support.

(m) Trays shall be fixed using nuts and bolts as welding will not be permitted.

24.7.3 Cable laying in conduits

(a) Cables shall be laid in GI conduits while laying on or crossing floors/ wall/ railway lines/ roads.

(b) While laying on floor or wall or crossing roads conduits shall be embedded in concrete/wall.

(c) When laid on floor the top cover shall be minimum 10 mm.

(d) At rail/ road crossings, the conduits shall be laid not less than 1 meter below top surface of the road.

(e) Mechanical protection by G.I. Pipe shall be provided to all cables up to 1200 mm from ground/ floor level.

(f) Minimum diameter of G.I. pipes used for laying/ protection of cables shall be 1.6 times the cable diameter.

(g) Only one cable shall be laid in one conduit.

(h) Conduit shall be sealed after cable laying.

(i) Standard bends or fabricated bends shall not be used. wherever required, conduits shall be bent using bending machine. Bending radius shall not be less than 10 times the diameter of conduit.

(j) Jointing of the conduits shall be done using sockets which may be welded from top to avoid ingress of water.

(k) Ends of conduits shall be made smooth to avoid damage to cables.

24.7.4 Cable Jointing

(a) Joints in cable length less than standard drum length shall not be allowed.

(b) Joints, if unavoidable, shall be made at most suitable places.

(c) Joints shall not be made at passageways or under rail/ road crossings and in hazardous area.

(d) Joints shall be segregated by not less than 2 meters so as to reduce the possibility of one joint failure affecting the other.

(e) Individual cores in cables shall always be joined number to number or colour to colour of the insulation over the conductors.

(f) Continuity and current carrying capacity for earth conductor and/ or armour shall be provided.

(g) Cable jointing shall be done by joiners who possess certificate of competency for carrying out particular joint.

(h) Minimum 2 meters cable loops shall be kept near each joint.

24.7.5 Cable Termination

(a) Double compression heavy type glands/ heat shrinkable termination kits and bi-metallic/ copper lugs shall be used for termination of cables.

(b) Paint of the gland plate at the contact point of gland shall be removed for proper contact.

(c) Cable glands/ termination kits shall be earthed.

(d) Cables to individual cubicles shall be neatly laid out and supported.

(e) Cables shall be clamped at a distance of 400 mm from gland/ termination.

(f) Conductors of control cables shall be neatly arranged in compact group. The entire group shall be placed and tied with nylon straps.

(g) Spare cores shall be terminated with sufficient length to permit future connection to the terminal block associated with control cables.

24.7.6 Identification

(a) Cable tags shall be made of non- corrodible material, preferably SS.

(b) Voltage, cable number etc shall be engraved on each tag.

(c) Cable tags shall be tied to each cable at

(i) All termination (outside as well inside panel/ box.)

(ii) All bends.

(iii) All points before and after which their route cannot be easily identified.

(iv) Entry and exit from conduits.

(v) All joints.

(vi) Every 15 meter for straight run.

25.0 TESTING OF INSTALLATION AFTER ERECTION

25.1 The Contractor shall carryout tests/ checks after erection of equipment/ cables to check, ensure and demonstrate the conformity of equipment supplied and installation done with the specification and statutory requirement.

25.2 Prior to starting the test, the Contractor shall satisfy himself and ensure that

a. The installation is strictly in accordance with the specification, drawings and statutory requirement.

b. Any automatic controls that might vitiate the tests have been relaxed.

c. All instruments to be used for testing are suitable for the purpose and have been calibrated by a recognised laboratory within the last 12 months and copy of the calibration certificates have been submitted to the Owner/ Consultant.

d. The testing, commissioning, operation and maintenance manuals are available to the testing engineer and Owner/ Consultant.

e. Formats for recording test results have been finalised with the Owner/ Consultant and copies have been distributed to all concerned.

25.3 The skilled manpower to test all the equipment, cables, earthing etc deputed by Contractor is well aware of and prepared to perform checks/ tests.

25.4 The tests shall be witnessed by the representatives of Owner/ Consultant.

25.5 The Contractor shall compile and tabulate all the test results in agreed formats and submit to Owner/ Consultant for approval prior to acceptance of installation.

25.6 Testing and checking shall be carried out to demonstrate and record prior to completion, that supply and installation meets the requirement/ performances specified. The installation shall be tested in presence of Owner/ Consultant.

25.7 The Contractor shall give at least 24 hours notice to Owner/ Consultant to enable them to witness the test.

25.8 The Contractor shall submit to Owner/ Consultant test record sheets on daily basis.

25.9 Equipment or any part of the installation shall be energised only after all pre-energisation tests are completed and test results are approved by Owner/ Consultant.

25.10 Failure to submit test results as tests are completed may render the Contractor for carrying repeat tests.

25.11 The Contractor shall supply six (6) bound and indexed copies of all tests in agreed formats prior to preliminary acceptance and handing over of the equipment/ installation, duly signed by representatives of the Owner/ Consultant who have witnessed the tests.

25.12 It will be the responsibility of the Contractor to supply/ arrange at his own cost all necessary testing equipment and measuring equipment required for conducting the tests as per applicable standards.

25.13 Should any of the tests reveal any discrepancy or non-conformity, the same shall be attended to and retested before proceeding with any other tests.

25.14 All tests shall be conducted in accordance with this specification, standard specifications of Bureau of Indian Standards, recommendations of IEC and IE Rules.

25.15 Tests checks to done at site shall be inclusive of but not limited to the following:

a.	Physical Check & Verification	:	All Equipment/Cables etc
b.	Tightness of connections	:	All Equipment/Cables etc
c.	Checking for cleanliness	:	All Equipment/Cables etc
d.	Size & No. of Earth connection	:	All Equipment/Cables etc
e.	Erection, alignment, mounting height and clearances	:	All Equipment/Cables etc
f.	Insulation Resistance test	:	All Equipment/Cables etc
g.	Earth continuity test	:	All Equipment/Cables etc
h.	Earth Resistance test	:	All Equipment/Cables etc
i.	Earth loop impedance test	:	All Equipment/Cables etc
j.	No load & rated load current	:	All Motors/ Loads
k.	No load & rated load P.F.	:	All Motors/ Loads
l.	No load & rated load Power	:	All Motors/ Loads
m.	Functional checks	:	All Equipment & Controls
n.	Primary injection test	:	All switchgear
o.	Secondary injection test		All protective relays/ devices
p.	Ratio and polarity test		CTs
q.	Power frequency HV test		Power & Control circuit
r.	Phase sequence checks		/C & bus couplers
s.	Winding resistance test		Motors & Transformers
t.	Direction of rotation		All motors
u.	Free running for 2 Hrs		All motors
v.	Under voltage tests		All U/V Devices
w.	Calibration Checks		All instruments
x.	Load and Performance tests		UPS, PLC, & Variable Frequency equipment, Battery Bank
y.	Checking of Voltage, current		UPS, PLC, & Variable Frequency

		equipment
z.	Checking of specific gravity and acid level	Battery
aa.	Illumination levels	All areas

25.16 It is anticipated that following equipment will be necessary to perform testing of the installation. The Contractor shall, therefore, arrange these as well as any other equipment for testing of the installation.

a. HV Testing Set
b. Primary Injection Set
c. Secondary Injection Set
d. IR Testers
e. Earth Continuity testers
f. Soil resistivity Testers
g. Earth resistance Testers
h. Phase to earth loop impedance testers
i. Mili volt drop testers
j. Micro-ohm meter
k. Phase sequence testers
l. Clip-on ammeters
m. Voltmeters
n. Power factor meter
o. Frequency meter
p. 3 Ph 4 wire unbalance load kWh meter
q. Cable fault location equipment
r. Digital multi-meter suitable for testing IC voltage and current levels
s. Analogue Multi-meters
t. Portable multi-range precision ammeters, voltmeters complete with CTs, PTs for AC/ DC circuits.
u. Protection relay test plugs
v. Portable earthing equipment
w. Dual beam oscilloscope with storage facility.
x. UV recorder
y. Illumination level meter
z. Thermometers
aa. Power Analyser / Portable Power Meter
bb. Rpm meter
cc. Noise meter

25.17 At least following tests shall be specifically conducted before commissioning in presence of owner's representative. All the test results shall be recorded and submitted to the owner.

a) Insulation Test

b) Continuity Test

c) High Voltage Test

d) Simulation Test

e) Earth Resistance Test

26.0 QUALITY ASSURANCE

26.1 All equipment, components, materials proposed to be supplied by Contractor shall be procured, manufactured, erected, commissioned and tested as per a comprehensive Quality Assurance Programme (QAP) to be approved by the Owner/ Consultant.

26.2 The Successful Bidder shall submit within 1 Month of from order; Quality Assurance Plan (QAP) for all the equipment/ panels/ cables/ motors/ devices etc. under their scope of supply.

26.3 All routine and acceptance tests shall be carried out as per relevant IS / IEC/ Other Standards during inspection at manufacturer's works in presence of Owner or his representative.

26.4 The Contractor shall submit type test certificates for similar equipment supplied by him elsewhere. In case type test certificates (not more than 5 years old and conducted at duly accredited laboratory) for similar equipment is not available, the type test shall be conducted in presence of Owner or his representative without any financial implications to Owner.

26.5 The inspection procedure shall be finalized and approved by Owner and/ or their consultant/ authorized representative.

26.6 Inspection will be carried out as per drawings and quality assurance plan approved by the Owner/ Consultant. Inspection shall be carried out either at manufacturer's shop/ works or any other place where facilities for conducting tests/ checks are available.

26.7 Owner reserves the right to witness any of the tests and verify the documents of the Contractor , his supplier/ vendor/ manufacturer.

26.8 Manufacture test certificate for bought out components shall be submitted during inspection.

26.9 No equipment or part items shall be dispatched without final acceptance certificate and dispatch instructions in writing issued by Owner and/or their authorized representatives.

26.10 The Contractor shall carry out an inspection and testing programme during manufacture in his works and/ or that of his vendor's works to ensure accuracy/ correctness/ completeness of components, compliance with drawings, conformance to functional and / or performance requirements, identify and acceptability of all materials, parts and equipment. The Contractor shall also carry out all tests/ inspections required to establish that the items/ equipment conform to requirements of the specification and the relevant codes/ standards specified in the specification in addition to carrying out tests as per the approved Quality Plan.

26.11 Quality audit/ surveillance/ approval of the results of the tests and inspection, approval of drawings will not, however, prejudice the right of the Owner to reject the equipment at any subsequent stage if it does not comply with the specification or does not give complete satisfaction in service and shall in no way limit the liabilities and responsibilities of the Contractor of ensuring complete conformance of the materials/ equipment supplied to relevant specification, standard, data sheets, drawings etc.

26.12 The owner or their representative shall be allowed to visit the manufacturing works for stage inspection during manufacturing stage.

26.13 The Contractor shall intimate the owner 4 weeks in advance of the tests and submit the detailed schedule of tests.

26.14 Contractor shall supply reports of type tests, acceptance tests, all requisite factory tests and site tests in bound volumes.

26.15 All the equipment shall be tested at site to know their condition and to prove suitability for energisation and required performance.

27.0 **COORDINATION WITH OTHER CONTRACTORS**

27.1 Contractor shall coordinate with Owner's other Contractors and shall freely exchange all technical information required for this purpose.

27.2 All civil works connected with electrical installation shall be under the Contractor 's scope.

28.0 **DEVIATIONS**

28.1 Deviations, if any from this standard (clause wise) shall be clearly indicated in the offer with reasons thereof. In the absence of any such deviation the compliance to the clauses shall be deemed automatically.

28.2 Successful Bidder shall also note that all those deviations mentioned in bid but not accepted by Owner/Consultant in writing shall be considered as withdrawn by bidder.

28.3 Any and all deviations mentioned anywhere else in the bid but not specifically and unambiguously mentioned under specific section 'List of deviations' shall not be considered.

ANNEXURE-I

ILLUMINATION LEVELS

Average illumination levels (Mean Lux) for various areas shall be as follows:

Sl. No.	AREA	LUX
1.0	**ROADS**	
1.1	Plant roads	20
2.0	**YARD**	
2.1	Marshalling yard	20
2.2	Loading/unloading areas	50
2.3	Open areas	20
3.0	**PLANT**	
3.1	Operating platforms	100
3.2	Non-operating platform/ general process areas & walk ways	50
3.3	Pipe rack	100
3.7	Area near large rotating equipment/plant	200
3.8	Air Conditioning Plant Room	200
3.9	Elevator machine Room	200
4.0	**SUB-STATION / MCC Room**	
4.1	Switch room - Front of panel	250
	- Back of panel	150
	- Battery room	150
4.2	Transformer room, cable room.	70
4.3	Outdoor/transformer bay	70
5.0	**CONTROL ROOMS**	
5.1	Front of panel	500
5.2	Back of panel	200
6.0	OFFICES	300
7.0	**STORES, BATH ROOM**	100
8.0	**STAIR CASES**	
8.1	Safe areas	100
8.2	Hazardous areas	100
9.0	**Bagging Plant**	
9.1	Operating floor	150
9.2	Empty Bag storage	60
9.3	Filled bag storage	60
9.4	Loading area	150
10.0	Transfer Tower	150
11.0	Conveyor Gantry	100
12.0	**PANIC LIGHTING**	10

Lux level for A.C. Emergency lighting in Control Room shall be 250 lux.

SPECIFICATION SHEET
11 kV Switchboard

PROJECT: Coal Based Fertilizer Plant			PLANT: Urea Handling & Bagging Package		
ISSUED FOR : PROPOSAL ☐	ENQUIRY ☒	ORDER ☐	FINAL ☐		
GENERAL			**AMBIENT CONDITION**		
Ref. Stds. : IS ☒	IEC ☒		Temp. Max./Min./Design Ref. : 46 / 1 / 50°C		
Encl. Docs. :			Relative Humidity: 100%	Alt. above sea <1000 M	
Make :			**ATMOSPHERIC POLLUTION**	Dusts : Coal Dust & Urea Dust	
Maker's Ref. No. :				Vapour : Ammonia & Highly Corrosive	
			LOCATION	Indoor ☒	Outdoor ☐
				Gr. Floor ☐	1st floor ☐
ADDL. SCOPE	Incoming Bus Duct ☐		Tie Bus Duct ☐		
	Erection & Comm. ☒		Supervision of Erection & Comm. ☐		
TESTS:	Routine ☒	Type ☐	Others ☐		

BASIC DATA

	Description		11kV Switchbaord
REFERENCE DRAWINGS	Single Line Diagram		
	Feeder Details		
	P.T. Bus Arrangement		--
SYSTEM DETAILS	Rated Voltage with variation		11 kV ± 10%
	Rated Frequency with variation		50Hz ± 5%
	Highest System Voltage		12 kV
	Combined V & F Variation		± 10%
	No. of Phases & Wires		3 Phase, 3 Wire
	Insulation Level		70 kVp/ 28kV BIL
	Fault Level		750 MVA for 3 sec.
	Earthing Mode		Non effectively earthed through resistor
BUS BARS	**Rating**	Continuous	_____A
		Short Time for 3 sec.	40KA for 3 sec.
	Type of Insulation		Insulating heat shrinkable Sleeved
CIRCUIT BREAKER	Type		Vacuum Circuit Breaker
	Breaking Capacity	Symmetrical	40 KA for 3 sec.
		% DC Component	20% (Min.)
	Making Capacity (peak)		2.55 times Breaking Capacity
	Earthing Switch		Integral type
CONTROL SUPPLY	Closing & Indication		110V DC **
	Tripping		110V DC **
	Alarm / Signal		110V DC **
	Space Heater		240V AC
MISC. DATA	Cable Entry Top / Bottom		Bottom
	Dummy Panel Reqd. Yes / No		As required
	Width of Dummy Panel		--
	No. of Dummy Panel		--
	PAINTING	Type	Epoxy Based
		Shade	631 of IS: 5
	Spares Parts Reqd. for a Period of		2 Years

** NOTE:
- 110V DC Power required for closing, tripping and indication of circuit breaker feeder shall be provided from DCDB.

- For metering, protection etc. refer SLD.
- All unfilled data shall be filled by the Contractor. Completely filled in Specification Sheet duly stamped & signed by the Contractor shall be submitted after award of order.

TECHNICAL PARTICULARS
11 KV Switchboard

PROJECT: Coal Based Fertilizer Plant	PLANT: Urea Handling & Bagging Package	
ISSUED FOR : PROPOSAL ☐	ENQUIRY ☒	ORDER ☐ FINAL ☐
GENERAL		
Make / Maker's Type :		
Ref. Standards		
Rated Operational Voltage with ± %		
Rated Insulation Voltage		
Rated Voltage of Aux. Circuits with ± %		
Rated Current		
Short Time Rating		
Degree of Protection of Enclosure		
Service Conditions : Indoor / Outdoor		
DRAWOUT FACILITIES	Circuit Breaker's	
	P.T.'s	
	Protective Relays	
	Meters	
SHEET STEEL TYPE & THICKNESS	Base Channel	
	Others	
Material of Gaskets		
Material of External Hardware		
Operating Height : Max. / Min.		
Space Heater Rating of each Panel		
PAINTING	Method of Pre-treatment	
	Thickness of Paint	
	Type & Shade	
Final Temperature		
PROVISIONS / FACILITIES	Safety Shutters	
	Interlocks	
	Earthing Facility	
	Base Channels with Fdn. Bolts	
	Gland Plate with Glands	
	Limit of Maximum Nos. of Cables Termination Possible	
Dimensions : L X B X H / Dim. Drg. Ref. No.		
Shipping Dimensions of Largest Package		
Weight : Static / Dynamic		
Heat Dissipation		
BUS - BARS		
Material		
SIZE	HBB	
	VBB	
	Ground	
	Supporting Calculation Attached	
MINIMUM CLEARANCE	Between Phases	
	Between Phase & Earth	
Minimum Creepage Distance		
CURRENT RATING	Continuous	
	Short Time for 3 secs.	
Max. current density for bus-bars		
Temp. Rise for : Cont. Load / Short Ckt. Current		
SUPPORT	Material	
	Voltage Class	
	BIL	
	Arrangement :Separate/Common	
Power Frequency test Voltage for 1 Min. Duration		
Material of Bus-bar Insulation		
Material of Inter Panel / Compartment Barrier		
Shrouding Material for Joints		
Bus Bar Phase Identification Mark		

No. & Type of Bolts per Joint		
CIRCUIT BREAKERS		
Make / Maker's Type		
Ref. Standards		
Type of Circuit Breaker		
Principle / Collaborator		
Rated Operating Sequence		
Rated Voltage		
Rated Frequency		
No. of Poles		
CURRENT RATING	Continuous in IPH6 Enclosure	
	3 second RMS	
	Momentary (Peak)	
BREAKING CURRENT	Symmetrical KA	
	Asymmetrical KA	
	% D.C. Component	
Making Current (Peak)		
Derating Factor, if any for Site Condition		
LIMITATION OF CURRENT RATING FOR	Motor Duty	
	Capacitor Duty	
	Transformer Switching	
	Cable Charging	
Restriking Voltage (Peak)		
INSULATION LEVEL	1 Min. PF withstand Voltage	
	Impulse withstand Voltage	
No. of Breaks per Pole		
TYPE AND MATERIAL OF	Fixed Contact	
	Moving Contact	
	Arcing Contact	
Type of Closing Mechanism		
Type of Tripping Mechanism		
ARC CONTROL DEVICE	Type	
	Material of Arc Chamber	
Details of Anti – Pumping Feature		
Details of Trip Free Feature		
Total Closing Time		
Total Interrupting Time at 10%, 50%, 100% of rated		
Interrupting Capacity		
SPRING CHARGING MOTOR	Rating	
	Voltage	
	Insulation	
	Duty	
	Type	
Spring Charging Time		
VOLTAGE / CURRENT REQD. FOR	Closing	
	Tripping	
	A.C. Supply	
AUXILIARY CONTACTS	No. of Spare Contacts NO / NC	
	Contact Rating Ac / Dc	
	Convertible Type	
INSULATING OIL	Ref. Standard	
	Volume of Oil Required	
Mounting Arrangement		
Temp. Rise of Different Parts		
DETAILS FOR SF_6	SF_6 Gas Pressure	
	Wt. Of SF_6 Gas per Breaker	

DETAILS FOR SF_6	Gas Leakage Detector Provided	
	Gas Density Monitor Provided	
DETAILS FOR VCB	Pressure inside the Interrupter	
	Contact Wear Indication Provided	
	Facility for Checking Loss of Vacuum Provided	
RECOMMENDED TIME INTERVAL FOR	Inspection of Drives	
	Inspection of Contacts	
	Quenching Devices	
	Replacement of Oil	
Dimensions : L X B X H / Dim. Drg. Ref. No.		
Type Testing Authority & Test Report Ref. No.		
Net Weight of Breaker		
CURRENT TRANSFORMERS		
Make / Maker's Type		
Ref. Standard		
Type of Primary Winding		
No. of Cores		
Ratio		
Rated Burden		
Accuracy Class		
ALF / ISF		
Thermal Limit		
Dynamic Limit		
Insulation Class / Material		
Basic Insulation Level		
Ref. Magnetisation Curve No.		
POTENTIAL TRANSFORMERS		
Make / Maker's Type		
Ref. Standard		
Winding Connection : Pri. / Sec.		
Ratio		
Rated Burden		
Accuracy Class		
Insulation Class / Material		
Basic Insulation Level		
Weight		
Dimension		
Rated Voltage Factor		
SURGE DIVERTER		
Type & Maker's Type		
Rated Voltage KV		
Nominal Discharge Current (8/20 µ sec. wave)		
Residual Voltage at Rated Discharge Current		
Power Frequency Spark Over Voltage		
1.2/50 µ sec. Spark Over Voltage		
RELAYS		
Application		
Make / Maker's Type :		
Ref. Standards		
Operating Principle		
Rated Voltage / Current		
Rated Burden		
Setting Range		
Type of Mounting		
Reset : Hand or Self		
Flag Indication Type		
Ref. Characteristic Curve Type		
Ref. Descriptive catalogue		
INSTRUMENTS AND METERS		
Application		
Make / Maker's Type :		

Ref. Standards	
Operating Principle	
Rated Burden	
Scale Range	
Accuracy	
Size	
Type of Mounting	
CONTROL SWITCHES	
Application	
Make / Maker's Type :	
Ref. Standards	
Contact Rating	
Utilisation Category	
PUSH BUTTON	
Make / Maker's Type :	
Ref. Standards	
Contact Rating	
Utilisation Category	
SIGNAL LAMPS	
Make / Maker's Type :	
Ref. Standards	
Rated Voltage / Wattage	
Type of Lamp Holder	
Type of Globe	
Accessibility from Front	
MOULDED CASE CIRCUIT BREAKERS	
Make / Maker's Type	
Ref. Standard	
Current Rating	
Breaking Capacity	
Setting Range of Thermal Release	
Setting Range of Magnetic Release	
MINIATURE CIRCUIT BREAKER	
Make / Maker's Type :	
Ref. Standards	
Rated Current	
Breaking Capacity	
CABLE GLANDS	
Material	
Type	
TERMINAL BLOCKS	
Make	
Type	
Current Rating	

NOTE: Completely filled in Technical Particulars Sheet in line with NIT/PO, shall be submitted after award of order for Owner/Consultant approval, before commencement of manufacturing.

SPECIFICATION SHEET
11 / 3.45 KV DISTRIBUTION TRANSFORMERS

PROJECT: Coal Based Fertilizer Plant — PLANT: Urea Handling & Bagging Package

ISSUED FOR : PROPOSAL ☐ ENQUIRY ☒ ORDER ☐ FINAL ☐

GENERAL

Item No. :	Ref. Stds. : IS-1180, IS-2026, IEC-60076
Quantity :	Encl. Docs. :
Description : Distribution Transformers	Vendor :
Code No. :	Vendor's Ref. No. :

TEST TO BE WITNESSED : Routine : ☒ Heat Run : ☐ Impulse : ☐ Others : ☐

SERVICE CONDITIONS

SYSTEM DETAILS (PRI. / SEC.)	AMBIENT CONDITIONS	
Nom. Voltage with ± % : 11KV±10% / 3.3KV±10%	Temp.- Max./Min./Design Ref. : 46 / 1 / 50°C	
Highest System Voltage : 12 / 3.45 KV	Rel. Humidity : 100 %	Alt. above Sea < 1000M
Number of phases : 3 Ph / 3 W + N	**Atmospheric Pollution**	Dusts : Coal Dust & Urea Dust
Rated Frequency with ± : 50 Hz ± 5%		Vapour : Ammonia & Highly Corrosive
Combined V & F Variation : ± 10 %	**Location**	Indoor : ☐ Outdoor : ☒
Fault MVA : 750 MVA / 150 MVA	**AUX. POWER SUPPLY**	
Earthing Mode : Solidly Earthed	**System Data**	A.C. : 415V ± 10%, 3P & N, 50Hz ± 5%
		D.C. : 110 V
	Instrument Contact Rating	A.C. : 240 V, 5 Amps
		D.C. : 110 V, 5 Amps

BASIC DATA

RATING			TERMINAL CONFIGURATION				
Rated Capacity : _____ KVA					W		
No Load Voltage Ratio : 11 KV / 3.3 KV				X		Z	
Highest Voltage for Eqpt. : 12 KV / 3.45 KV					Y		
Insulation level Pri.-/ Sec	Impulse : 75 KV / 40 kV		Shall be provided later.				
	Power Freq. : 28 KV / 10 KV		**TERMINAL CONNECTIONS**				
Impedance at 75 ° C: As per IS (without negative tolerance)			**PRI.**	Arrangement	O/H bushing : ☐		
Vector Group : Dyn 11					Bus Duct : ☐		
Cooling System : ONAN					Cable : ☒		
Motor I Start & T Start : Shall be informed later				Cable cond.	Type : 11 KV XLPE-A-FRLS-PVC (Al) UE		
TAP CHANGER					No. & Size :		
Type of Taps	On Load : ☐	Off Ckt. : ☒	**SEC.**	Arrangement	O/H bushing : ☐		
Range of Taps : -5% TO +5%					Bus Duct : ☐		
No. of Taps : 5 @ 2.5 %					Cable : ☒		
C.T. REQUIREMENTS				Bus cond.	Type :		
Differential Protection	3 nos. on Trf. : ☐				No. & Size:		
	3 nos. Loose : ☐		**Control Cable**		Type : 1.1 kV XLPE-A-FRLS PVC (ST2) (Cu)		
Restricted earth fault Protection	1 no. on Trf: ☒ **CI.-PS**				No. & Size :		
	3 nos. Loose : ☒		**Earth Conductor**		Body :		
Standby earth fault Protection	1 no. on Trf. : ☒ **CI.-5P10**				Neutral :		
ADDITIONAL FITTINGS			**Cable Gland Type & Material**		Primary : Double		
1. LV Neutral terminal box					Secondary compression		
2. Thermometer pocket with cover					Control : Rolled Al		
3. Tank magnetic oil level gauge			**PAINTING**				
4. Bi-directional roller			Type : EPOXY BASED				
			Shade : 631 OF IS : 5				
			Reqd. : ☒ For a period of 2 Years				

- All unfilled data shall be filled by the bidder. Completely filled in Specification Sheet duly stamped & signed by the bidder shall be submitted after award of order.
- Impulse test certificate for similar rating shall be furnished after award of order.

SPECIFICATION SHEET
11 / 0.433 KV DISTRIBUTION TRANSFORMERS

PROJECT: Coal Based Fertilizer Plant — PLANT: Urea Handling & Bagging Package

ISSUED FOR : PROPOSAL ☐ ENQUIRY ☒ ORDER ☐ FINAL ☐

GENERAL

Item No. :	Ref. Stds. : IS-1180, IS-2026, IEC-60076
Quantity :	Encl. Docs. :
Description : Distribution Transformers	Vendor :
Code No. :	Vendor's Ref. No. :

TEST TO BE WITNESSED : Routine : ☒ Heat Run : ☐ Impulse : ☐ Others : ☐

SERVICE CONDITIONS

SYSTEM DETAILS (PRI. / SEC.)	AMBIENT CONDITIONS	
Nom. Voltage with ± % : 11KV±10% / 0.433KV±10%	Temp.- Max./Min./Design Ref. : 46 / 1 / 50°C	
Highest System Voltage : 12 / 0.457 KV	Rel. Humidity : 100 %	Alt. above Sea < 1000M
Number of phases : 3 Ph / 3 W + N	**Atmospheric Pollution**	Dusts : Coal Dust & Urea Dust
Rated Frequency with ± : 50 Hz ± 5%		Vapour : Ammonia & Highly Corrosive
Combined V & F Variation : ± 10 %	**Location**	Indoor : ☐ Outdoor : ☒
Fault MVA : 750 MVA / 36 MVA	**AUX. POWER SUPPLY**	
Earthing Mode : Solidly Earthed	**System Data**	A.C. : 415V ± 10%, 3P & N, 50Hz ± 5%
		D.C. : 110 V
	Instrument Contact Rating	A.C. : 240 V, 5 Amps
		D.C. : 110 V, 5 Amps

BASIC DATA

RATING			TERMINAL CONFIGURATION				
Rated Capacity : _____ KVA					W		
No Load Voltage Ratio : 11 KV / 0.433 KV				X		Z	
Highest Voltage for Eqpt. : 12 KV / 0.457 KV					Y		
Insulation level Pri.-/ Sec	Impulse : 75 KV / --		Shall be provided later.				
	Power Freq. : 28 KV / 3 KV		**TERMINAL CONNECTIONS**				
Impedance at 75 ° C: As per IS (without negative tolerance)			**PRI.**	Arrangement	O/H bushing : ☐		
Vector Group : Dyn 11					Bus Duct : ☐		
Cooling System : ONAN					Cable : ☒		
Motor I Start & T Start : Shall be informed later				Cable cond.	Type : 11 KV XLPE-A-FRLS-PVC (Al) UE		
TAP CHANGER					No. & Size :		
Type of Taps	On Load : ☐	Off Ckt. : ☒	**SEC.**	Arrangement	O/H bushing : ☐		
Range of Taps : -5% TO +5%					Bus Duct : ☐		
No. of Taps : 5 @ 2.5 %					Cable : ☐		
C.T. REQUIREMENTS				Bus cond.	Type :		
Differential Protection	3 nos. on Trf. : ☐				No. & Size:		
	3 nos. Loose : ☐		**Control Cable**		Type : 1.1 kV XLPE-A-FRLS PVC (ST2) (Cu)		
Restricted earth fault Protection	1 no. on Trf: ☒ **CI.-PS**				No. & Size :		
	3 nos. Loose : ☒		**Earth Conductor**		Body :		
Standby earth fault Protection	1 no. on Trf. : ☒ **CI.-5P10**				Neutral :		
ADDITIONAL FITTINGS			**Cable Gland Type & Material**		Primary : Double		
1. LV Neutral terminal box					Secondary compression		
2. Thermometer pocket with cover					Control : Rolled Al		
3. Tank magnetic oil level gauge			**PAINTING**				
4. Bi-directional roller			Type : EPOXY BASED				
			Shade : 631 OF IS : 5				
			Reqd. : ☒ For a period of 2 Years				

- All unfilled data shall be filled by the bidder. Completely filled in Specification Sheet duly stamped & signed by the bidder shall be submitted after award of order.
- Impulse test certificate for similar rating shall be furnished after award of order.

TECHNICAL PARTICULARS
TRANSFORMERS

PROJECT: Coal Based Fertilizer Plant		PLANT: Urea Handling & Bagging Package	
ISSUED FOR : PROPOSAL ☐	ENQUIRY ☒	ORDER ☐	FINAL ☐
GENERAL			
Item no. :		Ref. Stds. :	
Quantity :		Make :	
Description :		Maker's Type :	
Code no. :			
ELECTRICAL DATA			
Rating / Voltage Ratio			
Rated Current - Primary / Secondary			
Rated No Load Current			
Temp. Rise over Ambient - Oil / Winding			
Load Loss at Rated Current at 75° C			
No Load Loss at Rated Voltage / Copper Loss			
Full Load Efficiency at CosΦ - Unity / 0.8 Lag			
Maxm. Efficiency & Load at which it occurs			
Full Load Regulation at CosΦ - Unity / 0.8 Lag			
Short Circuit Withstand Capacity			
B max. at Rated V & F (Tesla)			
Excitation Loss per Kg. at B max.			
X/R Ratio			
INSULATION GRADED / UNIFORM	Primary		
	Secondary		
Induced Over Voltage Withstand Capacity : Pri / Sec.			
OLTC : Rated Voltage / Rated Current			
Total Auxiliary Power Requirement : AC / DC			
CONTROL PANELS	Sheet Metal Thickness		
	Enclosure Type		
	Control Scheme Ref. No.		
Cooling Fans : Qty. / Rating			
Minimum Clearance : H.V. / L.V.	i. Between phases		
	a. In air mm b. In oil mm		
	ii. Between phase & earth		
	a. In air mm		
	b. In oil mm		
Short-circuit Impedance at 75 o C			
MECHANICAL DATA			
Core : Material & Grade			
Winding Type : Pri. / Sec.			
INSULATING MATERIAL	Between Turns		
	Between Primary & Secondary		
	Between Core & Winding		
RADIATORS	Cooling Tubes / Separate Bank		
	Thickness		
	Vacuum Withstand Capacity		
TANK	Material		
	Thickness : Side / Bottom / Cover		
	Vacuum Withstand Capacity		
	Over Pressure Capacity		
DIMENSIONS	Overall (LXBXH)		
	Roller C/L		
	Largest Package (LXBXH)		
Minimum Height required to lift the Core			
WEIGHT	Core & Winding		
	Total		
	Heaviest Package		
Oil Quantity in Litres			
Noise Level			
BUSHING DATA (PRI. / SEC. / NEUTRAL)			
Type & Make			
Ref. Standard			
Rated Voltage			
Rated Current			
Creepage Distance			

MAKE & TYPE OF BOUGHT OUT ITEMS	
Temperature Indicators : Winding / Oil	
Buchholz Relay / Magnetic Oil Level Gauge	
Cooling Fans / Current Transformers	
OLTC	
Control Panels	
Pressure Release Device	

NOTE:
- Completely filled in Technical Particulars Sheet for each type and rating of transformer shall be furnished after award of order for owner/consultant approval before commencement of manufacturing in line with NIT/PO.

SPECIFICATION SHEET
415 V Switchboard

PROJECT: Coal Based Fertilizer Plant PLANT: Urea Handling & Bagging Package

ISSUED FOR: PROPOSAL ☐ ENQUIRY ☒ ORDER ☐ FINAL ☐

GENERAL		**AMBIENT CONDITION**		
Ref. Stds. : IS & IEC		Temp. Max./Min./Design Ref.: 47 / 1.7 / 50°C		
Encl. Docs. :		Relative Humidity 100 %	Alt. above sea : <1000 M	
Vendor :		**Atmospheric Pollution**	Dusts : Coal Dust & Urea Dust	
Vendor Ref. No. :			Vapour : Ammonia & Highly Corrosive	
		Location	Indoor ☒	Outdoor ☐
			Gr. Floor ☐	1st floor ☒

Addl. Scope :	Incoming Bus Duct ☐	Tie Bus Duct ☐
	Erection & Comm. ☒	Supervision of Erection Comm. ☐

TESTS: Routine ☒ Type ☐ Others ☐

BASIC DATA

TAG NO.	Item No.		
	Description		415V SWITCHBOARDS
	Code No.		--
REFERENCE DRAWINGS	Single Line Diagram		
	Feeder Details		
	Auto Trip Alarm Scheme		
	Non Trip Alarm Scheme		
	Trip Circuit Supervision Scheme		
	Auto C/O Scheme		
	P.T. Bus Arrangement		
SYSTEM DETAILS	Nominal Voltage with Variation		415V ± 10%
	Rated Frequency with Variation		50Hz ± 5%
	Combined V & F Variation		± 10%
	No. of Phases & Wires		3 Ph & 4W
	Insulation Level		2.5 KV
	Fault Level		36 MVA
	Earthing Mode		Solidly Earthed
BUS BARS	**Rating**	Continuous	_____ A
		Short Time for 1 sec.	50 KA
	Bare / Insulated		Insulated
	Type of Insulation		Heat Shrinkable PVC sleeved
EXECUTION	**Breaker Feeders**	I/C: ST / DT	ST
		Others: ST / DT	DT
	Other Feeders	Single front / Double front	Double Front
		Fixed / Drawout	Drawout
	Cable Entry : Top / Bottom		Bottom
	Bus Duct Entry : Top / Bottom		--
	Accessibility : Front / Back		Front / Back
CONTROL SUPPLY	**Breaker Feeders**	Closing & Indication	110V DC **
		Tripping	110V DC **
	Contactors		240V AC
	Space Heater		240V AC
MISC. DATA	**Painting**	Type	Epoxy
		Shade	631 of IS: 5
	Period for which Spares required		2 Years

ST- SINGLE TIER
DT- DOUBLE TIER

** NOTE:
- 110V DC Power required for closing, tripping and indication of circuit breaker feeder shall be provided from DCDB.

- For metering, protection etc. refer SLD.
- All unfilled data shall be filled by the Contractor. Completely filled in Specification Sheet duly stamped & signed by the Contractor shall be submitted after award of order.

TECHNICAL PARTICULARS
415V SWITCHBOARDS

PROJECT: Coal Based Fertilizer Plant		PLANT: Urea Handling & Bagging Package
ISSUED FOR: PROPOSAL ☐	ENQUIRY ☒	ORDER ☐ FINAL ☐
GENERAL		
Manufacturer's Type		
Ref. Standards		
Rated Operational Voltage with ± %		
Rated Insulation Voltage		
Rated Voltage of Aux. Circuits with ± %		
Rated Current		
Short Circuit Rating		
Degree of Protection of Enclosure		
Service Conditions : Indoor / Outdoor		
DRAWOUT FACILITIES	Circuit Breakers	
	P.Ts.	
	Motor Starters	
	Protective Relays	
	Meters	
SINGLE FRONT / DOUBLE FRONT	C.B. Feeders	
	Other Feeders	
Cable Entry :	Top / Bottom	
Accessibility :	Front / Back	
MAXIMUM NOS. OF FEEDERS IN ONE PANEL	Circuit Breakers	
	Motor Starters	
	Switch Fuse	
SHEET STEEL TYPE & THICKNESS	Load Bearing member	
	Non Load Bearing member	
	Base Channel	
Material of Gaskets		
Material of External Hardware		
Operating Height : Max. / Min.		
Space Heater Rating of each Panel		
PAINTING	Method of Pre-treatment	
	Type	
	Thickness of Paint	
	Finishing Shade	
Dimensions : L X B X H / Dim. Drg. Ref. No.		
Shipping Dimensions of Largest Package		
Weight : Static / Dynamic		
BUS - BARS		
Material		
SIZE	HBB : Phase / Neutral	
	VBB : Phase / Neutral	
	Ground	
	Supporting Calculations Attached	
MINIMUM CLEARANCE	Between Phases	
	Between Phase & Earth	
Minimum Creepage Distance		
Current Rating : Continuous / Short Time		
Temp. Rise for : Cont. Load / Short Time Current		
SUPPORT	Material	
	BIL	
	Arrangement :Separate/Common	
Material of Bus-bar Insulation		
Shrouding Material for Joints		
No. & Type of Bolts		
CIRCUIT BREAKERS		

Make			
Maker's Type			
Ref. Standards			
Type of Circuit Breaker			
Short Circuit Category			
Maximum Operating Voltage			
No. of Poles			
CURRENT RATING	Continuous		
	1 second RMS		
	Momentary (kA Peak)		
BREAKING CURRENT	Symmetrical KA		
	Asymmetrical KA		
	Sym. MVA at Rated Voltage		
Making Current (Peak)			
INSULATION LEVEL	1 Min. PF withstand Voltage		
	Impulse withstand Voltage		
No. of Breaks per Pole			
TYPE AND MATERIAL OF	Main Contacts		
	Arcing Contacts		
Contact Pressure			
Type of Closing Mechanism			
Type of Tripping Mechanism			
Type of Arc Control Device			
Arc Pumping Features with Details			
Trip Free Features with Details			
Total Closing Time			
Interrupting Time at 10%, 50%, 100% of rated Interrupting Capacity	Total		
	Arcing Time		
SPRING CHARGING MOTOR	Rating		
	Voltage		
	Insulation		
	Duty		
Spring Charging Time			
CONTROL VOLTAGE WITH RANGE	Closing		
	Tripping		
	Alarm and Indication		
POWER/ CURRENT REQUIRED FOR	Closing		
	Tripping		
AUXILIARY CONTACTS	No. of Spare Contacts : NO / NC		
	Contact Rating : AC / DC		
	Convertible : Yes / No		
Net Weight of Breaker			
Type Testing Authority & Test Report Ref. No.			
CURRENT TRANSFORMERS			
Make / Maker's Type			
Ref. Standard			
Type of Primary Winding			
Ratio			
Rated Burden			
Accuracy Class			
ALF / ISF			
Insulation Class & Material			
Ref. Magnetisation Curve No.			
POTENTIAL TRANSFORMERS			
Make / Maker's Type			
Ref. Standard			
Winding Connection			
Ratio			
Rated Burden			

Accuracy Class		
Insulation Class & Material		
SWITCHES		
Make / Maker's Type		
Ref. Standard		
Type of Switch		
Rated Operational Voltage		
Utilisation Category		
Rated Operational Current		
Short Time Withstand Current		
No. of Poles / Break		
Type Test Certificate Ref. No.		
FUSES		
Make / Maker's Type		
Ref. Standard		
Type of HRC Fuse		
Rated Voltage / Current		
Category of Duty		
Prospective Breaking Current		
CURRENT TIME CURVE SHOWING PRE-ARCING AND TOTAL I^2T VALUES	Ref. No.	
	Attached	
CONTACTORS		
Make / Maker's Type		
Ref. Standard		
Rated Operational Voltage		
Utilisation Category		
Rated Duty		
Rated Thermal Current		
OPERATING VOLTAGE OF COIL	Pick up Max./Min.	
	Drop off Max./Min.	
Coil Consumption Pick up / Hold on		
RELAYS		
Make / Maker's Type		
Ref. Standard		
Operating Principle		
Setting Range		
Type of Mounting		
Burden		
Reset : Hand or Self		
Flag Indication Type		
Ref. Characteristic Curve Type		
Ref. Descriptive catalogue		
INSTRUMENTS AND METERS		
Make / Maker's Type		
Ref. Standard		
Operating Principle		
Scale Range		
Accuracy		
Size		
Type of Mounting		
CONTROL SWITCHES		
Make / Maker's Type		
Ref. Standard		
Contact Rating		
Utilisation Category		
PUSH BUTTONS		
Make / Maker's Type		
Ref. Standard		
Contact Rating		
Utilisation Category		
SIGNAL LAMPS		

Make / Maker's Type	
Ref. Standard	
Rated Voltage / Watts	
Type of Lamp Holder	
Type of Globe	
MINIATURE CIRCUIT BREAKER	
Make / Maker's Type :	
Ref. Standards	
Rated Current	
Breaking Capacity	
MOULDED CASE CIRCUIT BREAKERS	
Make / Maker's Type	
Ref. Standard	
Current Rating	
Breaking Capacity	
Setting Range of Thermal Release	
Setting Range of Magnetic Release	
CABLE GLANDS	
Material	
Type	
TERMINAL BLOCKS	
Make	
Type	
Current Rating	

NOTE:
- Completely filled in Technical Particulars Sheet shall be furnished after award of order for owner/consultant approval before commencement of manufacturing in line with NIT/PO.
- Inter-tripping of primary and secondary of transformer shall be provided for all faults through lockout relays.

SPECIFICATION SHEET
INDUCTION MOTOR

PROJECT: Coal Based Fertilizer Plant			PLANT: Urea Handling & Bagging Package		
ISSUED FOR : PROPOSAL ☐	ENQUIRY ☒	ORDER ☐	FINAL ☐		
GENERAL					
Item No. :		Ref. Stds. : IS ☒	IEC ☒		
Quantity :		Encl. Docs. :			
Description : 3 Phase Induction Motor		Make : As per enclosed vendor list			
Code No. :		Maker's Type. :			
TESTS: Routine ☒	Type ☐	Others ☐			
SERVICE CONDITIONS					
SYSTEM DETAILS		**AMBIENT CONDITION**			
Rated Voltage with ± % : 11kV/3.3KV /415V ± 10%		Temp. Max./Min./Design Ref. 46 / 1 / 50°C			
No. of phases : 3		Relative Humidity 100%	Alt. above sea : <1000 M		
Rated Frequency With ± % : 50 Hz ± 5%		**ATMOSPHERIC POLLUTION**	Dusts : Coal Dust & Urea Dust		
Combined V & F variation : ± 10%			Vapour : Ammonia & Highly Corrosive		
Fault Level : As per System Fault level		**Area**	Safe ☐	Hazardous ☐	
Space Heater Supply : 240 V AC		**Haz. Area class:** Zone:	Temp. class :	Encl. Gr.	
Low Voltage Heating Supply :		**Location** : Indoor ☐	Outdoor ☐		
INSTRUMENT CONTACT RATING A.C. :		**COOLING WATER**			
D.C. :		Inlet Press. : Kg/sq.m.	Inlet Temp. °C		
Aux. Motor Supply :		Fauling Factor :	Outlet Temp. °C		
BASIC DATA					
RATING & DUTY		**DRIVEN M/C DATA**			
Rated Output :		Type :			
Syn. Speed :		Make :			
Duty :		Absorbed Power :			
Rotor Type : Squirrel Cage		Coupling :			
Starting Method : DOL		Torque-Starting / Max. :			
Max I Start/I Rated : Refer Technical Specification		GD^2 at Motor Speed :			
Min. V Start at Terms : 80% of rated voltage		Thrust - Radial / Axial :			
Min. Starting Torque at V_R :		Addl. Data :			
EXECUTION		**ACCESSORIES**			
Degree of Protection :		Foundation Bolt ☒	Space Heater ☒		
Addl. Degree of Protection :		Lifting Eye Bolt ☒	Drain Plug ☒		
Mounting Arrangement :		Cable Glands ☒	Cable Lugs ☒		
Direction of Rotation : Bi-directional		Diff. C.T.s ☐	C.W. Flow Indicator ☐		
Insulation Class: 'F' with temp. rise limited to 'B'		**RTDs for HT Motor** Wdgs. ☒	Hot Air ☐	Bearings ☒	
Cooling Method :		**Thermometer For HT Motor**	Hot Air ☐	Bearings ☒	
Stator Connection : Delta		**Earthing Terminals**	On Body ☒	In T.B. ☒	
CABLING DATA		Name Plate : ☒	Addl. name plate : ☒		
Power cable :		Rain Protecting Hood : ☒	Thermistor ☐		
Heater cable :3x2.5 Sq.mm (Cu) subject to Cl.no.7.1 of ES: 8102.		**SPARE PARTS**			
C.T. cable :		Required ☒	For Period of 2 Years		
R.T.D. cable :		Bearings (DE & NDE) : ☒	Cooling Fan ☒		
Alarm cable :		Grease Nipple & Plug : ☒	Fan cover ☒		
CABLE GLAND Type : Double Compression		RTD for: winding and bearing ☒			
Material :		Terminal Plate complete with stud & shorting link : ☒			
		Inner & Outer covers for DE & NDE bearing: ☒			
PAINTING Type : Epoxy		Terminal Block ☒			
Shade : 631 of IS : 5					

- **Note:** 1) All unfilled data shall be filled by the Contractor. Completely filled in Specification Sheet duly stamped & signed by the Contractor shall be submitted after award of order.
  2) Space heater shall be provided for all motors rated 30KW & Above.
  3) Power cables shall be of 11kV3.3KV/1.1KV grade XLPE-A-FRLS and space heater cables shall be of 1.1 KV grade XLPE-A-FRLS PVC.

TECHNICAL PARTICULARS
INDUCTION MOTOR

PROJECT: Coal Based Fertilizer Plant		PLANT: Urea Handling & Bagging Package	
ISSUED FOR : PROPOSAL ☐	ENQUIRY ☒	ORDER ☐	FINAL ☐
GENERAL			
Item No.			
Quantity			
Description			
Code No.			
Ref. Standard			
Make			
Maker's Type			
ELECTRICAL DATA			
Rated Output			
Rated Voltage			
No. of Starts - Hot / Cold			
Torque - Starting / Pull Up / Pull Out			
Starting Time at min. V Start (Hot / Cold)			
Safe Stall Time at V_R / $1.1V_R$			
Stator Time Constant			
Temp. Rise at Full Load - Wdg. / Hot Air / Brg.			
TEMP. RISE OF STATOR / ROTOR AFTER	3 Starts From Cold		
	2 Starts From Hot		
Current at FL / 0.85 FL			
Efficiency at FL / 0.85 FL			
Speed at FL / 0.85 FL			
Power Factor at FL / 0.85 FL / Start			
Push Pull Voltage withstand Capacity			
Max. V dip for 1 sec. / 10 sec. / 60 sec.			
Losses - Fixed / Copper / Total			
Space Heater Rating			
Suitable for Low Voltage Heating			
C.T. Ratio & Accuracy Class			
C.T. V_K & Imag. at V_K / 2			
Heating Time Constant			
Cooling Time Constant			
MECHANICAL DATA			
Frame Size / Ref. Dimensional Drg.			
Weight - Stator / Rotor / Total			
Heaviest Weight to be Lifted			
Rotor GD^2 in Kgm^2			
REACTION AT SUPPORTS FOR	S/C Condition		
	Starting Condition		
	Running Condition		
	Push Pull Condition		
Max. Vibration Limit			
Max. Noise Level			
Suitable for Outdoor Use		Yes ☐	No ☐
Suitable for Bi-directional Rotation		Yes ☐	No ☐
Material of Insulation			
Treatment of Insulation			
Winding Coils Replaceable at Site			
Type & Material of Fan			
Material & Thickness of Cooler Tube			
Cooling Water Required in M^3 / hr			
Lubrication Type			
Lubricant Specn.			
Interval of Lubrication			
BEARING NOS. & TYPE	DE		
	NDE		
	GUIDE		
On Line Lubrication			
Type & Rating of Main Cable Box			
No. of Cable Glands in Control Cable Box			

- Completely filled in Technical Particulars Sheet shall be furnished after award of order for owner/consultant approval before commencement of manufacturing in line with NIT/PO.

SPECIFICATION SHEET
LOCAL CONTROL STATION

PROJECT: Coal Based Fertilizer Plant — PLANT: Urea Handling & Bagging Package

ISSUED FOR : PROPOSAL ☐ ENQUIRY ☒ ORDER ☐ FINAL ☐

GENERAL		**AMBIENT CONDITION**	
Ref. Stds. :IS / IEC		Temp. Max./Min./Design Ref. 46 / 1 / 50°C	
Encl. Docs. :		Relative Humidity: 100%	Alt. above Sea : Less than 1000 m
Vendor :		**Atmospheric Pollution**	Dusts : Coal Dust & Urea Dust
Vendor Ref. No. :			Vapour : Ammonia & Highly Corrosive
		Area	Safe : ☐ Hazardous : ☐
Sample : Reqd. : ☐ Not Reqd. : ☒		**Hazardous Area Classification**	Zone : Encl. Gr. :
Tests :	Routine : ☒ Type : ☐		Temp. Cl.
	Others:	**Location** :	Indoor ☒ / Outdoor ☒

BASIC DATA

Item No.		1	2	3
		LCS FOR HV/LV MOTORS (Breaker controlled)	LCS FOR LT MOTORS (above 22KW to 55KW)	LCS FOR LT MOTORS (up to 22KW)
		TYPE - 1	TYPE – 2	TYPE - 3
Quantity				
Rated Control Voltage with + %		110V DC ±5%	240V±10%	240V±10%
Rated Frequency with +		50Hz±5%	50Hz±5%	50Hz±5%
Enclosure for Hazardous Area				
Provisions required in LCS				
PUSH BUTTON	Start		Required	Required
	Stop		Required	Required
	Reverse			
	Forward			
CONTROL SWITCH	TNC	Required		
	Lock / Service			
	OFF / AUTO / ON			
	Local/Remote	Required	Required	Required
INDICATION LAMP	ON	Required	Required	Required
	OFF	Required	Required	Required
	Ready for Service	Required		
	Space Heater ON	Required	Required	
	C.B. tripped	Required		
METERS	Ammeter	Required	Required	Required*
	Range			
	C.T. Sec. Current	1 Amp.	1 Amp.	1 Amp.
RAIN HOOD	Reqd.	Required	Required	Required
	Not Reqd.			
Control Cable Size PVCAPVC (Cu)				
Painting Type & Shade		Epoxy Shade631of IS 5	Epoxy Shade631of IS 5	Epoxy Shade631of IS 5
Period For which Spares Reqd.				
		2Years	2Years	2Years

MAKE OF COMPONENTS

Push Buttons	L & T / Siemens / Alstom / Teknic / Vaishnav
TNC Switches	L & T / Siemens / Alstom / Teknic
Ammeter	AEP / IMP / Meco / Universal
Indication Lamp	L & T /Teknic / Vaishnav
Cable Gland	Baliga / Flexpro / CEAG FCGPL / FEPL
Terminal Box	Elemex / Siemens/ L& T

- Note 1) All unfilled data shall be filled by the Contractor. Completely filled in Specification Sheet duly stamped & signed
*2) From process point of view, ammeter shall be provided for motors below 5.5 KW .

PROJECT: Coal Based Fertilizer Plant — PLANT: Urea Handling & Bagging Package

ISSUED FOR : PROPOSAL ☐ ENQUIRY ☒ ORDER ☐ FINAL ☐

Details Of Local Control Stations

Sl.No.	ITEM NO.	CODE NO.	DESCRIPTION	IFL	C.T. Ratio	Remarks

TECHNICAL PARTICULARS
LOCAL CONTROL STATIONS

PROJECT: Coal Based Fertilizer Plant		PLANT: Urea Handling & Bagging Package
ISSUED FOR : PROPOSAL ☐ ENQUIRY ☒ ORDER ☐ FINAL ☐		
GENERAL		
Maker's Type		
CONSTRUCTIONAL FEATURES		
Material of Construction		
Thickness of Enclosure		
IP Class of Enclosure		
Mounting Arrangement		
Door hinged or not		
Gasketing Material		
External Hardwares		
Rainhood reqd. or not		
Mounting Component	On Door	
	On Base Plate	
Provision of Padlocking provided with		
Dimensions LxBxH / Dimensional Drg. Ref. No.		
Type Test Certificate No.		
WIRING		
Wiring Material & Size		
External Cable Size		
TERMINATION ARRANGEMENT		
Termination Arrangement		
Cable Glands	Material	
	Types	
Terminal	Make	
	Type	
	Rating	
PUSH BUTTONS		
Make & Maker's Type		
Ref. Standards		
Rated Voltage		
No. of Contacts N.O. / N.C.		
Contact Rating (V / A)		
AMMETER		
Make & Maker's Type		
Ref. Standards		
Rated Current / VA		
Accuracy Class		
Scale Band		
Size		
CONTROL SWITCHES		
Make & Maker's Type		
Ref. Standards		
Rated Voltage		
No. of Contacts N.O. / N.C.		
Contact Rating (V / A)		
Utilization Category		
SIGNAL LAMPS		
Make & Maker's Type		
Ref. Standards		
Rated Voltage / Watts		
Type of Holder		
Safety Resistor		

- Completely filled in Technical Particulars Sheet shall be furnished after award of order for owner/consultant approval before commencement of manufacturing in line with NIT/PO.

SPECIFICATION SHEET
LIGHTING SUB DISTRIBUTION BOARD

PROJECT: Coal Based Fertilizer Plant		PLANT: Urea Handling & Bagging Package	
ISSUED FOR : PROPOSAL ☐ ENQUIRY ☒ ORDER ☐ FINAL ☐			
GENERAL		***AMBIENT CONDITION***	
Ref. Stds. : IS/IEC		Temp.- Max / Min / Design ref.: 46 / 1 / 50°C	
Encl. Docs. :		**Relative Humidity:** ≤ 100%; Alt. above sea : <1000 M	
Vendor :		**Atmospheric Pollution**	Dusts : Coal Dust & Urea Dust
Vendor Ref. No. :			Vapour : Ammonia & Highly
SYSTEM DETAILS		**Area**	Safe ☐ Hazardous ☐
Nominal Voltage with + % : 415V+ 10%,		**Hazardous Area Class**	Zone : Encl. Gr. :
Rated Frequency with + % : 50 Hz± 5%,			Temp. Class : T3
Combined V & F Variation : ± 10%,		**Location** Indoor ☐	Outdoor ☒
No. of Phases & Wires : 3-Phase, 4-wire			
TESTS TO BE WITNESSED: Routine ☒	Type ☐	Others ☐	

BASIC DATA				
Item No. :				
Quantity :				
Description :		LSDB	LSDB	DC LSDB
Code No.				
Incoming & Outgoing feeders		No. & Outgoing – 18/12 Nos.	1 No.& Outgoing – 9/6 Nos.	Incoming - 1 No. & Outgoing -9 Nos
Degree of Protection :		Min IP55	Min IP55	Min IP55
Addl. Degree of Protection :		--	--	--
Cable Type & size	Incoming			
	Outgoing	1.1 KV, 3x2.5 sq. mm. (Cu) XLPE-A-FRLS PVC	1.1 KV, 3x2.5 sq. mm. (Cu) XLPE-A-FRLSPVC	1.1 KV, 3x2.5 sq. mm. (Cu) XLPE-A-FRLSPVC
Painting Type & Shade :		Epoxy based, RAL 7032	Epoxy based, RAL 7032	Epoxy based, RAL 7032
Period for which Spares required :		2 years	2 years	2 years

MAKE OF COMPONENTS

SWITCH	: L&T / Siemens / Alstom Power / Kaycee
M.C.B.	: Legrand / Schneider / ABB / Siemens
CABLE GLANDS	: Dowell / Braco / Cambre / Thomas & Betts / Blackburn / Klauke / Panduit
TERMINAL BLOCKS	: Connectwell / Wago / Phoenix

All unfilled data shall be filled in by the bidder.

TECHNICAL PARTICULARS

Completely filled in Technical Particulars Sheet shall be furnished after award of order for owner/consultant approval before commencement of manufacturing in line with NIT/PO.

General	Item No. :		
	Make & Maker's Type		
	Material & Thickness of Enclosure		
	Gasketing Material		
	COVER TYPE	Internal :	
		External :	
	PAINTING	Pre treatment	
		Shade	
	Material of Ext. Hardware < 8mm / > 8mm		
	Dimensional Drawing Reference No. :		
	Weight :		
M.C.B.	Make & Maker's Type		
	Reference Standards		
	Category of Duty :		
	Rated Current :		
	No. of Poles :		
	Type of Neutral :		
Terminal Block	Make & Type		
	Rated Current		
Cable Gland	Type :		
	Material :		

SPECIFICATION SHEET
SWITCH SOCKET & PLUG

PROJECT: Coal Based Fertilizer Plant PLANT: Urea Handling & Bagging Package Plant

ISSUED FOR : PROPOSAL ☐ ENQUIRY ☒ ORDER ☐ FINAL ☐

GENERAL		**AMBIENT CONDITION**	
Ref. Stds. : IS / IEC		Temp.- Max / Min / Design ref.: 46 / 1 / 50°C	
Encl. Docs. :		Max Relative Humidity ≤ 100% Alt. above sea : <1000 M	
Vendor :		Atmospheric Pollution	Dusts : Coal Dust & Urea Dust
Vendor Ref. No. :			Vapour : Ammonia & Highly Corrosive
Sample Reqd. :		Area	Safe ☐ Hazardous - ☐
		Hazardous Area Class	Zone : Encl. Gr. :
			Temp. Class :
		Location :	Indoor ☒ Outdoor ☒

TESTS TO BE WITNESSED : Routine ☒ Type ☐ Others ☐

BASIC DATA		
Item No.		
Quantity		
Rated Voltage & Frequency		415V/240V+ 10%, 50 Hz± 5%,
Rated Current		63A/15 Amp
No. of Phases & Pins		3ph/1 Ph, 3 Pin
Degree of Protection		IP55
Addl. Degree of Protection		--
Cable Size	Supply	
	Plug	--
Period for which Spares required		2 Years

MAKE OF COMPONENTS	
MCB	Legrand / Schneider / ABB / Siemens
SOCKETS :	Legrand / Schneider / ABB / Siemens
PLUG :	Legrand / Schneider / ABB / Siemens
CABLE GLANDS :	Dowell / Braco / Cambre / Thomas & Betts / Blackburn / Klauke / Panduit
TERMINAL BLOCKS :	Connectwell / Wago / Phoenix

All unfilled data shall be filled in by the bidder.

TECHNICAL PARTICULARS

Completely filled in Technical Particulars Sheet shall be furnished after award of order for owner/consultant approval before commencement of manufacturing in line with NIT/PO

General	Make & Maker's Type		
	Material & Thickness of Enclosure		
	Gasketing Materials		
	Material of Ext. Hardwares < 8mm / > 8mm		
	Cable glands Type & Material		
	Painting	Pre treatment	
		Shade	
	Dimensional Drawing Reference No.		
	Weight of Switch Socket / Plug		
Switch	Make & Maker's Type		
	Reference Standards		
	Rated Current		
	Utilisation Category		
Fuse	Make & Maker's Type		
	Reference Standards		
	Rated Current		
Socket	Make & Maker's Type		
	Reference Standards		
	Rated Current		
Plug	Make & Maker's Type		
	Reference Standards		
	Rated Current		

SPECIFICATION SHEETS
JUNCTION BOX

PROJECT: Coal Based Fertilizer Plant		PLANT: Urea Handling & Bagging Package	
ISSUED FOR : PROPOSAL ☐	ENQUIRY ☒	ORDER ☐	FINAL ☐
GENERAL			
Ref. Stds.		IS / IEC	
Encl. Docs.			
Make			
Maker's type			
Sample Required		Yes ☐	No ☒
AMBIENT CONDITIONS			
Temp. Max. / Min. / Design Ref.		46 / 1 / 50°C	
Rel. Humidity		100%	
Alt. Above Sea Level		<1000M	
ATMOSPHERIC POLLUTION	Dusts	Dusts : Coal Dust & Urea Dust	
	Vapours	Vapour : Ammonia & Highly Corrosive	
Area		Safe ☒	Hazardous ☐
Hazardous area classification		Zone: Encl. Gr.:	Temp. Class:
Location		Indoor ☒	Outdoor ☒
TESTS	Routine ☒	Type ☐	Others ☐

BASIC DATA	
Item No.	
Quantity	
Rated Voltage	240V±10%
Rated Frequency	50Hz±5%
Rated Current	16A
No. of Phases & Wires	1Phase / 3wires (PNE)
Application	For looping of cable
Material of Enclosure	
Shape of Enclosure	Round
Degree of Protection	IP-55
Addl. Degree of Protection	--
Type of Cover	Dome
No. of Outlets	3 nos. + one plug
PAINTING	Type: Epoxy based
	Shade: 631 as per IS: 5
SPARE	Required: Yes
	Duration: 2 Years
No. of Terminals: As required	
Cable gland: 4 nos.	
Stopping Plug: 1 no.	
CABLE SIZE	Incoming -- 3Cx2.5 mm^2 (Cu) 1.1 KV XLPE ARMOURED FRLS PVC
	Outgoing -- 3Cx2.5 mm^2 (Cu) 1.1 KV XLPE ARMOURED FRLS PVC

Note:
- Double compression rolled aluminium cable glands, lugs and plugs shall be provided
- All unfilled data shall be filled by the Contractor. Completely filled in Specification Sheet duly stamped & signed by the Contractor shall be submitted after award of order.

TECHNICAL PARTICULARS
JUNCTION BOX

PROJECT: Coal Based Fertilizer Plant	PLANT: Urea Handling & Bagging Package
ISSUED FOR : PROPOSAL ☐ ENQUIRY ☒ ORDER ☐ FINAL ☐	
GENERAL	
Item No.	
Ref. Std.	
Type of Junction Box	
Make	
Maker's type	
CONSTRUCTIONAL FEATURES	
Material of Construction	
Thickness of Enclosure	
Enclosure Protection Class	
Mounting Arrangement	
Cover Fixing Arrangement	
Gasketing Material	
External Cable Sizes	
Dimensions LX B X H / Dimensional Drg. Ref. No.	
Weight	
Painting	
Type Test Certificate No.	
CABLE GLAND	
Type	
Material of Construction	
Make	
TERMINAL BLOCK	
Nos. of Terminals	
Material	
Type	
Current Rating	
Fixing Arrangement	
Make	

- NOTE: Completely filled in Technical Particulars Sheet shall be furnished after award of order for owner/consultant approval before commencement of manufacturing.

SPECIFICATION SHEET
BATTERY CHARGER

PROJECT: Coal Based Fertilizer Plant			PLANT: Urea Handling & Bagging Package	
ISSUED FOR : PROPOSAL ☐	ENQUIRY ☒	ORDER ☐	FINAL ☐	
GENERAL			**AMBIENT CONDITION**	
Ref. Stds. : IS/IEC			Temp.- Max / Min / Design ref.: 46 / 1 / 50°C	
Encl. Docs : ☐			Relative Humidity 100% Max.	Alt. above Sea Level < 1000M
Make : As per vendor list enclosed		**ATMOSPHERIC POLLUTION**	Dusts : Coal Dust & Urea Dust	
Maker's Type :			Vapour : Ammonia & Highly Corrosive	
		LOCATION	A/C Room ☐	Ventilated Room ☒
			Non Ventilated Room ☐	
TESTS: Routine ☒	Type ☐		Others ☐	

BASIC DATA		
TAG NO. & QUANTITY	Item No.	
	Code No.	
	Description	Battery Charger
	Quantity	
A.C. SUPPLY SYSTEM DETAILS	Nominal Voltage with ±%	415 V ± 10 %
	Rated Frequency with ±%	50 Hz ± 5 %
	No. of Phases & Wires :	3 Phase, 4 Wire
	Earthing Mode	Solidly Earthed
	Fault Level	36 MVA
LOAD DETAILS	Continuous Current	_ A
	Rated D.C. Voltage	110V
ASSOCIATED BATTERY DETAILS	Make & Type	Ni-Cd
	No. of Cells	
	Nominal Voltage	110 V ,DC,± 10%
	Float Charging Current in Amp.	
	Float Charging Voltage	1.1
	Boost Charging Current Starting/ Finishing	Ni-Cd - 1.3-1.45
	Charging Final Voltage	
	Tapping provided at Cell No.	Ni-Cd - 1.42-1.7
	Boost Charging Time	10 Hrs
	Internal Resistance per Cell (□□Ω)	
CABLING DETAILS	A.C. Power Supply	
	Battery	**XLPE insulated FRLS-PVC sheathed**
	Load	**XLPE insulated FRLS-PVC sheathed**
	Control	
PAINTING	Type & Shade	
SPARE PARTS		

- Note: All unfilled data shall be filled by the Contractor. Completely filled in Specification Sheet duly stamped & signed by the Contractor shall be submitted after award of order.

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TECHNICAL PARTICULARS
BATTERY CHARGER

PROJECT: Coal Based Fertilizer Plant PLANT: Urea Handling & Bagging Package

ISSUED FOR : PROPOSAL ☐ ENQUIRY ☒ ORDER ☐ FINAL ☐

GENERAL	Item No.		
	Make		
	Maker's Type		
CONSTRUCTIONAL DETAILS	Degree of Protection for Enclosure		
	Type of Sheet Steel		
	Thickness of Sheet Steel		
	Gasket Material		
	External Hardware <8 mm / >8 mm		
	Dimensions (L x B x H)		
	Total Weight		
	Painting	Type	
		Shade	
FLOAT / STAND BY FLOAT CHARGER	Type of Charger.		
	DC Output Voltage		
	DC Output Current		
	Manual range of Output Voltage Variation		
	Output Voltage Regulation		
	Ripple Content		
	Voltage Drop Across Dropper Diodes at FL		
	Over Load Capacity		
	Type of Cooling		
BOOST CHARGER	Type of Charger		
	Output Current : Starting / Finishing		
	Output Voltage Range		
	Ripple Content		
	Float Current for Automatic Switching		
	Charge Termination Device		
	Type of Cooling		
FLOAT/ STAND BY FLOAT / BOOST CHARGER	**CHANGE-OVER ARRANGEMENT FROM**	Float to Standby Float	
		Standby Float to Float	
		Float / Standby Float to Boost	
		Boost to Float / Standby Float	
	Short Circuit current		
	Heat Dissipation		

		Float / Standby float	**Boost**
RECTIFIER TRANSFORMER	Make		
	Type		
	Class of Insulation		
	Vacuum Impregnated		
	KVA Rating (Design / Load)		
	Temp. Rise Over Ambient		
THYRISTORS	Make		
	Type		
	VRRM		
	Iav		

		Rectifier – Float / Boost	**Blocking Diodes**	**Dropper Diodes**
DIODES	Make			
	Type			
	VRRM			
	Iav			

PCBS	Make		
	Type		
	Self Diagnostic feature		
FILTER CAPACITOR	Make		
	Type		
	Capacity		
	Rated Voltage		
D.C. CHOKE	Make & Type		
	Insulation Class		

	Rating : Current / Inductance					
BATTERY E/F RELAY	Make					
	Type					
	Setting Range					
DC U/V RELAY	Make					
	Type					
	Setting Range					
THERMAL RELAY		**Float / Standby float**		**Boost**		
	Make					
	Type					
	Setting Range					
AUX. RELAY	Make					
	Type					
SWITCHES		**Float / Standby Float**		**Boost**		**Battery**
		Input	Output	Input	Output	
	Make					
	Type					
	Rated Voltage/Current					
	Utilisation Category					
CONTACTORS		**Float/Standby Float I/P**		**Boost I/P**		**D.C. Contactor**
	Make					
	Type					
	Rated Voltage/Current					
	Utilisation Category					
	Operating Voltage of Coil					
FUSES		**Float/Standby Float**		**Boost**		
		Input/Output/SCR/Diodes		Input/Output/SCR/Diodes		
	Make					
	Type					
	Rated Voltage/Current					
	Prospective Breaking Current					
PUSH BUTTONS	Make					
	Type					
	Current / Voltage Rating					
	Utilisation Category					
CONTACTORS & SELECTOR SWITCHES	Make					
	Type					
	Current / Voltage Rating					
	Utilisation Category					
TIMER	Make					
	Type					
	Timer Range					
INSTRUMENTS & METERS	Make					
	Type					
	Operation					
	Accuracy					
	Size					
SIGNAL LAMPS	Make					
	Type					
	Rated Voltage / Wattage					
	Rating of Safety Resistor					
CABLE GLAND	Make					
	Type					
	Material					
TERMINAL BLOCK	Make					
	Type					
	Current Rating					

NOTE:

- Completely filled in Technical Particulars Sheet shall be furnished after award of order for owner/consultant approval before commencement of manufacturing in line with NIT/PO.

SPECIFICATION SHEET
BATTERY

PROJECT: Coal Based Fertilizer Plant PLANT: Urea Handling & Bagging Package

ISSUED FOR : PROPOSAL ☐ ENQUIRY ☒ ORDER ☐ FINAL ☐

GENERAL		AMBIENT CONDITIONS	
Ref. Stds. : IS/IEC		Temp.- Max / Min / Design ref.: 46 / 1 / 50°C	
Encl. Docs. : ☐		Relative Humidity: 100% Max.	Alt. above Sea Level <1000M
Make : As per enclosed vendor list		**Atmospheric Pollution**	Dusts : Coal Dust & Urea Dust
Maker's Type :			Vapour : Ammonia & Highly Corrosive
		Location	A/C Room ☐ Ventilated Room ☒
			Non Ventilated Room ☐

TESTS: Type ☐ Routine ☒ Acceptance ☐ Others ☐

BASIC DATA

TAG NO. & QUANTITY	Item No.	
	Code No.	
	Description	Ni- Cd Battery
	Quantity	
BATTERY DETAILS	Rated Nominal Voltage of battery bank	110 V DC
	Capacity in AH at 2 hrs rate	
	No. of Cells	
	Nominal Voltage per cell	
	Cell Designation	
	Intermediate Tapping point	
	Earthing mode	
CABLE DETAILS	No.	
	Size	
	Type	
ROOM DIMENSION	Length	
	Breadth	
	Height	
SPARE PARTS	Required ☒ for a Period of 2 Years operation and maintenance	

Note: All unfilled data shall be filled by bidder and shall be furnished after award of order for owner/consultant approval before commencement of manufacturing.

TECHNICAL PARTICULARS
BATTERY

PROJECT: Coal Based Fertilizer Plant		PLANT: Urea Handling & Bagging Package	
ISSUED FOR : PROPOSAL ☐ ENQUIRY ☒ ORDER ☐ FINAL ☐			
GENERAL			
Item No.			
Make			
Maker's Type			
No. of Cells Per Battery			
Capacity at 10 Hr Rate			
CONSTRUCTIONAL DETAILS			
POSITIVE PLATES	Type		
	Size		
	Number Per Cell		
NEGATIVE PLATES	Type		
	Size		
SEPARATORS	Type		
	Material		
	Thickness		
CONTAINERS	Thickness		
	Material		
CONNECTORS BETWEEN CELLS	Size		
	Material		
	Method of Connection		
Clearance Between Bottom of Plates & Containers			
Overall Dimensions of each Cell			
Weight of Complete Cell			
ELECTRICAL DATA			
RECOMMENDED RATES OF CHARGE	Starting (A)		
	Finishing (A)		
	Float (A)		
	First Charge (A)		
RECOMMENDED VOLTAGE PER CELL	Float Charging		
	Boost Charging	Start	
		Finish	
Open Circuit Voltage On Full Charge			
GUARANTEED γ AT 10 Hr. RATE	Amp. Hr. %		
	Watt Hr. %		
Internal Resistance Per Cell			
DISCHARGE CAPACITY IN Amp.	5 Hr. Rate to V Per Cell		
	3 Hr. Rate to V Per Cell		
	1 Hr. Rate to V Per Cell		
	30 Min. Rate to V Per Cell		
	15 Min. Rate to V Per Cell		
	5 Min. Rate to V Per Cell		
	1 Min. Rate to V Per Cell		
	30 Sec. Rate to V Per Cell		
	15 Sec. Rate to V Per Cell		
	5 Sec. Rate to V Per Cell		
	1 Sec. Rate to V Per Cell		
MISCELLANEOUS DATA			
Electrolyte Details	Qty. Per Cell for First Filling		
	Sp. Gr. for First Filling		
	Sp. Gr. at the end of Full Charge		
	Sp. Gr. at the end of Discharge		
Recom. Max. Period of Storage before 1st Charge			
Battery Supporting Rack Dimensions			

- NOTE: Completely filled in Technical Particulars Sheet shall be furnished after award of order for owner/consultant approval before commencement of manufacturing in line with NIT/PO.

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SPECIFICATION SHEET
DCDB

PROJECT: Coal Based Fertilizer Plant		PLANT: Urea Handling & Bagging Package	
ISSUED FOR : PROPOSAL ☐ ENQUIRY ☒ ORDER ☐ FINAL ☐			
GENERAL		**AMBIENT CONDITIONS**	
Ref. Stds. : IS/IEC		Temp.- Max / Min / Design ref.: 46 / 1 / 50°C	
Encl. Docs. : ☐		Relative Humidity: 100% Max.	Alt. above Sea Level <1000M
Make : As per enclosed vendor list		**Atmospheric Pollution**	Dusts : Coal Dust & Urea Dust
Maker's Type :			Vapour : Ammonia & Highly Corrosive
		Location	A/C Room ☐ Ventilated Room ☒
			Non Ventilated Room ☐
TESTS: Type ☐ Routine ☒ Acceptance ☐ Others ☐			

BASIC DATA			
TAG NO.	Item No.		DCDB
	Description		DC DISTRIBUTION BOARD
	Code No.		
REFERENCE DRAWINGS	Single Line Diagram		--
SYSTEM DETAILS	Nominal Voltage with Variation		110V DC
	Rated Frequency with Variation		--
	Combined V & F Variation		--
	No. of Phases & Wires		1 Phase 2 wire
	Insulation Level		1.1 KV
	Fault Level		
	Earthing Mode		
BUS BARS	**Rating**	Continuous	
		Short Time for 1 sec.	16 kA
	Material of Construction		Al
	Bare / Insulated		Insulated
	Type of Insulation		Heat Shrinkable Raychem Sleeves
EXECUTION	Single Front / Double Front		Single Front
	Drawout / Non Drawout		Non Drawout
	CABLE ENTRY	Top	--
		Bottom	Yes
MISC. DATA	Dummy Panel Reqd. (Yes / No)		No
	Width of Dummy Panel		--
	No. of Dummy Panel		--
	PAINTING	Type	Epoxy Based
		Shade	RAL 7035
	Spares Parts Reqd. For a Period of		

Note: All unfilled data shall be filled by bidder and shall be furnished after award of order for owner/consultant approval before commencement of manufacturing.

SPECIFICATION SHEET
LIGHTING TRANSFORMER

PROJECT: Coal Based Fertilizer Plant			PLANT: Urea Handling & Bagging Package		
ISSUED FOR : PROPOSAL ☐	ENQUIRY ☒	ORDER ☐	FINAL ☐		
GENERAL					
Item No. :		Ref. Stds. : IS/IEC			
Quantity : As Required		Encl. Docs. :			
Description : Auxiliary Service Transformer		Make : As per enclosed vendor list			
Code No. :		Maker's Type :			
TESTS : Routine ☒	Heat Run ☒	Others : ☒	Impulse ☒		
SERVICE CONDITIONS					
SYSTEM DETAILS (PRI. / SEC.)		**AMBIENT CONDITIONS**			
Nom. Voltage with ± % : 415 ± 10 % V		Temp.- Max./Min./Design Ref. : 46 / 1 / 50°C			
Highest System Voltage : 457 KV		Rel. Humidity: 100% Max. Alt. above Sea < 1000M			
Number of phases : 3 Ph + N		**Atmospheric Pollution**	Dusts : Coal Dust & Urea Dust		
Rated Frequency with ± : 50 ± 5 % Hz			Vapour : Ammonia & Highly Corrosive		
Combined V & F Variation : ± 10 %		**Location**	Indoor : ☒	Outdoor : ☐	
Fault MVA :					
Earthing Mode : Solidly Earthing					
BASIC DATA					
RATING		**TERMINAL CONNECTIONS**			
Rated Capacity :		**PRI.**	Cable / Cond.	Type :	
No Load Voltage Ratio : 415/433 V				No. & Size :	
Highest Voltage for Eqpt. 457 V		**SEC.**	Cable / Cond.	Type :	
Connection	Primary : Delta			No. & Size :	
	Secondary : Star	**Earth Conductor**		Body :	
% Impedance :				Neutral :	
Cooling System :					
PAINTING		**SPARE PARTS**			
Type : Epoxy based		Reqd. : ☒	For a period of 2 Years operation and maintenance		
Shade :					
ADDITIONAL FITTINGS					
Refer Technical Specification					

- 1) All unfilled data shall be filled by the Contractor. Completely filled in Specification Sheet duly stamped & signed by the Contractor shall be submitted after award of order.

SPECIFICATION SHEET
UNINTERRUPTED POWER SUPPLY SYSTEM

PROJECT: Coal Based Fertilizer Plant PLANT: Urea Handling & Bagging Package

ISSUED FOR : PROPOSAL ☐ ENQUIRY ☒ ORDER ☐ FINAL ☐

GENERAL	**AMBIENT CONDITION**	
Ref. Stds. : IS/IEC	Temp.- max/min/design ref. 46 / 1 / 50°C	
Encl. Docs. :	Rel. Humidity: 100% Max.	Alt. above sea < 1000M
Make : As per enclosed Vendor List	**Atmospheric Pollution**	Dusts : Coal Dust & Urea Dust
Maker's type :		Vapour : Ammonia & Highly Corrosive
	Location	A/C Room ☒ Ventilated Room ☐
		Non Ventilated Room ☐

TEST : Routine ☒ Type ☒ Others ☒

SCOPE

SUPPLY		**SERVICES**	
Rectifier cum battery charger :	☒	Erection, Testing & Commissioning :	☒
Inverter :	☒	Supervision of Erection, Testing & Comm. :	☐
D.C. Battery :	☒		
Stabilizer in By Pass Supply :	☒		
UPS Distribution Board :	☒		
Inter Connecting Cable :	☒		
Soft Starters Terminals for Trouble shooting	☒		

BASIC DATA

TAG NO. & QTY.	Item No.		
	Quantity		
	Description		Uninterrupted Power Supply System
	Code No.		
SYSTEM DETAILS	Rated Voltage with variation ± %		AC 415 V ± 10%
	Rated frequency with variation ± %		50 Hz ± 5%
	Combined V & F variation		± 10%
	No. of Phases & wires		3 Ph, 4 Wire
	Earthing Mode		Solid
INVERTER DETAILS	Type		Redundant Type with By=pass
	Load Sharing Mode		
	Rated Capacity		KVA
	Output Voltage		115 V ± 1% / 240 V ± 1%
	Output Frequency		50 Hz
	No. of Phases & Wires		1 Phase, 2 wire
	Service for which required		
	Load Details		
	Load Power Factor Range		0.8
	Earthing Mode		
BATTERY DETAILS	Type		Ni-Cd
	Nominal Voltage		
	No. of Cells		
	Battery Backup of Full rated output		
	Float Charging Current in Amp.		
	Float Charging Voltage		
	Boost Charging Current Starting/Finishing		
	Charging Final Voltage		
	Discharge Final Voltage		
	Internal Resistance per Cell (micro-ohm)		
CABLING DATA	**Mains**	Type	XLPE-A-PVC (FRLS)
		No. & Size	
	Battery	Type	
		No. & Size	
	Load	Type	XLPE-A-PVC (FRLS)
		No. & Size	
	Remote Control	Type	
		No. & Size	
MISC. DATA	Painting Type		
	Period for which Spares required.		2 Year Operation & Maintenance Spares

- 1) All unfilled data shall be filled by the Contractor. Completely filled in Specification Sheet duly stamped & signed by the Contractor shall be submitted after award of order.

SPECIFICATION SHEET
415 V BUSDUCT

PROJECT: Coal Based Fertilizer Plant		PLANT: Urea Handling & Bagging Package	
ISSUED FOR : PROPOSAL ☐	ENQUIRY ☒	ORDER ☐	FINAL ☐
GENERAL			
Ref. Stds. : IS/IEC			
Encl. Docs. :			
Make : As per enclosed Vendor list			
Maker's Type :			
AMBIENT CONDITION			
Temp.- Max./Min./Design Ref. : 46 / 1 / 50°C			
Relative Humidity 100% Max.		Alt. above sea : < 1000 M	
Atmospheric Pollution		Dusts : Coal Dust & Urea Dust	
		Vapour : Ammonia & Highly Corrosive	
Location		Indoor ☒	Outdoor ☒
TESTS : Routine ☒	Temp. Rise ☒	Others ☒	
BASIC DATA			
TAG NO. & QTY.	Item No. :		
	Description :	Bus Duct	
	Code No.		
SYSTEM DETAILS	Rated Voltage with Variation :	415 V (± 10%)	
	Rated Frequency with Variation :	50 Hz ± 5%	
	Highest System Voltage :	/ 457 V	
	Combined V & F Variation :	± 10 %	
	No. of Phases & Wires :	3 Ph, 3 W & 3 Ph, 4 W	
	Fault Level : ----/----/----	36 (MVA)	
	Earthing Mode :	Solidly Grounded	
CURRENT RATING	Continuous :		
	Short Time Current / Time :		
PAINTING	Type :	Epoxy based	
	Shade :	Shade 631 of IS: 5	
Spares Parts Reqd. for a Period of :		2 Years operation and maintenance	
Fire rating			
Seismic Compliance			

- 1) All unfilled data shall be filled by the Contractor. Completely filled in Specification Sheet duly stamped & signed by the Contractor shall be submitted after award of order.

TECHNICAL PARTICULARS
415 V BUSDUCT

PROJECT: Coal Based Fertilizer Plant			PLANT: Urea Handling & Bagging Package
ISSUED FOR : PROPOSAL ☐	ENQUIRY ☒	ORDER ☐	FINAL ☐
GENERAL			
Item No. :			
Description :			
Code No.			
Ref. Stds. :			
Make :			
Maker's Type :			
TECHNICAL DATA			
BUS - BARS	Material & Grade **:**		
	Size	Phase	
		Neutral	
ENCLOSURES	Material :		
	Thickness :		
	Cross - Sectional area :		
MIN. CLEARA-NCE BETWEEN	Live Parts :		
	Live Parts & Accidentally Dangerous Parts :		
Min. Creepage Distance :			
TEMP. RISE OVER AMBIENT	Bus Bar :		
	Enclosure :		
BUS - BAR SUPPORTS	Material & Grade :		
	Interval :		
Resistance of Bus - Bar per M :			
Reactance of Bus - Bar per M :			
EARTHING	No. of Conductors :		
	Material & Size :		
No. of Inspection Windows :			
No. of Ventilating Louvers :			
No. of Expansion Joints :			
Phase Cross - Over Provided :			
FIRE RESISTANCE BARRIERS PROVIDED AT	Transformer End :		
	Switch Gear End :		
Drain Plug Provided :			

- Completely filled in Technical Particulars Sheet shall be furnished after award of order for owner/consultant approval before commencement of manufacturing in line with NIT/PO.

SPECIFICATION SHEET
ELECTRICAL EQUIPMENT FOR CRANES & HOISTS

PROJECT: Coal Based Fertilizer Plant — PLANT: Urea Handling & Bagging Package

ISSUED FOR : PROPOSAL ☐ ENQUIRY ☒ ORDER ☐ FINAL ☐

GENERAL

Item No. :	Ref. Stds. : IS/IEC
Quantity :	Encl. Docs.
Description :	Make : As per vendor list enclosed
Code No. :	Maker's Type. :

TESTS: Routine ☒ Type ☒ Others ☒

SERVICE CONDITIONS

SYSTEM DETAILS	AMBIENT CONDITION		
Rated Voltage with + % : 415 V ± 10 %	Temp: - 46 / 1 / 50°C		
No. of phases : 3 Ph, 4 Wire	Relative Humidity: 100% Max.	Alt. above sea : <1000 M	
Rated Frequency With + % : 50 Hz ± 5 %	**ATMOSPHERIC POLLUTION**	Dusts : Coal Dust & Urea Dust	
Combined V & F variation : ± 10 %		Vapour : Ammonia & Highly Corrosive	
Fault Level :	**AREA ***	Safe ☐	Hazardous ☐
Earthing Mode : Solidly Earthed	**HAZ. AREA CLASS. ***	Zone :	Encl. Gr. :
Control Supply Voltage : 240 V AC, 1 Ph.		Temp. Cl.	
Lighting & Fan Supply Voltage : 415 V (3 Ph)/ 240 V (1Ph) AC	**Location :**	Indoor ☐	Outdoor ☐
Hand Lamp Supply Voltage:- 24 V AC			

MISCELLANEOUS DATA

POWER FEED METHOD		PAINTING
Flexible Cable :		Type :
Overhead Bar Conductor :		Shade : of IS : 5
Incoming Cable	Type :	
	size :	**SPARE PARTS**
		Required ☒ For Period of 2Years operation & maintenance

CONTROLS	
Pendant Control Station :	
Operator's Cabin :	

MAKE OF EQUIPMENT AND COMPONENTS

Motors :	
Switch :	
Contactor :	
Fuse :	
Push Button :	
Limit Switch :	
Brake :	
Cable :	
Control Transformer :	
Lighting fixture :	
Junction Box :	
Terminal Block :	
Control Panel :	

TECHNICAL PARTICULARS
ELECTRICAL EQUIPMENT FOR CRANES & HOISTS

PROJECT: Coal Based Fertilizer Plant PLANT: Urea Handling & Bagging Package

ISSUED FOR : PROPOSAL ☐ ENQUIRY ☒ ORDER ☐ FINAL ☐

POWER CONTROL PANEL

GENERAL	Make & Maker's Type		
	Ref. Standard		
	Service		
	Degree Of Protection		
	Matl. Of Construction & Thickness		
	Gasket Material		
	External Hardwares		
	Clearance Available on all sides		
BUS BAR	Material Of Construction		
	Size & Rating		
	Minimum Clearances / Creepage Distance		
	Insulation & Temp. Rise		
	Support Details		
SWITCHES	Make & Maker's Type		
	Ref. Standard		
	Duty Category		
	Rated Voltage & Current		
	Making / Breaking Speed		
	Making / Breaking Capacity		
FUSES	Make & Maker's Type		
	Ref. Standard		
	Duty Category		
	Rated Voltage		
	Rated Current		
	Prospective Current		
	Fuse Puller : Included		
	Distance of Gland Plate from Bottom		
CONTACTORS	Make & Maker's Type		
	Ref. Standard		
	Utilization Category		
	Rated Voltage & Thermal Current		
	Making / Breaking Capacity		
	Coil Voltage		
PUSH BUTTON	Make & Maker's Type		
	Ref. Standard		
	Rated Voltage & Current		
	No. of Aux. Contacts	NO	
		NC	
CONTROL TRANSFOR-MER	Make & Maker's Type		
	Ref. Standard		
	Rating		
	Class Of Insulation		
SIGNAL LAMPS	Make & Maker's Type		
	Ref. Standard		
	Rated Voltage / Wattage		
	Type Of Lamp & Lamp Holder		
LIMIT SWITCH	Make & Maker's Type		
	Ref. Standard		
	Duty Category		

MOTORS					
Description					
Code No.					
Make					
Maker's Type					
Rating					
Rated Output					
Synchronous Speed					
Duty					
Rotot Type					
Starting Method					
Max I Start / I Rated					
Min. V Start at Terms					
Min. M Start at VR					
EXECUTION	Degree of Protection	**IP**	**IP**	**IP**	**IP**
	Addl. Degree of Protection				
	Insulation				
	Cooling Method	**IC**	**IC**	**IC**	**IC**
	Stator Connection				
ELECTRICAL DATA	No. of Starts / Stop per Hour				
	Torque-Starting / Pull Up / Pull Out				
	Safe Stall Time at V_R / 1.1 V_R				
	Stator Time Constant				
	Max. Temp. Rise				
	Current at FL / 0.85 FL				
	Push Pull with Stand Capacity				
	Max. V Deep for 1 Sec. / 10 Sec.				
	Space Heater Rating				
ACCESSORIES	Lifting Eye Bolt				
	Earthing Terminals On Body				
	Earthing Terminals In T.B.				
	Name Plate				
	Addl. Name Plate				
CABLING DATA	Power Cable				
	Heater Cable				
	Cable Gland Type				
	Cable Gland Material				
MECHANICAL DATA	Frame Size / Weight				
	Ref. Dimensional Drg.				
	Material of Insulation				
	Size of Wdg. Wire				
	Type & Material of Fan				
	Lubrication Specification				
	Interval of Lubrication				
	Bearing Type with No. DE / NDE				

SPECIFICATION SHEET
HT CABLES

PROJECT: Coal Based Fertilizer Plant			PLANT: Urea Handling & Bagging Package	
ISSUED FOR : PROPOSAL ☐	ENQUIRY ☒	ORDER ☐	FINAL ☐	
GENERAL			**AMBIENT CONDITION**	
Encl. Docs. :			Temp. Max./Min./Design Ref. 46 / 1 / 50°C	
Vendor :			Relative Humidity: 100 %	Alt. above Sea Level < 1000M
Vendor Ref. No. :			**Atmospheric Pollution**	Dusts : Coal Dust & Urea Dust
				Vapour : Ammonia & Highly Corrosive
TESTS TO BE WITNESSED: Routine ☒	Type ☐	Acceptance ☒	Others ☐	
Type Tests Certificate of Similar Cable : Required ☒		Not required ☐		

BASIC DATA				
Item No.		1	2	
Ref. Stds.		IS:7098 (PART-2)	IS:7098 (PART-2)	
Voltage Grade		11 KV POWER CABLE	11 KV EARTHING CABLE	
System Earthing		UE	E	
Type of Cable		POWER	EARTHING	
CONDUCTOR	ALUMINIUM/ COPPER	ALUMINIUM		
	STRANDED	STRANDED		
Insulation Type		XLPE EXTRUDED	XLPE EXTRUDED	
Inner Sheath Type		EXTRUDED PVC (ST2)	--	
CONDUCTOR SCREEN	Required	--		
	Not Required	--		
Material of Conductor Screen		AS PER IS		
ARMOURING	Required	YES		
	Material	GALVANISED STEEL STRIP / WIRE		
	No. of Layer			
Outer Sheath Type		EXTRUDED FRLS PVC TYPE-ST2	EXTRUDED FRLS PVC TYPE-ST2	
Special Requirements		INSULATION SCREEN REQUIRED	--	
Drum Material		STEEL	WOOD	

- 1) All unfilled data shall be filled by the Contractor. Completely filled in Specification Sheet duly stamped & signed by the Contractor shall be submitted after award of order.

SPECIFICATION SHEET
LT POWER & CONTROL CABLES

PROJECT: Coal Based Fertilizer Plant			PLANT: Urea Handling & Bagging Package	
ISSUED FOR : PROPOSAL ☐	ENQUIRY ☒	ORDER ☐	FINAL ☐	
GENERAL			**AMBIENT CONDITION**	
Encl. Docs. :			Temp. Max./Min./Design Ref.: 46 / 1 / 50°C	
Vendor :			Relative Humidity: 100 %	Alt. above Sea Level < 1000M
Vendor Ref. No. :			**Atmospheric Pollution**	Dusts : Coal Dust & Urea Dust
				Vapour : Ammonia & Highly Corrosive
TESTS TO BE WITNESSED: Routine ☒	Type ☐	Acceptance ☒	Others ☐	
Type Tests Certificate of Similar Cable : Required ☒	Not required ☐			

BASIC DATA

Item No.				
Ref. Stds.		IS:7098 (PART-1)	IS:7098 (PART-1)	IS:7098 (PART-1)
Voltage Grade		1.1 KV POWER CABLE	1.1 KV CONTROL CABLE	1.1 KV EARTHING CABLE
System Earthing		NEUTRAL SOLIDLY EARTHED	NEUTRAL SOLIDLY EARTHED	NEUTRAL SOLIDLY EARTHED
Type of Cable		POWER	CONTROL	EARTHING
CONDUCTOR	ALUMINIUM/ COPPER	ALUMINIUM / COPPER	COPPER	ALUMINIUM
	STRANDED	STRANDED	STRANDED	STRANDED
Insulation Type		XLPE EXTRUDED	XLPE EXTRUDED	XLPE EXTRUDED
Inner Sheath Type		EXTRUDED PVC (ST2)	EXTRUDED PVC (ST2)	--
CONDUCTOR SCREEN	Required	--	--	
	Not Required	--		
Material of Conductor Screen		--	--	
ARMOURING	Required	YES	YES	--
	Material	GALVANISED STEEL STRIP / WIRE	GALVANISED STEEL WIRE	--
	No. of Layer	SINGLE	SINGLE	--
Outer Sheath Type		EXTRUDED FRLS PVC TYPE-ST2	EXTRUDED FRLS PVC TYPE-ST2	EXTRUDED FRLS PVC TYPE-ST2
Special Requirements		--	--	--
Drum Material		WOOD	WOOD	WOOD

TECHNICAL PARTICULARS
CABLES

PROJECT: Coal Based Fertilizer Plant		PLANT: Urea Handling & Bagging Package
ISSUED FOR : PROPOSAL ☐ ENQUIRY ☒ ORDER ☐ FINAL ☐		
GENERAL		
Make		
Ref. Standard		
Item No.		
Voltage Grade		
Suitable For Earthed / Unearthed System		
No. of Cores & Size of Conductor		
CONSTRUCTIONAL DETAILS		
CONDUCTOR	Material	
	Construction	
	No. & Dia of wires per Core	
CONDUCTOR SCREEN	Material	
	Thickness	
INSULATION	Material	
	Thickness	
	Core Identification Method	
INSULATION SCREEN	Material	
	Thickness	
INNER SHEATH	Type & Material	
	Thickness	
ARMOURING	Type & Material	
	Dia of Wire / Strip Thickness	
OUTER SHEATH	Material	
	Thickness	
ELECTRICAL DATA		
CONTINUOUS CURRENT RATING WHEN LAID IN	Ground At 30^0 C	
	Air At 40^0 C	
Short Circuit Current For 1 sec.		
CONDUCTOR TEMP.	Continuous	
	Short Time	
Resistance At Operating Temp. (Ohm / KM)		
Reactance At 50 C/S (Ohm/KM)		
Capacitance (F/Km)		
Insulation Resistance		
Polarisation Index		
DERATING FACTOR CHART ATTACHED FOR	Temperature	
	Grouping	
	Exposure to Sun	
MECHANICAL DATA		
DIAMETER WITH TOLERANCE	Over Inner Sheath	
	Over Armour	
	Overall	
Weight Of Cables Per KM		
Minimum Bending Radius		
Maximum Pulling Tension		
Standard Drum Length		
Tolerance On Drum Length		

Notes: Completely filled in Technical Particulars Sheet shall be furnished separately for each type & size of cable and shall be submitted after award of order for owner/consultant approval before commencement of manufacturing in line with NIT/PO.

TECHNICAL PARTICULARS
LIGHTING FIXTURES AND ACCESSORIES

PROJECT: Coal Based Fertilizer Plant PLANT: Urea Handling & Bagging Package

ISSUED FOR : PROPOSAL ☐ ENQUIRY ☒ ORDER ☐ FINAL ☐

FIXTURE		
Item No.		
Make		
Type		
Ref. Standard		
Suitable For	Type Of Lamp	
	Wattage Of Lamp	
Suitable For Outdoor Use		
Control Gear Integral / Separate		
Degree of Protection	Fixture	
	Control Gear Box	
Additional Degree of Protection	Fixture	
	Control Gear Box	
Material & Finish	Housing	
	Reflector	
	Control Gear Box	
	Diffuser / Louvre	
	Gasket	
	Ext. Hardwares <8mm/>8mm	
Pre - treatment	Housing	
	Reflector	
	Control Gear Box	
Thickness of material	Housing	
	Reflector	
	Control Gear Box	
Minimum Mounting Height		
Spacing / Height Ratio		
Light Output Ratio - Up / Down		
Surface Temp. Rise Range (For FLP Fxt)		
Cable Gland	Type	
	Material	
	Qty. Fittings / Control Gear Box	
Threaded Plug Provided	Fixture	
	Control Gear Box	
Looping Facility Available	Fixture	
	Control Gear Box	
Mounting Bracket Provided		
Weight Of Fixture		
Catalogue attached indicating	General Arrangement	
	Light Distribution	
	Utilisation Factors	
	I FL / I Starting	
ACCESSORIES		
Ballast	Make & Maker's Type	
	Ref. Standard	
	Rating	
	Winding Wire Material	
	Insulation Class	
	Power Loss in Ballast	
Capacitor	Make & Maker's Type	
	Ref. Standard	
	Rating	
Lamp Holder	Make & Maker's Type	
	Ref. Standard	
	Rating	
Starters	Make & Maker's Type	
	Ref. Standard	

- NOTE: Completely filled in Technical Particulars Sheet shall be furnished after award of order for owner/consultant approval before commencement of manufacturing in line with NIT/PO.

TECHNICAL SPECIFICATION

UNINTERRUPTED POWER SUPPLY

CONTENTS

1.0 SCOPE

1.1 The specification covers the design, manufacture, testing at works and despatch in well packed condition of Uninterrupted Power Supply System required to supply AC power for non linear loads (i.e. instrumentation loads).

1.2 This standard shall be read in conjunction with block diagram & UPS distribution diagram.

1.3 The scope shall include the following:

i) Full wave controlled rectifier

ii) Inverter

iii) Static switches

iv) Storage battery

v) Static voltage stabilizer for bypass supply

vi) Manual bypass switches

vii) Isolation / output transformer to achieve desired output voltage

viii) UPS Distribution Boards

ix) Interconnecting cabling between various units of UPS

x) All other items required, but not specified for safe and reliable operation of UPS system.

2.0 STANDARDS TO BE FOLLOWED

2.1 The equipment shall conform to the latest issue of the following and relevant Indian Standard specifications Equipment complying with equivalent IEC standards shall also be acceptable.

IS-13314	-	Solid state inverters run from storage batteries
IS-11260	-	Stabilized power supplies AC output
IEC-146	-	Solid state inverters

2.2 The equipment shall also conform to the provision of Indian Electricity Rules, Indian Supply Act and any other statutory regulations in force from time to time.

3.0 AMBIENT CONDITIONS & ELECTRICAL SYSTEM CHARACTERISTICS

These shall be as specified in the enclosed Design Philosophy - Electrical.

4.0 DESIGN AND OPERATIONAL REQUIREMENTS

4.1 The UPS unit and its associated equipments shall be suitable for operating at the specified rating continuously with the specified voltage and frequency variations under the ambient conditions without exceeding the temperature rise limits specified in relevant standards and without any detrimental effect on any part.

4.2 The UPS system shall be based on latest generation of IGBT based, pulse width modulated (PWM) design with proven performance. The basic scheme required for UPS system shall be as indicated in Block diagram in this specification.

4.3 The UPS shall have Redundant Scheme with Bypass. Under normal operating conditions, both inverter units should run in parallel sharing 50% load in synchronism with by-pass power and supply uninterrupted A.C. power to load. On failure of one of these inverters, the faulty inverter should get automatically disconnected from the load and healthy inverter should supply 100% load in synchronism with by pass supply. In

the event of second inverter also developing a fault, a no-break load transfer to standby power supply should take place through static switch.

4.4 Output frequency of the inverters must remain synchronised to one another which in turn shall be synchronised to the standby power supply frequency provided the latter does not vary by more than +3% to -5%. It should be possible to change the setting of frequency range of synchronism between above limits by frequency selector switch. Outside these limits inverter should desynchronise with the bypass and run at its own frequency. When running at its own frequency, frequency variation shall be maintained less than ±1.0%. Resynchronisation with bypass power supply must take place automatically with some time delay when frequency comes back to +3% to -5% range. Change-over from inverter to bypass or bypass to inverter shall also be possible in desynchronised mode of operation. Change-over time in both synchronised and desynchronised mode operation shall be indicated.

4.5 The UPS unit shall be suitable for 0.7 lagging to unity power factor. The overall power factor may be taken as 0.8 lagging.

4.6 The maximum waveform distortion of the output voltage shall not exceed 5% r.m.s. for linear loads and 10% r.m.s for non-linear loads. The UPS unit shall be suitable for operation for non-linear loads having crest factor of 3.

4.7 The inverter steady state output voltage and frequency (free running) variation shall not exceed ±1% for specified input power supply condition and no-load to full load condition.

4.8 Voltage dip / rise on sudden application / throw of 100% load or on changeover from inverter to bypass or vice versa shall not exceed 15% and shall be recovered within 100 m. sec. to rated voltage.

4.9 UPS shall be designed for overload of 125% for 10 min. and 150% for 10 sec. after which drooping characteristic shall come into operation.

4.10 On failure of the main supply, inverter unit shall continue to supply rated load from the battery bank for two hours duration.

4.11 Charger shall simultaneously supply entire power necessary for inverter and to keep the battery of required capacity in fully charged condition. Provision for automatic charging in both float and boost shall be made.

4.12 Battery shall be Nickel-Cadmium or Lead Acid Plate tubular positive plate or VRLA type. The battery capacity shall be decided considering load power factor as 0.8, derating factor for ageing 0.8 and derating for minimum ambient temperature as applicable.

4.13 The ventilation fans, if provided shall be fully redundant and connected to the output from the inverter and an audio-visual alarm shall be provided on its failure. It shall be possible to operate inverter for about half an hour even after the failure of the fan without temperature rise inside the inverter cubicle exceeding the safe operating temperature limits.

4.14 In case of inverter failure due to any reason or overload, affected unit shall be isolated and changeover to other inverter or to bypass shall take place automatically.

4.15 Noise level at a distance or 1m from UPS panels shall not exceed 60 dB.

4.16 UPS system shall be provided with necessary control, protection, metering, indication, alarm & annunciation for reliable and safe operation of the system. The suggestive list is indicated in Annexure-II.

4.17 All semi-conducting devices shall be protected by fast acting semi-conducting fuses. These fuses shall be co-ordinated with load side HRC fuses.

4.18 The battery may be taken out of service for maintenance during which period it shall be possible for the inverter to continue operation taking power from the rectifier. The input filter of the inverter shall be suitably designed to take care of this operational requirement.

4.19 It shall be possible to vary the output voltage steplessly within ±5% of the specified output voltage. This adjustment shall be possible to be made when UPS is in operation.

4.20 UPS system shall be suitable for both floating output and earthing of one leg in case of single phase system / star-point in case of three phase system.

4.21 The UPS system shall have very high system of reliability having minimum MTBF of 50,000 hrs. Vendor shall furnish the value of MTBF, MTTR & availability factor.

5.0 CONSTRUCTIONAL DETAILS

5.1 The equipment shall preferably be supplied in enclosed, dust & vermin proof, floor mounted, sheet steel enclosure. In case, it is necessary to provide opening for ventilation, this should be closed by fine mesh. Minimum degree of protection for enclosure shall be IP-43 as per IS/IEC-60947.

5.2 Enclosure shall be fabricated with cold rolled sheet annealed steel of minimum thickness 2.0 mm.

5.3 The door hinges shall be concealed type. The doors and the removable covers shall be provided with non-deteriorating neoprene gaskets without any discontinuities. Gaskets shall be held in position in groove in shaped sheet steel work or these shall be of U type.

5.4 All external hardware shall be cadmium plated steel. Hardware for fixing the removable parts shall be provided with retaining devices.

5.5 Panels shall be liberally designed. All components shall be so mounted that they are easily accessible for inspection and maintenance.

5.6 UPS unit shall preferably have separate panels for each rectifier inverter units, bypass supply, distribution boards etc. Various panels of UPS except distribution boards shall be mounted side-by-side & bolted together to form compact assembly.

5.7 Distribution boards shall be of fixed type single front execution in fully compartmentalised design and divided into distinct panels each comprising of bus-bar chambers, individual feeder modules and vertical cable alley.

5.8 Mounting height of components requiring operation and observations shall not be lower than 300 mm and higher than 1800 mm.

5.9 All the live parts which are accessible after opening the front cover / back cover shall be properly insulated or provided with insulating barrier to prevent accidental contact. Bus bars of distribution boards shall be PVC sleeved.

5.10 Nameplate consisting of black Perspex with white engraving shall be provided for each panel and for each equipment mounted on the front of the panel. Suitable label identification for each component mounted inside the panel shall also be provided.

5.11 All the wirings shall be properly laid and ferruled at both ends. PVC channels may be used for wiring. For control wiring, minimum 1.5 sq. mm copper conductor shall be used.

5.12 The power connections shall be made by PVC insulated flexible copper cables or taped copper / aluminium strip.

5.13 All power & control cables shall enter from the bottom.

5.14 Removable bolted aluminium gland plate, heavy duty compression type rolled aluminium cable glands, crimping type aluminium cable lugs for Al. cables and copper cable lugs for Cu. cables, pressure clamp / bolted type terminals etc. shall be provided for each incoming and outgoing cable.

5.15 Terminal blocks shall be grouped according to circuit functions and suitably numbered. 20% extra terminals shall be provided in the terminal block.

5.16 A suitably sized earth bus shall be provided at the bottom of panel with provision for earth connection at both ends to purchaser's earth grid.

5.17 All panels shall be of same height so as to form a bank which shall give good aesthetic appearance.

6.0 COMPONENT DETAILS

6.1 All components shall conform to relevant IS / IEC standards and shall be of reputed make. Makes of all components shall be subject to owner's / consultant's approval.

6.2 **Thyristors, diodes and transistors**
The thyristors, diodes and transistors shall have adequate safety margins to withstand specified operating conditions. A factor of safety of minimum 4 shall be taken against voltage surges.

6.3 **PCBs**
All electronic control & monitoring printed circuit cards shall preferably be modular plug in type. Monitoring points shall be provided in each of the PCB, PCBs shall be firmly clamped in position so that vibration or long usage does not result in loose contacts. Failure of each PCB shall be indicated by visual alarm and indication. The visual fault diagnostic shall preferably indicate fault into various sections of the card.

6.4 **Transformers and Chokes**
All transformers and chokes shall be of dry type and air cooled. This shall be class 'H' insulated, vacuum impregnated. Class B insulated cast resin transformers and chokes shall be also acceptable.

6.5 **Electrolytic Capacitors**
These shall be polarised aluminium type I, suitable for long life and category I, as per IS-4317 or equivalent IEC. The capacitor shall preferably be self healing type. These shall be so located in inverter panels that the operating temperature does not exceed 65ºC maximum.

6.6 **Instruments**
Ammeters & voltmeters shall be moving coil type of class 1.5 accuracy as per IS-1248. These shall be flush mounting type of minimum size of 96 mm x 96 mm and shall have taut band scale of 240º. Frequency meter shall be of reed type having range of 45 Hz to 55 Hz.

6.7 **Static Switches**
Static switches shall be naturally commutated type with parallel inverse connected thyristors. These shall be rated for continuous duty for 100% load. Short time rated static switches are not acceptable.

6.8 **Voltage Stabilizer**
Voltage stabilizer shall be static type and shall satisfy the following requirements:

i) Maximum output voltage variation under steady state condition shall be ±3%.

ii) Maximum harmonic distortion shall be less than 5%.

iii) The output voltage shall be restored within ±2% of nominal value in less than 2 secs.

6.9 **Battery**
Battery along with accessories shall conform to Engineering Standard ES-0814.

6.10 **Indication Lamps**
All indication lamps shall be of LED type suitable for the specified control voltage, having minimum illumination of 40 milli candela. The colour of the LEDs shall be as follows:

ON	:	Red
OFF	:	Green
FAULT	:	Yellow

6.11 **Moulded Case Circuit Breakers**
For isolating devices of various equipment, moulded case circuit breakers shall be used. These shall be provided with overload and short circuit protective devices and shall conform to IS 2516.

7.0 OPTIONAL ITEMS
These shall supplied as per requireemnt.

7.1.1 **Monitoring System**Microprocessor based monitoring system for UPS to supervise the UPS operation and to print out the following data at a preset time automatically by using its own printer shall be provided.

i) Output voltage of UPS (Common)

ii) Output current of UPS (Common)

iii) Input DC voltage of each inverter

iv) Input voltage of each rectifier (Ph to Ph)

v) Input current of each rectifier

vi) Output current of each inverter

vii) Output voltage of each inverter

viii) Room temperature

ix) Input frequency of each inverter

x) Output frequency of each inverter

7.1.2 In addition to print out once in a preset time, above data shall also be automatically printed for the following conditions:

i) Power source change over from mains to battery and vice-versa.

ii) Change over of load from UPS to bypass supply and vice versa.

iii) On failure of UPS

iv) On failure of either inverter

v) Also facility for on demand print out of above data shall be provided.

7.1.3 On failure of UPS, the printer shall print out the waveform of the following:

i) Output voltage of UPS

ii) Output current of UPS

iii) Output voltage of each UPS

iv) Output current of each UPS

7.2 **Insulation monitoring & automatic earth fault finding system**

Insulation monitoring and automatic earth fault finding system shall be provided to detect earth fault in unearthed system. The system shall preferably be of the type which injects a low frequency alternating voltage between the earth and the network which is used for determining the insulation resistance and to detect and locate earth faults. There shall be fixed detectors located in incoming feeders of main distribution boards and portable detector for location of fault within a feeder. The fixed detector shall be connected to a central unit which can display a faulty feeder.

7.3 Potential free contact shall be brought to outgoing terminal for remote monitoring system for the following:

i) UPS-1 fault

ii) UPS-2 fault

iii) Load on inverter

iv) Load on bypass

8.0 PAINTING

8.1 The enclosure after suitable pre-treatment shall be painted with two coats of anti-rust paint followed by two coats of anticorrosive paint.

8.2 All paints shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off, crinkle or be removed by abrasion due to normal handling.

8.3 Unless otherwise specified, the finishing shade shall be light grey shade no.631 as per IS: 5.

8.4 Electrostatic powder paint shall be preferred.

9.0 TESTS AND INSPECTION

9.1 The UPS units shall be subjected to tests as per relevant standards. The tests shall include, but not limited to the following:-

i) Rectifier & inverter soft starting

ii) Regulation test

iii) Heat run test for 8 hours

iv) Overload test

v) Test for changeover time in synchronised and desynchronised mode.

vi) Test for dynamic response and transient performance

vii) Sequence & transfer test

viii) Noise level measurement

ix) Test to check the selectivity of protective devices

x) Alarm test (simulation of various fault conditions)

xi) Measurement of harmonic distortion

xii) Ventilation test (operation without fan)

xiii) Insulation test

xiv) Current division in parallel UPS

9.2 All the above tests shall be carried out in presence of purchaser's representative. In addition, the equipment shall be subjected to stage inspection during process of manufacture at works and site inspection.

9.3 These inspections, shall, however, not absolve the vendor from his responsibility for making good any defects which may be noticed subsequently.

10.0 DRAWINGS AND DOCUMENTS

10.1 Drawings and documents as per Annexure-I shall be supplied, unless otherwise specified.

10.2 All drawings and documents shall have the following description written boldly.

- Name of client
- Name of consultant
- Enquiry / order number with plant / project name
- Equipment Code no. & Description

11.0 SPARES

11.1 Commissioning Spares: Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for approval.

11.2 Spares for 2 Years operation (Mandatory), as specified shall be supplied.

11.3 Recommend 2 years Operational Spares (other than mandatory spare) alongwith recommended quantity & item-wise unit price shall be furnished.

11.4 All spare parts shall be identical to the parts used in the equipment

12.0 PACKING

12.1 The board shall be properly packed before despatch to avoid damage during transport, storage and handling.

12.2 The packing box shall contain a copy of the installation, operation and maintenance manual.

12.3 A sign to indicate the upright position of the panels to be placed during transport and storage shall be clearly marked. Also proper arrangement shall be provided to handle the equipment.

13.0 DEVIATIONS

13.1 Deviations, if any, from this standard shall be clearly indicated in the offer with reasoning.

ANNEXURE - I

DOCUMENTATION FOR UNINTERRUPTED POWER SUPPLY

Sl. No.	Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification sheet	N	Y	Y
2.	Technical Particulars	N	Y	Y
3.	Block Diagram	N	Y	Y
4.	General Arrangement drawings and foundation plan	N	Y	Y
5.	Calculation for battery sizing	N	N	N
6.	Feeder Details for Distribution Boards	N	Y	Y
7.	Descriptive literature and catalogues	N	N	Y
8.	Bill of materials	N	Y	Y
9.	Schematic & Wiring Diagram	N	Y	Y
10.	Installation, operation & maintenance manual	N	N	Y
11.	Spare parts list with identification	N	N	Y
12.	Test Certificates	N	N	Y
13.	Guarantee certificates	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N – No

ANNEXURE – II

METERING INDICATIONS AND ALARM SCHEDULE

A. METERING

1. Incoming Voltmeter with selector switches for each incomer
2. Ammeter with selector switches for each incomer
3. Ammeter & Voltmeter at each inverter output and bypass output.
4. Frequency meter & power factor meter at one common point of output
5. Ammeter & Voltmeter at incoming of each UPS distribution boards
6. Ammeter at each rectifier output
7. Battery charge / discharge meter

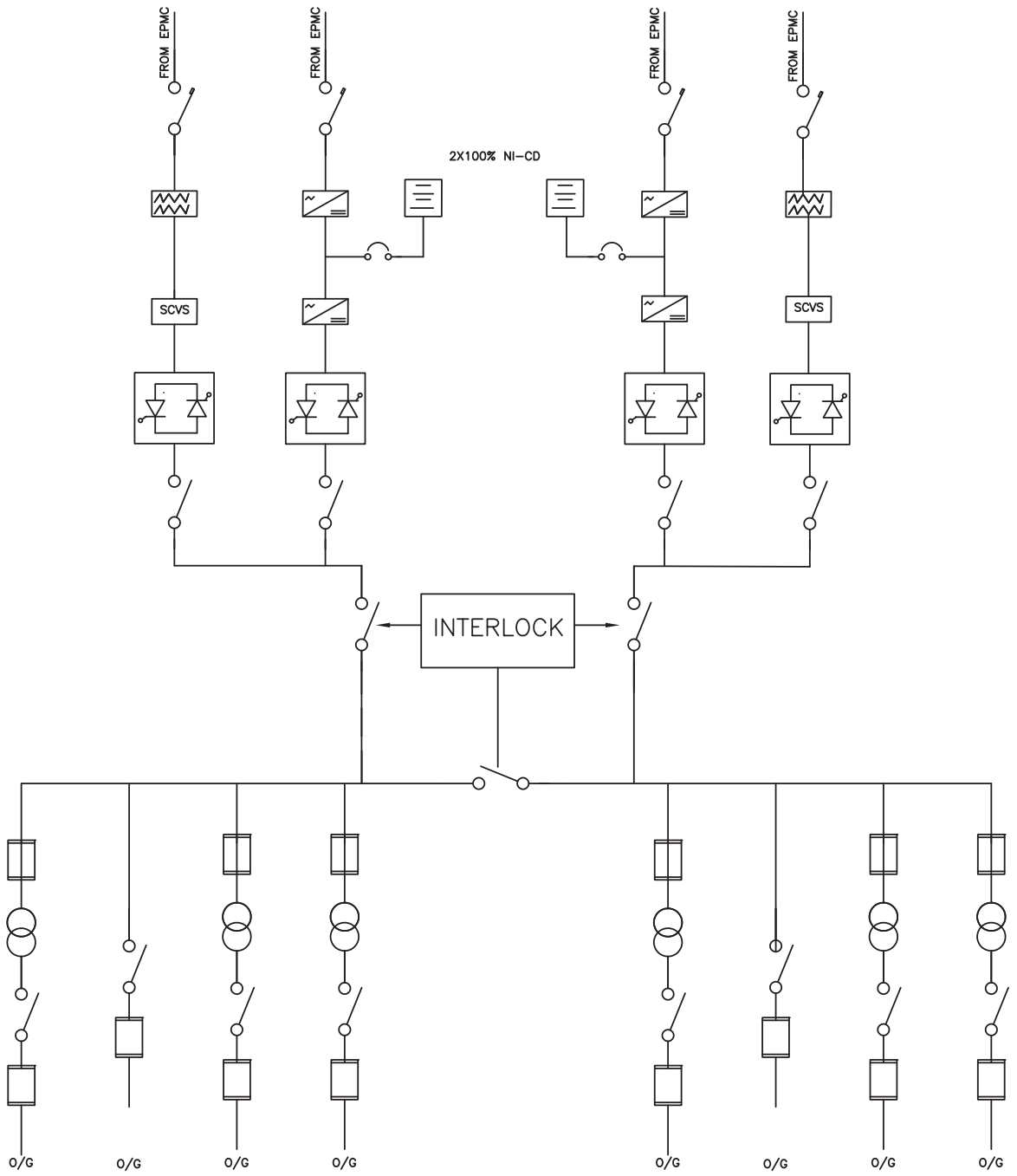
B. LED INDICATION

1. A.C. Mains ‘ON’
2. Rectifier output ‘ON’
3. Load on inverter
4. Load on bypass
5. Inverter synchronised to mains
6. Battery on float
7. Battery on boost
8. Fault (one lamp for all types of fault)

C. AUDIO-VISUAL ALARM (with Accept, Reset & Test facilities)

1. Mains failure
2. Rectifier failure
3. Inverter output over voltage
4. Inverter output under voltage
5. Inverter fuse failure
6. Rectifier fuse failure
7. Fan failure
8. Inverter temperature high
9. Static switch failure
10. Bypass input failure
11. Inverter desynchronised

पी डी आई एल PDIL	BLOCK DIAGRAM FOR PARALLEL RUNNING REDUNDANT UPS SYSTEM	PDS:E 802	0
		DOCUMENT NO.	REV
		SHEET 1 OF 1	



TYPICAL ACDB ARRANGEMENT
UPS SYSTEM

1ACDB SHALL HAVE TWO NO. INCOMER AND ONE NO. BUS COUPLER
2BATTERY CHARGER AND BATTERY FOR UPS SHALL BE AS PER JOB SPECIFICATION.

REV	REV.DATE	EFF.DATE	PURPOSE	PREPD	REVWD	APPD
0	09.06.21	09.06.21	FOR ENQUIRY	AK	RK	SKB

TECHNICAL SPECIFICATION

POWER TRANSFORMERS

CONTENTS

1.0 SCOPE

1.1 This standard covers the technical requirements of design, manufacture, testing at works and despatch in well-packed condition of Power Transformers.

1.2 This standard shall be applicable for 3 phase, core type, separate winding power transformers of rating 315 KVA and above.

1.3 This standard shall be read in conjunction with the relevant part of Design Philosophy – Electrical.

2.0 STANDARDS TO BE FOLLOWED

2.1 The design, manufacture and testing of the equipment covered by this standard shall comply with the latest issue of IS 2026, unless otherwise specified. Equipment complying with equivalent IEC standards shall also be acceptable.

2.2 The design and operational features of the equipment offered shall comply with the provisions of the latest issue of the Indian Electricity Rules and other relevant Statutory Acts and Regulations. The supplier shall, wherever necessary, make suitable modifications in the equipment to comply with the above.

2.3 Wherever any requirement, laid down in this standard, differs from that in Indian Standard Specifications, the requirement specified herein shall prevail.

3.0 SERVICE CONDITIONS

3.1 **Ambient Conditions**

These shall be as indicated in Design Philosophy – Electrical.

3.2 **System Details**

These shall be as indicated in Design Philosophy – Electrical.

4.0 OPERATING REQUIREMENTS

4.1 The transformer shall be suitable for operating at the rated capacity continuously at any of the taps, under the ambient conditions and with the voltage and frequency variations without exceeding the permissible temperature rise and without any detrimental effect on any part.

4.2 The transformer shall also be capable of delivering rated current at a voltage equal to 105 % of the rated voltage.

4.3 The maximum flux density in any part of the core and yoke at the rated MVA, voltage and frequency shall be such that under 10 per cent continuous over voltage condition it does not exceed 1.9 Tesla at any tap position.

4.4 The transformer shall be capable of allowing at least three consecutive starts of the largest Squirrel Cage Induction Motor, while delivering 85% of its rated power without any harmful effect on its insulation. It shall be possible to repeat the starting cycle once in eight hours.

4.5 The transformer shall be designed to be loaded as per IS 6600.

4.6 The transformer shall be so designed as to operate in parallel satisfactorily with similar transformers.

5.0 GENERAL DESIGN FEATURES

5.1 Transformers shall be built under strict quality assurance procedures to comply with IEC 60076 and or IEC 60726 and shall have a guaranteed life time of 30 years.

5.2 Transformers shall be suitable for continuous operation at full load for at least 30,000 hours without maintenance requiring the transformer to be de-energized

5.3 The design of the transformers shall be in accordance with the latest practice.

5.4 **Rated Voltage, Frequency and Phase Connection**
These shall be as indicated in Design Philosophy – Electrical.

5.5 The transformer shall be so designed that it is capable of operation at 125% rated voltage for a period of one minute and 140% rated voltage for a period of five seconds due to sudden load throw off.

5.6 Transformer shall be capable of withstanding thermal and mechanical stresses caused by symmetrical or asymmetrical faults on any winding.

5.7 Transformers shall withstand, without injurious heating, combined voltage and frequency fluctuations which produce the following over fluxing conditions:

110% for continuous operation

125% for 1 - minute

140% for 5 – seconds

5.8 **Tap Changing Gear**

5.8.1 Each transformer shall be provided with on-load/ off-circuit tap changing equipment on the high voltage winding with taps. It shall be mounted on one side, in an easily accessible position.

5.8.2 The range of tap changer shall be as indicated and arranged in steps of 2.5%.

5.8.3 The off-circuit tap changing shall be affected by an externally operated handle capable of being padlocked in any position and provided with tap position indicator and mechanical stops at the extreme positions.

5.8.4 For transformer specified with on-load tap changer, tap changing gear shall be complete with tap position indicator, limit switch, lock and key and necessary control panel. Provision shall be made for auto-manual operation. The manual operation shall be possible both from the panel as well as from field. In case the tap changer is located in a separate housing, the housing shall be connected with the conservator for oil connection. A separate buchholz relay shall be provided in such a case. Emergency mechanical manual device shall also be provided. A minimum of 2 lakh trouble-free operations shall be guaranteed.

5.9 **On-Load Tap-Changing Mechanism (O.L.T.C.)**

5.9.1 For transformer specified with on-load tap changer, high speed tap changing gear shall be complete with tap position indicator, limit switch, lock and key and necessary control panel. Provision shall be made for auto-manual operation. In case the tap changer is located in a separate housing, the housing shall be connected with the conservator for oil connection. A separate buchholz relay shall be provided in such a case. Emergency mechanical manual device shall also be provided. A minimum of 2 lakh trouble-free operations shall be guaranteed. The OLTC gear shall have diverter resistance and the current diverting contacts shall be housed in a separate oil chamber segregated from the main tank of the transformer.

5.9.2 Transformer shall be provided with an on-load tap changing mechanism, as required. This shall be designed suitable for remote control operation from switch boards in the control room in addition to being capable of local manual as well as local electrical operation.

5.9.3 It shall not be possible to use the electric drive when manual gear is in use and it shall be possible to use only one electrical control at a time. Operation of the local or remote control switches shall cause one tap movement only until the control switch is returned to the off position for the next operation.

5.9.4 The local electrical control switches shall be mounted in the outdoor cubicle.

5.9.5 The equipment shall be so arranged as to ensure that when a tap change operation has been commenced it shall be completed independently of the operation of the control relays and switches. If a failure of the auxiliary supply during a tap change or any other contingency result in that movement not being completed, adequate means shall be provided to safeguard the transformer and its auxiliary equipment from damage. Supervisory indication shall be provided to indicate “The change incomplete” foul.

5.9.6 Limit switches may be connected in the control circuit of the operation motor provided that a mechanical de-clutching mechanism is incorporated. Otherwise it shall be directly connected to the operating motor circuit and mechanical stop provided.

5.9.7 Thermal devices or other means shall be provided to protect the motor and control circuits. All relays switches, fuses etc. shall be mounted in the marshalling box and shall be clearly marked to indicate their purpose.

5.9.8 The whole of the apparatus shall be of robust design and capable of giving satisfactory service without undue maintenance under the conditions to be met in service, including frequent operation.

5.9.9 A five-digit counter shall be fitted to the tap changing mechanism to indicate the number of operations completed by the equipment.

5.9.10 A permanently legible lubrication chart shall be fitted within the driving mechanism chamber.

5.9.11 The On-Load Tap Changer shall include the following :-

a) An oil immersed tap selector and arcing switch or arc-suppressing tap selector, provided with resistor for reduction of make and break arcing voltage, overload and short circuits.

b) Motor driven mechanism.

c) Control and Protection devices.

d) Local and remote tap-changer position indicator.

e) Manual operating device.

5.9.12 The on-load tap changer shall be designed so that the contacts shall not interrupt arc within the main tank of the transformer. The tap selector and arcing switch or arc suppressing tap selector switch shall be located in one oil filled compartment. The compartment shall be provided with a means of releasing the gas produced by the arcing. It shall be designed so as to prevent the oil in the tap selector compartment from mixing with the oil in the transformer tank.

5.9.13 The oil in those compartments of the main tap-changing apparatus which do not contain contacts used for making or breaking current shall be maintained under conservator head by means of an adequate diameter pipe corresponding dia of OLTC oil surge relays connection from the highest point of the chamber connection corresponding to the dia. of OLTC oil surge relay from the highest point of the chamber to the conservator. This connection shall be controlled by a suitable valve and shall be arranged so that any gas leaving the chamber will pass into the gas and oil actuated relay.

5.9.14 The tap changer shall be capable of permitting parallel operation with other transformers for which necessary wiring and accessories, if any, shall be provided.

5.9.15 The centre of manual operating device shall be located at a height of 1500 mm from rail top so that it can be operated by a person standing at the ground level. The arrangement shall be strong and robust in construction. The transformer shall give full load output on all tap positions.

The mechanism shall be complete with normal accessories including at least the following:-

- A mechanical tap position indicator (Rated tap voltages shall be marked on the diagram plate).
- A mechanical operation counter.
- Mechanical stops to prevent over cranking of the mechanism beyond extreme tap positions.

5.9.16 The control scheme for the tap changer shall be provided for independent control of the tap changers when the transformers are in independent service. In addition, provision shall be made to enable parallel operation control also at time so that the tap changer will be operated simultaneously when one unit is in parallel with another will not become out of step and this will eliminate circulating current.

Additional features like Master / Follower and visual indication during the operation of motor shall also be incorporated.

Control circuit shall incorporate the following:

a) Local/remote manual electrical operation.

b) Device to ensure a positive and full completion of tap change once it is initiated even if there is loss of power.

c) An interlock to cut-off electrical control automatically upon recourse being taken to manual mechanical control in emergency.

d) Electrical interlock to cut-off a counter impulse for a reverse tap change, being initiated during a progressive tap change and until the mechanism comes to rest and resets circuits for a fresh operation.

e) All auxiliaries and devices for electrical control of OLTC gear should be housed in a weather-proof cabinet mounted on the transformer and shall include:

- Local tap position indicator
- 5 digit operation counter
- Cubicle lighting
- Thermostatically controlled space heater.
- Miniature circuit breaker with magnetic and thermal overload devices for controlling the incoming supply to the OLTC motor.
- Padlocking arrangement for the hinged cabinet door.
- Removable plate with cable glands.
- Inside tag with control scheme indelibly marked.

5.9.17 Necessary interlock, blocking independent control when the units are in parallel, shall be provided.

5.9.18 Under abnormal conditions such as may occur if the contactor controlling one tap changer sticks, the arrangement must be such as to switch off supply to the motor so that an out of step condition is limited to one tap difference between the units. Details of out of step protection provided for the taps should be furnished in the bid.

5.9.19 The contactor and associated gear for the tap change driving motors shall be housed in a local kiosk mounted adjacent to the transformer. The motors shall be suitable for operation on 230 V single phase or 3-phase 440 V, 50 cycle external power supply. The kiosk having space heater, shall be dust and vermin proof and suitable protected against corrosion or deterioration due to condensation, fungi etc.

5.9.20 Indoor cubicle (RTCC panel) shall be provided in the control room which shall contain :

a) Indication of the transformer ratio in use on each transformer and the number designating the tap in use by means of digital type indicators.

b) Raise and lower push Button switch and AVR Relay.

c) Independent/Master/Follower selector switch.

d) Remote tap position indicator with indicating lamp.

e) Repeater dial of winding temperature indicator for remote indication with a device for indicating hottest spot winding temperature in addition to a pointer to register the highest temperature reached.

f) An indication lamp showing tap change in progress.

g) Necessary audible and visual alarms.

h) Pressure relief device operation alarm.

i) Out of step relay with two spare contacts (2 NC and 2 NO).

j) The remote indoor cubicle in addition to the above indications shall also have the following trip and non-trip alarm windows facias with 5 spare windows suitable for 110V DC supply.

i. Oil Temperature alarm
ii. Winding Temperature alarm
iii. Winding temperature trip
iv. Buchholz alarm
v. Buchholz trip
vi. Sudden Pressure trip (Main tank)
vii. Surge Relay trip (OLTC Gear)
viii. Tap changer out of step alarm
ix. Low oil level alarm
x. Cooling fans working indication
xi. Oil pumps on and off indication
xii. Failure of group of fans alarm
xiii. Failure of group of oil pumps alarm
xiv. Failure of supply
xv. Oil flow alarm

Each relay for tripping function shall have two normally open and two normally closed contacts for connection.

5.9.21 Remote Electrical Group Control

The OLTC control scheme offered shall have provision of remote electrical group control during the parallel operation of transformer. This is in addition to independent control of OLTC:

i) A four position selector switch having Master, Follower, Independent and Off position shall be provided in the remote OLTC control panel for each transformer.

This shall be wired to enable operator to select operation of OLTC in Master, Follower or Independent mode.

ii) Out of step relays with timer contacts shall also be provided to give alarm and indication in case tap position in all the transformers under group control are not in same position.

iii) **Master Position**

If the selector switch is in Master position, it shall be possible to control the OLTC units in the follower mode by operating the controls of the master unit. Independent operation of the units under Follower mode shall have to be prevented. However the units under independent mode will be controlled independently.

iv) **Follower Position**

If the selector switch is in Follower mode, control of OLTC shall be possible only from panel of the Master unit.

v) **Independent Position**

In this position of Selector Switch, Control of OLTC of individual unit shall only be possible

5.9.22 The OLTC shall be provided on the conservator side of the Power Transformer and not in front of H.V. Bushings.

5.9.23 OLTC shall be suitable for bi-directional power flow.

5.10 **Impedance Voltage**
The impedance voltage of the transformer at 75^{O}C shall be as per relevant IS / IEC. This shall be guaranteed within limits specified in relevant IS / IEC at principal tap position.

5.11 **Losses**
The losses under the full load condition, at the rated voltage and frequency shall be indicated by the vendor at 75^{O}C. These shall be guaranteed within the tolerable limits specified in IS: 2026 at principal tap position. The purchaser has the right to impose penalty charges or reject the transformer in case of any difference in the test and guaranteed values.

For upto 2 MVA transformer losses shall be as per energy efficiency level-3 of latest IS 1180.

5.12 **Temperature Rise**
The temperature rise of the winding, oil and core shall not exceed the values specified in IS: 2026 when the transformer is delivering its rated output continuously under the service conditions.

5.13 **Insulation Level**
All windings up to maximum system voltage of 72 KV shall have uniform insulation to earth. For windings having higher maximum system voltage, graded insulation is acceptable.

5.14 **Terminal Arrangements**
The HV and LV side terminal arrangement shall be provided as required. Disconnecting link chambers shall be provided on the transformer primary side in all cases as well as on secondary side, except where the termination is through bus duct. The disconnecting chambers shall be oil filled, preferably connected with the main tank through an isolating valve and also provided with a drain valve. However for system not exceeding 11 KV, air filled disconnecting chamber may be accepted. Suitable cable end box complete with cable glands and lugs shall be provided for termination of cables. Gland plate for single core cables shall be non-magnetic.

5.15 The transformer shall be able to withstand the electro-dynamic and thermal stresses due to terminal short circuit of the secondary, assuming the primary side fed from an infinite bus. All leads and windings in cores shall be properly supported, clamped and tightened after vacuum drying to ensure the short circuit withstand capacity. The short circuit withstand duration shall be 3 Secs.

5.16 The short circuit test results for similar transformers shall be furnished.

5.17 The transformer shall be so designed as to minimise any undue noise and vibration.

The noise level shall be limited to the value specified by latest NEMA Standard / CBIP.

5.18 Due attention shall be given in the design for the suppression of harmonics.

5.19 **Cooling System**

5.19.1 The cooling system shall be provided as required. In case the transformer is designed for two types of cooling, the output rating for each type shall be indicated in the offer. The minimum acceptable output shall be 70% of rated output when forced type of cooling system is not in operation.

5.19.2 Wherever ONAF Cooling is specified, the cooling fans shall be adequately rated and shall be suitable for auto/manual and local/remote operation. Auto operation shall be through winding temperature indicator contact..

5.19.3 Transformer shall have multiple cooling units with standby cooling units.

5.19.4 Cooling fans for each radiator bank shall be housed in fan box to prevent ingress of rain water. Each fan shall be suitably protected by galvanized wire mesh guard. It shall be possible to remove the cooling fan with motors without disturbing and dismantling the cooler structural frame work.

5.19.5 Where OFAF cooling is applicable, two numbers of centrifugal oil pumps shall be used. Measures shall be taken to prevent mal-operation of Buchholz relay or sudden pressure relay when all oil pumps are simultaneously put into service. The pumps shall be so designed that

on failure of power supply to the pump motor, the pump impeller will not limit the natural circulation of oil.

5.19.6 Cooling fans and oil pump motors shall be of squirrel cage, totally enclosed whether proof type suitable for operation on 400 volts, three phase, 50 Hz power supply. All motors having ball and roller bearings and grease lubricators shall be fitted with hexagonal nipples conforming to relevant Indian Standard.

5.19.7 An oil flow indicator with alarm contacts shall be provided for the confirmation of the oil pump operating in a normal state. An indication shall be provided on the control panel to indicate that the pump is running.

5.19.8 The coolers and theirs accessories shall be hot dip galvanized or corrosive resistant painted.

5.19.9 The supporting arrangement for the cooler units or for radiator banks shall be in such a manner that the stresses if developed, shall not be transferred to the flanges of the butterfly valves.

5.19.10 The shut off valves shall be provided on the tank at each point of connection of cooler units radiators to the transformer tank. Removable blanking plates shall be provided to permit blanking off the oil connection to cooler radiators.

5.19.11 All valves shall be of gun metal or cast steel or may have cast iron bodies with gun metal fittings. They shall be of full way type with internal screw and shall be opened by turning counter clock-wise when facing the hand wheel.

5.19.12 Means shall be provided for pad locking of valves in the open and closed position.

5.19.13 Every valve shall be provided with indicator to show clearly the position of the valve whether open or closed.

5.19.14 All valves shall be provided with flanges having machined faces.

5.19.15 The drilling of valve flanges shall comply with the requirements of IS:3639.

5.20 CONTROL OF COOLER OPERATION

5.20.1 Each motor or group of motors shall be provided with an electrically operated contactor and with control gear of suitable design both for starting and stopping the motor manually and also automatically from the contacts on the winding temperature indicating device as specified. Additional terminal for remote manual electrical control of motors shall be provided. Overload and single phasing protection shall be provided. HRC fuses shall be provided for short circuit protection. This equipment shall be accommodated in the marshalling box. The power supply shall be adequately and properly fused.

5.20.2 Where small motors are connected in groups, the group protection shall be arranged so that it operates satisfactorily in the event of a fault occurring on a single motor.

5.20.3 Where fans and oil pumps are provided, the connection shall be arranged as to allow the motors or groups of motors to be started up and shutdown either collectively or individually.

5.20.4 All motor contactors and their associated apparatus shall be capable of holding in and operating satisfactorily and without over heating for a period of ten minutes if the supply voltage falls for that period, to 75% of normal value and at normal frequency. The motor contactors and associated apparatus shall be capable of normal operation with a supply voltage of 85 % of the normal value and at normal frequency.

5.20.5 All contacts and other parts which may require renewal, adjustment or inspection shall be readily accessible.

5.20.6 The control arrangements are to be so designed as to prevent the simultaneous starting of motors of total rating of more than 20 HP where such an eventually may arise, two step operation shall be preferred.

5.20.7 Alarm indication for failure of group of fans and oil pump shall be provided.

5.20.8 Alarm indication shall be provided to indicate failure of power supply.

5.20.9 Provision in the cooler control circuit may be made such that tripping of transformer breaker on Differential or Sudden Pressure should lead to supply disconnection to motor of the cooler pump.

6.0 CONSTRUCTIONAL FEATURES

6.1 Core

6.1.1 The transformer core shall be of high grade, non-ageing, electrical silicon cold rolled magnetic sheet steel of low hysteresis loss and high permeability. The maximum flux density in any part of the core and yoke at rated voltage and frequency shall not exceed 1.7 Tesla. The core structure shall be securely grounded to prevent electrostatic potential. Lifting eyes and lugs shall be provided on the limbs and coils assembly. Preferably no bolt shall be used in the cores. Clamping shall be done external to the limb. Bolts passing through the yoke, if any, shall be insulated for 2 KV for transformers rated up to 33 KV and 5 KV for higher voltage ratings (rms) for 1 minute.

6.1.2 The temperature of the core shall not exceed that permitted in IS.

6.1.3 The design of the magnetic circuit shall be such as to avoid static discharges, development of short circuit paths within itself or to the earthed clamping structure and production of flux component at right angles to the plane of laminations which may cause local heating. The temperature of any part of the core or its support structure in contact with oil shall not exceed 120 deg C under normal operating condition and 130 deg C under most extreme operating condition. Adequate temperature margin shall be provided to maintain longer life expectancy for this material.

6.1.4 Core and winding shall be capable of withstanding the shock during transport, installation and service. Adequate provision shall be made to prevent movement of core and winding relative to tank during these conditions.

6.1.5 All steel sections used for supporting the core shall be thoroughly sand blasted after cutting, drilling and welding.

6.1.6 Each core lamination shall be insulated with a material that will not deteriorate due to pressure and hot oil.

6.1.7 The supporting frame work of the core shall be so designed as to avoid presence of pockets which would prevent complete emptying of tank through drain valve or cause trapping of air during oil filling.

6.1.8 Adequate lifting lugs will be provided to enable the core and windings to be lifted.

6.1.9 The core shall be earthed to the core clamping structure at one point only, through a removable external link suitably located and protected to facilitate testing after installation of the transformer.

6.1.10 In case core laminations are divided into sections by insulating barriers or cooling ducts parallel to the plane of the lamination, tinned copper bridging strips shall be inserted to maintain electrical continuity between sections.

6.1.11 A drawing furnishing the details of the internal earthing design shall be included in the manual

6.2 Tank

6.2.1 The tank shall be made of good commercial grade low carbon steel plate of adequate thickness capable of withstanding stress not less than 0.40 kg/cm^2, properly welded and gusseted to ensure a rigid construction. It shall also be able to withstand normal transportation shocks without any deformation and shall be capable of withstanding following vacuum.

Highest System Voltage	MVA Rating	Vacuum in mm of Hg
Up to 72 KV	Up to 1.6	250
	Above 1.6 to 20	500
	Above 20	760

Above 72 KV	For all Ratings	760

6.2.2 For outdoor transformer, the top of the tank, the marshalling box and the headers of radiators, shall be of such a construction so as to prevent accumulation of water.

6.2.3 Guides shall be provided to facilitate tanking and untanking of the core with the coil assembly. The details of anchoring of core and coil assembly of the tank shall be furnished.

6.2.4 Radiators, where necessary, shall be provided on the tank to facilitate cooling. These shall be detachable type and shall be provided with isolating valves at ends, drain plug and air release plug. The radiators shall be fabricated out of minimum 1.25 mm thick seamless steel tubing or pressed sheet steel. For sizes up to 500 KVA, cooling tubes shall be acceptable.

6.2.5 Each tank shall be provided with:

a) Lifting lugs suitable for lifting the equipment complete with oil.

b) A minimum of four jacking pads in accessible position to enable the transformer complete with oil to be raised or lowered using hydraulic jacks. Each jacking pad shall be designed to support with an adequate factor of safety for at least half of the total mass of the transformer filled with oil allowing in addition for maximum possible misalignment of the jacking force to the centre of the working surface.

c) Suitable haulage holes shall be provided.

6.2.6 The tank shall be designed in such a way that it can be mounted on the rollers.

6.2.7 The base of each tank shall be so designed that it shall be possible to move the complete transformer unit by skidding in any direction without injury when using plates or rails.

6.2.8 All bolted connections shall be fitted with weather proof, hot oil resistant, resilient gasket in between for complete oil tightness. If gasket is compressible, metallic stops/other suitable means shall be provided to prevent over-compression. All gasketed joints shall be designed, manufactured and assembled to ensure long-term leak and maintenance free operation. Groove provided to accommodate round nitrile rubber cord for rectangular openings shall be milled.

6.2.9 The transformer shall be mounted on rollers, as per manufacturer's standard practice.

6.2.10 The roller mounted transformers are to be provided with flanged bi-directional wheels and axles. This set of wheels and axles shall be suitable for fixing to the under carriage of transformer to facilitate its movement on rail track. Suitable locking arrangement along with foundation bolts shall be provided for the wheels to prevent accidental movement of transformer.

6.2.11 The rail track gauge shall be 1676 mm.

6.2.12 To prevent transformer movement during earthquake, suitable clamping devices shall be provided for fixing the transformer to the foundation.

6.2.13 The tank cover shall be designed to prevent retention of rain water and shall not distort when lifted. The internal surface of the top cover shall be shaped to ensure efficient collection and direction of free gas to the buchholz relay.

6.2.14 At least one adequately sized inspection openings shall be provided in the transformers for easy access to bushings and earth connections. The inspection covers shall not weigh more than 25 kg. Handles shall be provided on the inspection cover to facilitate lifting.

6.2.15 The tank covers shall be fitted with pockets at the position of maximum oil temperature at maximum continuous rating for bulbs of oil and winding temperature indicators. It shall be possible to remove these bulbs without lowering the oil in the tank. The thermometer shall be fitted with a captive screw to prevent the ingress of water.

6.2.16 Bushing turrets, covers of inspection openings, thermometer pockets etc. shall be designed to prevent ingress of water into or leakage of oil from the tank.

6.2.17 All bolted connections shall be fitted with weather proof, hot oil resistant, resilient gasket in between for complete oil tightness. If gasket is compressible, metallic stops/other suitable means shall be provided to prevent over-compression. All gasketed joints shall be designed, manufactured and assembled to ensure long-term leak and maintenance free operation. Groove provided to accommodate round nitrile rubber cord for rectangular openings shall be milled.

6.2.18 The maximum temperature on any metal part shall not exceed 130 deg. Celsius.

6.2.19 Seamless pipe shall be used upto 80mm confirming to IS 1978 & IS 1979, ERW mild steels pipes as per IS 1239 (Part 1) medium shall be used for ≥100mm and IS 3589 for 150mm. Non-magnetic Stainless-steel materials used shall conform to IS 6911 or ISO 683-13 or EN 10088-2 or AISI 304L or ASTM A240 or J4(S20430 Modified).

6.3 **Windings**

6.3.1 Each coil shall be made out of paper insulated electrolytic grade copper conductor. Similar coils shall be interchangeable. Successive coils of a winding shall be connected by accessible joints and shall be brazed and finished smooth to prevent abrasive damage to insulation. There shall be no sharp bends in the connecting leads to prevent corona discharge. Aluminium foil wound transformer will also be acceptable.

6.3.2 Immediately after winding process, it shall be vacuum dried, dimensionally pre-stabilized and oil impregnated before next process.. The insulation resistance and polarization index of the winding measured after impregnation shall be furnished in the test certificate.

6.3.3 The magnitude of impulse surges transferred from HV to the LV winding by inductive and capacitive coupling shall be limited to a value below the rated impulse strength of the LV winding. The impulse voltage test results and surge distribution on windings for similar transformer shall be furnished.

6.3.4 The manufacture shall ensure that windings are made in dust proof, Positive pressure, Desert Climate environment. Movement of windings and active part shall be done on air-castors to prevent shocks and abnormal jerks.

6.3.5 Winding clamping arrangement shall distribute the clamping forces evenly over the ends of the windings. All insulating materials and structures shall be protected from contamination and the effects of humidity during and after fabrication, and after receipt, by storing them in a separate, climate-controlled area.

6.4 **Insulating Oil**

6.4.1 The insulating oil shall be virgin high grade inhibited, conforming to IEC-60296 & all parameters specified below, while tested at supplier's premises. The contractor shall furnish test certificates from the supplier against the acceptance norms as mentioned below, prior to dispatch of oil from refinery to site. Under no circumstances, poor quality oil shall be filled into the transformer and only thereafter be brought up to the specified parameter by circulation within the transformer.

6.4.2 At manufacturer's works the quality of oil used for first filling, testing and impregnation of active parts shall meet at least parameters as mentioned in IEC . The oil test results shall form part of equipment test report.

6.4.3 Prior to filling in main tank at site and shall be tested for

1. Break Down voltage (BDV) : 70kV (min.)
2. Moisture content : 5 ppm (max.)
3. Tan-delta at 90 °C : 0.0025 (max)
4. Interfacial tension : More than 0.004 N/m

6.4.4 Prior to energisation at site oil shall be tested for following properties &acceptance norms as per below generally in line with IEC 60422:

1. Break Down voltage (BDV) : 70 kV (min.)

2. Moisture content : 10 ppm (max.)
3. Tan-delta at 90 °C : 0.01 (max.)
4. Resistivity at 90 °C : 6 X 10 ^12 ohm-cm (min.)
5. Interfacial tension : 0.035 N/m (min.)
6. *Oxidation Stability (Test method as per IEC 61125 method C,Test duration: 500hour for inhibited oil)
   a) Acidity: 0.3 (mg KOH /g) (max.)
   b) Sludge: 0.05 % (max.)
   c) Tan delta at 90 °C: 0.05 (max.)
7. * Total PCB content : Not detectable (2 mg/kg total)

* For Sr. No. 6 & 7 separate oil sample shall be taken and test results shall be submitted within 45 days after commissioning for approval of Consultant.

Oil sample shall be drawn before and after heat run test and shall be tested for dissolved gas analysis. Oil sampling to be done 2 hours prior to commencement of temperature rise test. For ONAN/ONAF cooled transformers, sample shall not be taken earlier than 2 hours after shutdown. The acceptance norms with reference to various gas generation rates shall be as per IEC 61181.

6.5 **Insulation Materials**

6.5.1 Class ‘A’ insulating materials specified in IS 1271 shall be used. Paper insulation shall be new and free from punctures. Wood insulation, where used, shall be well seasoned and treated.

6.5.2 The mineral oil shall comply with IS: 335. 10% extra oil shall be supplied along with the transformer in non-returnable drums.

6.5.3 For the transformers required to be filled up with inert gas for transport purpose, the required amount of oil including 10% extra shall be supplied in non-returnable drums.

6.6 **Bushing**

6.6.1 The bushing insulator shall be rated for the maximum system voltage and shall comply with the requirements laid down in IS. The minimum current rating shall be 400 Amps. in case of overhead line connected transformers, the bushings shall be outdoor type having creepage distances of 31mm/kV and complete with arcing horns. In case of transformers connected with bus duct or cable, the bushings shall be enclosed in the terminal box. In either case, they shall be detachable from outside of the tank. The hardware shall be of tinned copper or nickel plated brass suitable to receive the conductors. Separate neutral bushings shall be provided for earthing the neutral, as required. All bushings shall be marked with the symbols corresponding to the connection diagram indicated in the diagram plate and in accordance with IS.

6.6.2 Bushing rated 52 KV class and above shall be oil impregnated paper condenser bushings.

Bushing rated below 52KV voltage class shall be solid porcelain or oil communicating type.

6.7 **Conservator**

6.7.1 Main conservator shall have air cell type constant oil pressure system to prevent oxidation and contamination of oil due to contact with moisture, and shall be fitted with magnetic oil level gauge with low oil level potential free contacts.

6.7.2 OLTC shall have conventional type conservator with prismatic oil level gauge.

6.7.3 Conservator tank shall have adequate capacity with highest and lowest visible-levels to meet the requirements of expansion of total cold oil volume in the transformer and cooling equipment from minimum ambient temperature to 100degC. The capacity of the conservator tank shall be such that the transformer shall be able to carry the specified overload without overflowing of oil. The Calculation shall be submitted during design review.

6.7.4 The conservator shall be fitted with integral lifting lugs in such a position so that it can be removed for cleaning purposes. Suitable provision shall be kept to replace air cell and cleaning of the conservator wherever applicable.

6.7.5 Conservator shall be positioned so as not to obstruct any electrical connection to transformer. Pipe work shall neither obstruct the removal of tap changers for maintenance or the opening of inspection or manhole covers.

6.7.6 Pipe work connections shall be of adequate size for their duty and as short and direct as possible. Only radiused elbows shall be used.

6.7.7 The feed pipe to the transformer tank shall enter the transformer cover plate at its highest point and shall be straight for a distance not less than five times its internal diameter on the transformer side of the Buchholz relay, and straight for not less than three times that diameter on the conservator side of the relay.

6.7.8 This pipe shall rise towards the oil conservator, through the Buchholz relay, at an angle of not less than 5 degree.

6.7.9 Contact of the oil with atmosphere is prohibited by using a flexible air cell of nitrile rubber reinforced with nylon cloth.

6.7.10 The temperature of oil is likely to rise upto 100 deg C during operation. As such air cell used shall be suitable for operating continuously at 100 deg C.

6.7.11 Air cell of conservator shall be able to withstand the vacuum during installation /maintenance periods. Otherwise provision shall be kept to isolate the conservator from the main tank when the latter is under vacuum by providing a vacuum sealing valve or other suitable means in the pipe connecting main tank with the conservator.

6.7.12 The transformer manual shall give full and clear instructions on the operation, maintenance, testing and replacement of the air cell. It shall also indicate shelf life, life expectancy in operation, the recommended replacement intervals and the supplier.

6.7.13 The connection of air cell to the top of the conservator is by air proof seal preventing entrance of air into the conservator.

6.8 **Neutral Earthing Arrangement**

The neutral terminals of transformer shall be brought to the ground level by a brass/tinned copper grounding bar, supported from the tank by using porcelain insulators. The end of the brass/tinned copper bar shall be brought to the bottom of the tank, at a convenient point, for making bolted connection to two (2) 75 x 6 mm galvanised steel flats connected to Owner's grounding mat.

7.0 FITTINGS

7.1 Fittings as listed in Annexure - I shall be provided. Any other fittings which may be necessary for the satisfactory operation of the transformer shall also be provided on each transformer.

7.2 All fittings shall conform to relevant Indian Standard Specifications.

7.3 Fittings such as conservator and associated pipes, explosion vent pipe etc. shall be designed to withstand vacuum as specified in Clause 6.2.1 against atmospheric pressure.

7.4 Fittings such as rating plate, dehydrating breather, off-circuit tapping switch, dial type thermometer etc. which need to be observed/ operated, shall be mounted at convenient heights of not more than 1.5 M from the base of the transformer and located so as to be clearly visible from the front.

7.5 All opening shall be provided with gasketted metallic covers for protection during transportation.

7.6 All valves shall be of globe/butterfly type provided with blanking plates. The valve body shall be made of either Carbon Steel with trim of 13 Cr. steel or gun metal.

7.7 The rating plate, the terminal diagram and terminal marking plates shall be made of Aluminium and shall contain relevant details as per IS 2026. The Code No. of equipment shall be marked on a separate plate.

7.8 All terminals shall be anti loosening type and complete with connectors of required size. The earthing terminals shall have identification marks.

7.9 All valves in oil line shall be suitable for continuous operation with transformer oil at 115 deg C.

7.10 The oil sampling point for main tank shall have two identical valves to be put in series .Oil sampling valve shall have provision to fix rubber hose of 10 mm size to facilitate oil sampling.

7.11 A valve or other suitable means shall be provided to fix (in future) on line dissolved gas monitoring system to facilitate continuous dissolved gas analysis. The location & size of the same shall be finalised during detail engineering stage

7.12 **Winding Temperature Indicator**

Winding temperature indicator for measuring hot spot temperature of the winding shall comprise of current transformer image coil, temperature sensing element, capillary tube jacketed with PVC sleeve, 150 mm dia. local indicating instrument with two pairs of contacts one for alarm and other for trip and maximum point indicator capable of being reset by hand without tools.

In addition to the above, the following equipment shall be provided for remote indication of winding temperature for each of the winding:

a)Signal transmitter for each winding

Signal transmitter shall have additional facility to transmit signal for recording winding temperature at Owner's data acquisition system, for which duplex platinum RTD with nominal resistance of 100 ohms at zero degree centigrade shall be supplied. The RTD shall be three wire ungrounded system. The calibration shall be as per SAMA (USA) standard or equivalent. The RTD may be placed in the pocket containing temperature sensing element and image coil for WTI system which will be used for both remote WTI and DAS. Necessary equipment for sending the signal to remote WTI and DAS shall be provided. In lieu, separate RTD for each of the functions shall be provided.

b) Remote winding temperature indicator

It shall be suitable for flush mounting on Owner's panel. This shall not be repeater dial of local WTI and will operate by signal transmitter. Any special cable required for shielding purpose, for connection between cooler control cabinet and remote WTI control circuit, shall be in the scope of Contractor. Only one RWTI with a selector switch shall be provided for all the windings (HV and LV).

7.13 **Oil Temperature Indicator**

Oil temperature indicator for measuring top oil temperature shall comprise of 150 mm dial type thermometer, thermometer pocket and capillary tube jacketed with PVC sleeve. Thermometer shall have two pairs of contacts, one for alarm and other for trip and maximum point indicator capable of being reset by hand without tools.

In addition to the above, the following equipment shall be provided for remote indication of oil temperature:

a) Signal transmitter

Signal transmitter shall have additional facility to transmit signal for recording oil temperature at Owner’s data acquisition system, for which duplex platinum RTD with nominal resistance of 100 ohms at zero degree centigrade shall be supplied. The RTD shall be three wire ungrounded system. The calibration shall be as per SAMA (USA) standard or equivalent. The RTD may be placed in the pocket containing temperature sensing element and image coil for OTI system which will be used for both remote OTI and DAS. Necessary equipment for sending the signal to remote OTI and DAS shall be provided. In lieu, separate RTD for each of the functions shall be provided.

b) Remote oil temperature indicator

It shall be suitable for flush mounting on Employer's/RTCC panel. This shall not be repeater dial of local OTI and will operate by signal transmitter. Any special cable required for shielding purpose, for connection between cooler control cabinet and remote OTI control circuit, shall be in the scope of Contractor. Only one ROTI with a four point selector switch shall be provided.

7.14 **Buchholz Relay**

The Buchholz relay as per IS 3637 shall be of double float type, provided with, two pairs of contacts, one for alarm and other for trip, facility for testing by injection of air by hand pump and with a cock for draining and venting of air. The relay shall be provided with shutoff valves on the conservator side as well as on the tank side.

The alarm and trip contacts of all protective devices shall be potential free and rated for 1 Amp at 110 V / 220 V D.C.

7.15 **Marshalling Box**

A marshalling box shall be provided to accommodate all auxiliary devices except those which are to be located directly on transformer or housed in a separate panel.

i. Terminal boxes, Junction Boxes & Marshalling Panel shall have IP 55 enclosure(min.), dust, weather and vermin proof type.

ii. ii.The marshalling box shall be dust, weather and vermin proof type made of sheet steel of not less than 2 mm thick. The box shall be rectangular in shape having sufficient space for easy termination of cables. The terminal block shall be pressure clamp type. 10% spare terminals shall be provided.

Suitable heavy duty double compression type rolled Aluminium cable glands for all incoming and outgoing cables shall be provided.

7.16 **Current Transformers**

The current transformers shall be provided and shall comply with IS 2705. The C.T. terminals shall be accessible through a weatherproof removable cover for the purpose of testing etc. CT polarity shall be clearly marked. The C.T. for standby earth fault protection shall be 15 VA, 5P10. The C.T's for differential and restricted earth fault protection shall be of Class PS accuracy. The values of V_k and Imag for these CTs shall be furnished at the order stage.

7.17 **Wiring**

All controls, indication and protective devices provided on the transformer shall be wired upto the terminal block inside the marshalling box, by means of stranded copper heat resistant PVC insulated armoured cable of 1.1 KV grade and size not less than 2.5 sq. mm. Wiring shall be properly fixed on cable tray with at least 100 mm clearance from the transformer body. Suitable identification mark shall be provided on all wires.

7.18 All bought out items shall be of reputed make to be approved by Consultant/ Owner.

7.19 **NITROGEN INJECTION FIRE PREVENTION AND EXTINGUISHING SYSTEM**

7.19.1 Nitrogen Injection Fire Prevention and Extinguishing System shall be provided for fire protection of Transformer against fire due to an arc, during internal faults and external fires is for preventing tank explosion. The system design shall also conform to TAC/ NFPA norms.

7.19.2 The system should comprise the following :-

i. Fire Extinguishing Cubicle with base frame and containing, oil drain assembly, nitrogen cylinder, electric mechanical control unit for oil drain and nitrogen release detections necessary for monitoring system flanges on top panel for connecting pipe connections from transformer, panel lighting etc.

ii. Control Box for monitoring system operation, automatic control and remote operation, with alarms, indication light switches, push buttons, audio signal, suitable for tripping and signaling on 110V DC supply.

iii. Pre-stressed non-return valve (PNRV) working on transformer oil flow rate, with proximity switch for remote alarm indication and with visual position indicator.

iv. Required number of fire detectors rated for 141^0C for heat sensing, each fitted with two number cable glands.

v. Signal box for terminating cable connections from PNRV and fire detectors.

vi. Pressure relief valve with limit switch.

7.19.3 The following arrangements are required to be made on the transformer Tank at the time of fabrication of the tank :-

i. Oil drain opening with pipe, flange and manual gate valve at about 120mm below the top cover. Pipe size DN125 for 100 MVA and higher ratings.

ii. Nitrogen Injection openings with pipe size DN 25 with flange and manual gate valve on tank sides at about 100-200 mm from the bottom plate.

iii. Flanges having 4 Nos. 18 dia. holes with pcd as 155mm and dummy pipe on the conservator pipe between buchholz relay and conservator tank manual gate valve, for fixing PNRV.

iv. Fire detector brackets on top cover.

v. Brackets for fixing signal box at a suitable location on top cover or tank size wall.

7.19.4 **ACTIVATION OF NIFPES:**

Mal-functioning of fire prevention / extinguishing systems is their major shortcoming which leads to interruption in power supply. The Contractor shall ensure that the chances of malfunctioning of NIFPES are practically nil. To achieve this objective, the Contractor shall work out their scheme of activating signals which, while preventing mal-operation, should not be to rigorous to make the operation of NIFPES impracticable in case of actual need. Transformer isolation shall be the mandatory pre-requisite for activation of the system in Automatic mode or Remote mode in the control room.

In addition, at least following electrical-signals shall be provided in series for activating NIFPES.

7.19.5 Auto Mode

a) For Prevention of Fire **:**
- i. Differential Relay Operation
- ii. Buchholz Relay parallel with Pressure Relief Valve or RPRR. (Rapid Pressure Release Relay)
- iii. Tripping of all concerned breakers is a prerequisite for initiation of system activation.

b) For Extinguishing Fire **:**
- i. Fire Detector
- ii. Buchholz Relay paralleled with Pressure Relief Valve or RPRR.
- iii. Tripping of all connected breakers is a prerequisite for initiation of system activation.

7.19.6 Manual Mode (Local/Remote): Tripping of all connected breakers is a pre-requisite for initiation of system activation.

7.19.7 Manual Mode (Mechanical): Tripping of all connected breakers is a pre-requisite for initiation of system activation.

7.19.8 **General Description of NIFPES**

7.19.9 **Schematic of the System**

NIFPES should be a stand alone dedicated system for oil filled. It should have a fire extinguishing FE) cubicle placed on a plinth at a distance of 6-10 mtrs. from the transformer. The F.E. cubicle may be connected to the transformer oil tank (near its top) and to the oil pit from its bottom through oil pipes with gate valves. The F.E. cubicle should house a pressurized nitrogen cylinder connected to the transformer oil tank (near its bottom). Cable connections are to be provided from signal box placed on the transformer to the control box in the control room and from control box to F.E. cubicle. Fire detectors placed at the top of transformer are to be connected in parallel to the signal box. The signal box may be connected to a pre-stressed non-return valve fitted between the conservator tank and Buchholz relay. Control box is also to be connected to relay panel is control room for system activation signals.

7.19.10 **Operation**

On receipt of all activating signals, drain of pre-determined quantity of oil commences thus removing high temp. top oil layer. Simultaneously nitrogen is injected under high pressure at a pre-fixed rate, string the oil thus bringing the temperature of top oil layer down. Nitrogen occupies the space created by oil drained out and acts as an insulating layer between the tank oil & fire on top cover. Pre-stressed non return valve blocks oil flow form conservator tank, thus isolating it & preventing aggravation of fire.

7.19.11 **System Components**

Broadly, NIFPES shall consist of the following components. It is emphasized that all components, necessary for fast reliable & effective working of NIFPES shall be considered within the scope.

7.19.12 **Fire Extinguishing Cubicle**

It shall be made of 3mm thick steel sheet, painted dark red from inside & outside with hinged split doors fitted with high quality tamper proof lock. It shall be complete with the base frame and the following:-

- Nitrogen gas cylinder with regulator and falling pressure electrical contact manometer
- Oil drain pipe with mechanical quick drain valve.
- Electro mechanical control equipment for oil drain and pre-determined regulated nitrogen release.
- Pressure monitoring switch for back-up protection for nitrogen release.
- Limit switches for monitoring of the system.
- Flanges on top panel for connecting oil drain and nitrogen injection pipes for transformer.
- Panel lighting (CFL Type)
- Oil drain pipe extension of suitable sizes for connecting pipes to oil pit.

7.20 **Control Box**

Control Box for monitoring system operation, automatic control and remote operation, with following alarms indication, light switches, push buttons, audio signal, line fault detection suitable for tripping and signaling on 110V DC supply :

- System on*
- PNRV open*
- Oil drain valve closed*
- Gas inlet valve closed*
- PNRV closed^
- Fire Detector Trip^
- Buchholz Relay Trip^
- Oil drain valve open^
- Extinction in pressure^

- Cylinder pressure low^
- Differential relay trip^
- PRV/RPRR trip^
- Transformer trip^
- System out of service
- Line fault free detector
- Line fault differential relay
- Line fault buchholz relay
- Line fault PRV
- Line fault transformer trip
- Line fault PNRV
- Auto/Manual/Off
- Extinction release on
- Extinction release off
- Lamp test
- Visual / Audio Alarm
- Visual / Audio alarm for DC supply fail

The signals marked (*) shall be in the topmost row of control box panel. The signals marked (^) shall follow next.

7.21 **Pre-stressed Non Return Valve (PNRV)**

PNRV is to be fitted in the conservator pipe line between conservator & Buccholz relay. It shall have the proximity switch for remote alarm, indication and with visual position indicator. The PNRV should be of the best quality because malfunction of PNRV shall be of serious consequence as its closing leads to stoppage of breathing of transformer.

7.22 **Fire Detectors**

The system shall be complete with adequate number of fire detectors fitted on the top of oil tank, OLTC/Off ckt. Tap changer rated for 1410C for heat sensing each fitted with two no. cable glands (water proof/weather proof).

7.23 **Signal Box**

It shall be fitted on the transformer for terminating cable connections from PNRV & fire detectors and for further connection to the control box.

7.24 **Cables**

Fire survival cables, able to withstand 7500C, 4 core x 1.5mm sq. for connection of fire detectors in parallel shall be used. Fire retardant low smoke (FRLS) cable 12 core x 1.5mm sq. for connection between transformer signal box/marshalling box to control box and control box to fire extinguishing cubicle shall be used.
Fire retardant low smoke (FRLS) cable 4 core x 1.5mm sq. for connection between control box to DC supply source and fire extinguishing cubicle to AC supply source, signal box marshalling box to prestressed non return valve connection on transformer shall be used.

7.25 **Pipes**

Pipes, complete with connections, flanges, bends, tees etc. shall be supplied alongwith the system.

7.26 **Other items**

a) Oil drain and nitrogen injection openings with gate valves on transformer tank at suitable locations

b) Flanges with dummy piece in conservator pipe between Buchholz relay and conservator tank for fixing PNRV.

c) Fire detector brackets on transformer top cover.

d) Spare potential free contacts for system activating signals i.e. differential relay, buchholz relay, pressure relief valve, transformer isolation (master trip relay).

e) Pipe connections between transformer to fire extinguishing cubicle and fire extinguishing cubicle to oil pit.

f) Cabling on transformer top cover for fire detectors to be connected in parallel and inter cabling between signal box to control box and control box to fire extinguishing cubicle

g) Mild steel oil tank with moisture proof coating with capacity as minimum 10% of total oil quantity of transformer, with water tight cover, to be place in the oil pit. This tank shall be provided with the manhole, air vent pipe through silica gel breather, drain valve and a spare gate valve at the top.

h) Gate valves on oil drain pipe & nitrogen injection pipe should be able to withstand full vacuum. A non-return valve shall also be fitted on nitrogen injection pipe between transformers & gate valve.

i) Pressure relief valve, wherever not fitted on the transformer.

j) The F.E. cubicle shall be painted with post office red colour (Shade 538 of IS-5). All the exposed parts i.e. pipes, supports, signal box etc. shall be painted with enameled paint.

7.27 **Modification on the transformer**

No modification on the transformer shall be allowed which affects its performance (i.e. efficiency, losses, heat dissipation ability etc.), safety, life etc. or its any other useful parameter. This requirement shall be of paramount importance and shall be followed.
However, in any case, performance of transformer should not be affected in any manner by having NIFPES system and the Contractor shall give an undertaking to this effect. All pipes should be washed/rinsed with transformer oil. If any damage is done to the transformer and/or any connected equipment during installation & commissioning full recovery therefore shall be effected from the Contractor.
It shall be solely the responsibility of Contractor/Sub-Contractor to install, carry out pre-commissioning tests & commission NIFPES at Ridge Valley indicated in this Specification, to the entire satisfaction of the Owner/Consultant..

7.28 **Interlocks**

It shall be ensured that once the NIFPES gets activated manually or in auto mode, all the connected breakers shall not close until the system is actually put in OFF mode. Also PNRV shall get closed only if all the connected breakers are open.

7.29 In general, following Fire Extinction period and other data shall be followed :

On commencement of Nitrogen Injection	:	Maximum 30 seconds
From the moment of system activation to complete cooling	:	Maximum 3 minutes
Fire detectors heat sensing temperature	:	141^0C
Heat sensing area	:	800mm radius
Pre-stressed non return valve setting for Operation	:	minimum 60 ltr. Per minute
Capacity of Nitrogen cylinder : .	:	Minimum 68 litre water capacity And shall hold minimum 10 cubic Meter gas to 150 bar pressure
Power Source	:	
Control Box		220VDC

Fire extinguishing cubicle for lighting 230VAC

7.30 The following information in detail shall be provided :

a) The maintenance and testing schedule for NIFPES.

b) All the steps required to be undertaken for restarting the transformer and connected equipment after operation and mal-operation (if any) of the NIFPES.

c) The process of venting nitrogen in case nitrogen pressure in the cylinder exceeds the stipulated maximum value.

8.0 PAINTING

8.1 The surface to be painted shall be shot or sand blasted to remove all dust, scale and foreign adhering matter. All traces of oil and greases should be removed by suitable treatment.

8.2 All steel surfaces in contact with insulating oil shall be painted with heat resistant oil insoluble insulating varnish.

8.3 All steel surfaces exposed to outside shall be painted with suitable anti-rust and anticorrosive paints. Epoxy paints shall be used.

8.4 All paints shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off, crinkle or be removed by abrasion due to normal handling.

8.5 The paint should not fade during drying process. The paint should be able to withstand temperature up to 120 deg. C .The detailed painting procedure shall also be submitted along with the bid which shall be finalized before award of the contract.

8.6 Unless otherwise specified, the finishing shade shall be light grey Shade No. 631 as per IS 5.

8.7 1 litre of paint per transformer shall be supplied for touch up at Site.

9.0 TESTS AND INSPECTION

9.1 All transformers shall be routine tested as per IS 2026. Transformer oil shall be tested as per IS 335. Heat run test shall be carried out for one transformer of each rating.

9.2 Type test certificate shall be furnished.

a. Temperature-rise tests (IEC 60076-2)

b. Dielectric tests: Full-wave impulse-voltage withstand test (IEC 60076-3)

9.3 Additional tests, wherever specified, shall be carried out on one transformer of each rating.

9.4 All the above mentioned tests shall be carried out in the presence of Purchaser's representative. In addition, the transformers shall be subject to stage inspection at works and inspection at site for final acceptance.

9.5 These inspections shall, however, not absolve the Vendor from their responsibility for making good any defect which may be noticed subsequently.

10.0 DRAWINGS AND DOCUMENTS

10.1 The drawings and documents as per Annexure-III shall be furnished, unless otherwise specified.

10.2 All drawings and documents shall have the following descriptions written boldly:

-- Name of Client

-- Name of Consultant

-- Enquiry / order number with plant / project name

-- Equipment Code No. and Description

10.3 The transformer shall be suitably packed to avoid damage in transit and shall be properly sealed so as to completely exclude oxygen and moisture from coming in contact with oil.

Bushing shall be wrapped in straw ropes or similar material and complete transformer shall be packed in wooden crates.

10.4 The packing box shall contain a copy of the installation, operation and maintenance manual.

10.5 All loose pieces shall be separately wrapped in moisture resistant paper and marked with identification mark of the corresponding transformer.

11.0 SPARES

11.1 Commissioning Spares: Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for approval.

11.2 Spares for 2 Years operation (Mandatory), as specified shall be supplied.

11.3 Recommend 2 years Operational Spares (other than mandatory spare) alongwith recommended quantity & item-wise unit price shall be furnished.

11.4 All spare parts shall be identical to the parts used in the equipment

11.5 All spare parts shall be identical to the parts used in the equipment

12.0 PACKING

12.1 The transformer shall be suitably packed to avoid damage in transit and shall be properly sealed so as to completely exclude oxygen and moisture from coming in contact with oil. Bushing shall be wrapped in straw ropes or similar material and complete transformer shall be packed in wooden crates.

12.2 The packing box shall contain a copy of the installation, operation and maintenance manual.

12.3 All loose pieces shall be separately wrapped in moisture resistant paper and marked with identification mark of the corresponding transformer.

13.0 DEVIATIONS

Deviations, if any, from this standard shall be clearly indicated in the offer with reasoning.

ANNEXURE - I
LIST OF FITTINGS

I. The fittings as given below shall be provided for all the ratings of transformers.

1. Oil Sampling Valve.
2. Filter valves with plug.
3. Radiator shutoff valves on top and bottom for each unit.
4. Buchholz relay shutoff valves.
5. Winding temperature indicator for 1000 KVA and above.
6. Oil temperature indicator.
7. Oil level indicator with minimum marking.
8. Oil conservator complete with drain plug and oil filling hole with cover.
9. Buchholz relay with air release device and alarm and trip contacts.
10. Silica gel breather with oil seal and connecting pipe.
11. Explosion vent.
12. Bi-directional rollers.
13. Inspection holes with cover.
14. Marshalling Box.
15. Rating Plate.
16. Diagram and Terminal marking plate.
17. Lifting lugs.
18. Jacking pad.
19. Earthing Terminals.
20. Air release device.
21. Neutral bushing for earthing.
22. Ladder with safety device for access to the top of transformer tank.

II. The additional fittings as given below shall also be provided, as per requirement:

1. Magnetic oil level gauge with low oil level alarm contact.
2. Hauling lugs for extra high voltage transformers.
3. Protective CTs for
   a) Stand-by earth fault.
   b) Restricted earth fault.
   c) Differential protection.
4. Bi-directional wheels if already bi-directional rollers not considered.
5. Skids.
6. Cooler units complete with valves, fans, pumps, oil flow indicators, supporting structure with fixing and foundation bolts etc as required and Cooler Control panel.
7. Tap-changing gear complete with tap position indicator, operation counter etc. For OLTC gear(where specified), oil surge relay(OSL) with shut-off valve, Local control cabinet.
8. Nitrogen Injection Fire Prevention and Extinguishing System

ANNEXURE - II

DOCUMENTATION FOR TRANSFORMERS

Sl. No.	Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheet	N	Y	Y
2	Technical Particulars	N	Y	Y
3	Dimensional drawing for complete Transformer, Marshalling Box, disconnecting chamber, terminal chambers etc.	N	Y	Y
4.	Schematic and Wiring Diagram	N	Y	Y
5.	Terminal arrangement drawing	N	Y	Y
6.	Installation, operation and maintenance manual	N	N	Y
7.	Catalogues and test certificates for bought out accessories	N	N	Y
8.	Type test certificates of similar transformer	N	N	Y
9.	Test Certificates	N	N	Y
10.	Guarantee Certificates	N	N	Y
11.	Spare parts list with identification marks	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N - No

TECHNICAL SPECIFICATION

NEUTRAL EARTHING RESISTOR

CONTENTS

1.0 SCOPE

1.1 This standard covers the technical requirements of design, manufacture, testing at works and despatch in well packed condition of Neutral Earthing Resistor for earthing the neutral of power transformers / generators for limiting the line to ground fault current.

1.2 This standard shall be read in conjunction with the relevant part of Design Philosophy – Electrical.

2.0 STANDARDS TO BE FOLLOWED

2.1 The design, manufacture and testing of the equipment covered by this standard shall comply with the latest issue of IS 3043, unless otherwise specified. Equipment complying with equivalent IEC standards shall also be acceptable.

2.2 The design and operational features of the equipment shall also comply with the provisions of latest issue of the Indian Electricity Rules and other relevant Statutory Acts and Regulations. The supplier shall, wherever necessary, make suitable modifications in the equipment to comply with the above.

2.3 Wherever any requirement, laid down in this standard, differs from that in Indian Standard Specifications, the requirement specified herein shall prevail.

3.0 SERVICE CONDITIONS

3.1 Ambient Conditions

These shall be as indicated in Design Philosophy – Electrical.

3.2 System Details

These shall be as indicated in Design Philosophy – Electrical.

4.0 OPERATING REQUIREMENTS

4.1 The neutral earthing resistor shall be suitable for carrying the rated current for duration of 30 seconds under the specified ambient conditions and voltage and frequency variations without the temperature exceeding 350ºC.

4.2 The resistor shall be designed to carry continuously 20% of the rated short time current without any harmful effect.

4.3 The housing shall be sized such that temperature rise of the metal parts through which current is not required to pass, when rated current is passed for the specified period, shall not exceed 40ºC.

5.0 GENERAL DESIGN AND CONTRUCTIONAL FEATURES

5.1 Resistors

5.1.1 The resistance bank shall be of heavy duty non-inductive type having high specific resistance and low temperature co-efficient.

5.1.2 The resistor elements shall be made of joint-less, non-corroding, sturdy and oxidation resistant AISI 304 / AISI 406 stainless steel of punched / formed construction.

5.1.3 The contact between elements shall be made by individually bolting the terminals of two adjacent elements and connecting them in series, parallel or combination of both to achieve the specified resistance. The interconnecting link shall be zinc plated copper of uniform cross section throughout.

5.1.4 The resistance grid shall be properly supported so that damage due to vibration and thermal or mechanical stresses is avoided.

5.1.5 Porcelain / Epoxy insulators rated for the highest system voltage shall be used to insulate the resistor elements from the body of the housing.

5.1.6 Insulation level for resistor bank shall be as follows:

Highest system voltage	Power frequency withstand voltage	Impulse withstand Voltage
Up to 3.6 KV peak	10 KV RMS	40 KV
7.2 KV peak	20 KV RMS	60 KV

5.2 Metal clad housing

5.2.1 The housing shall be fabricated out of 3 mm thick sheet steel fitted on a 6 mm thick mild steel frame work. This shall be floor mounting type and rectangular in shape.

5.2.2 It shall be suitable for outdoor installation and shall have minimum degree of protection IP: 43 as per IS 2147. Ventilating louvers, if provided, shall be covered by fine wire mesh from inside and shall be such that the above degree of protection for the enclosure is not altered. Top cover of the housing shall be slopping construction to prevent accumulation of water.

5.2.3 All external hardware below 8 mm size shall be of stainless steel and those of higher size of mild steel cadmium plated or zinc passivated.

5.3 Isolation Arrangement

5.3.1 An isolator shall be provided on the incoming side to isolate the resistors from the main equipment.

5.3.2 The isolating switch shall be single pole knife type having a rating of 1.5 times the rated current of the resistor. The switch shall have four sets of potential free auxiliary contacts, 2 NO and 2 NC for remote indication, wired to a terminal block. An external handle, suitably insulated and lockable both in the ON and OFF positions, shall be provided for the switch. The handle shall preferably be mounted at a height of 1.5 meters from the base of the housing.

5.4 Current Transformers

Epoxy moulded current transformer of accuracy 5P for stand by earth fault protection and PS for restricted earth fault protection shall be provided, as per requirement. The CT connections shall be brought to separate terminal box with shorting arrangement.

5.5 Terminal Arrangement

5.5.1 For incoming connection, either bushing or cable box arrangement shall be provided. In case of bushing connection, the bushing shall be provided on top of the housing. In case of cable box connection, the same shall be mounted on the side of the housing.

5.5.2 For the outgoing connection, cable box arrangement is to be considered in all cases. The cable box shall be mounted on the side of the housing.

5.5.3 Heavy duty double compression type rolled aluminium cable glands shall be provided for all the incoming and outgoing cables.

5.5.4 The equipment terminals shall be anti loosening type and complete with tinned copper cable lugs suitable for cables of specified size. For bushing connections, suitable tinned copper conductor shall be provided as per conductor size specified.

6.0 ACCESSORIES

6.1 The equipment shall be complete with cable glands, cable lugs, drain plug, lifting hook, name plate, foundation bolts and all other accessories required to make the equipment complete in all respects.

6.2 Name Plate

6.2.1 Name plate shall be of stainless steel with letters embossed on them.

6.2.2 The name plate shall contain all the required details and shall include at least the following:

i) Make
ii) Description of code no. of equipment
iii) Short time rating
  a) Current
  b) Duration
iv) Rated voltage
v) Maximum temperature rise over ambient
vi) Total resistance at ambient temp.
vii) Materials of resistors
viii) Degree of protection of enclosure

7.0 PAINTING

7.1 The enclosure, after suitable pre-treatment shall be painted with two coats of antirust paint followed by two coats of anti-corrosive paints.

7.2 Epoxy based paints shall be used.

7.3 All paints shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off, crinkle or be removed by abrasion due to normal handling.

7.4 The finishing paint shall be light grey shade no. 631 as per IS 5.

8.0 TESTS AND INSPECTION

8.1 Following tests shall be carried out on the neutral earthing resistors:

8.1.1 Routine Tests

i) Resistance value measurement at room temperature.
ii) Power frequency high voltage test for one minute.
iii) Insulation resistance test.

8.1.2 Type test

i) Heat run test.

8.2 The above mentioned tests shall be carried out in the presence of purchaser's representative. In addition, the equipment shall be subjected to stage inspection during process of manufacture at works and inspection at site for final acceptance.

8.3 The purchaser's inspection shall, however, not absolve the vendor from his responsibility for making good any defects which may be noticed subsequently.

9.0 DRAWINGS AND DOCUMENTS

9.1 The drawings and documents as per Annexure-I shall be furnished unless otherwise specified.

9.2 All drawings and documents shall have following descriptions written boldly.

- Name of the client
- Name of consultant
- Enquiry / order number with plant / project name
- Equipment code no. and Description.

10.0 SPARES

10.1 Commissioning Spares: Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for approval.

10.2 Spare Spares for 2 Years operation (Mandatory), as specified shall be supplied.

10.3 Recommend 2 years Operational Spares (other than mandatory spare) alongwith recommended quantity & item-wise unit price shall be furnished.

10.4 All spare parts shall be identical to the parts used in the equipment.

11.0 PACKING

11.1 The neutral earthing resistor shall be properly packed to safeguard against weather conditions and handling. It shall be wrapped in polythene bag with an additional wrapping of bitumen paper to make it completely waterproof before the equipment is packed in wooden crates.

11.2 A sign to indicate the upright position of the panel for placing during transport and storage shall be clearly marked.

11.3 Packing box shall include one copy of the installation operation and maintenance manual

12.0 DEVIATIONS

12.1 Deviations, if any, from this standard shall be clearly indicated in the offer with reasoning.

ANNEXURE - I

DOCUMENTATION FOR NEUTRAL EARTHING RESISTORS

Sl. No.	Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheet	N	Y	Y
2.	Technical Particulars	N	Y	Y
3.	General arrangement drawings	N	Y	Y
4.	Illustrative and descriptive catalogues	N	N	Y
5.	Installation, Operation and maintenance manual	N	N	Y
6.	Test Certificates	N	N	Y
7.	Guarantee Certificates	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N - No

TECHNICAL SPECIFICATION

MEDIUM VOLTAGE SWITCH BOARDS

CONTENTS

1.0 SCOPE

1.1 This standard covers the technical requirements of design, manufacture, testing at works and delivery in well-packed condition of Medium Voltage Switchboards.

1.2 This standard shall be applicable for the Power Control Centres, Power cum Motor Control Centres and Motor Control Centres.

1.3 This standard shall be read in conjunction with relevant part of Design Philosophy – Electrical, Schematic diagrams etc.

2.0 STANDARDS TO BE FOLLOWED

2.1 The design, manufacture and testing of the equipment shall comply with the latest issue of the following Indian Standards, unless otherwise Specified. Equipment complying with equivalent IEC standards shall also be acceptable.

IS 8623	-	Specification for low voltage switchgear and control gear assemblies
IS/IEC 60947	-	Low-voltage switchgear and control gear (General Rules)
IS 5578	-	Guide for marking of insulated conductors
IS 10118	-	Code of practice for selection, installation and maintenance of switchgear and control gear
IS 11353	-	Guide for uniform system of marking and identification of conductors and apparatus terminals

Various components housed in the switchboards shall conform to the Indian Standard specifications as mentioned against the component details or IEC specifications.

2.2 The design and operational features of all the equipment offered shall also comply with the provisions of the latest issue of the Indian Electricity Rules and other Statutory Acts and Regulations, as applicable. The supplier shall, wherever necessary, make suitable modifications in the equipment to comply with the above.

2.3 Wherever any requirement, laid down in this standard, differs from that in Indian Standard Specification / IEC Specification, the requirement specified herein shall prevail.

3.0 SERVICE CONDITIONS

3.1 Ambient Conditions

These shall be as indicated in Design Philosophy – Electrical.

3.2 System Details

These shall be as indicated in Design Philosophy – Electrical.

4.0 OPERATING REQUIREMENTS

The Medium Voltage Switchboards shall be suitable for operating at the specified rating continuously, with the specified voltage and frequency variations under the ambient conditions, without exceeding the permissible temperature rise and without any detrimental effect on any part.

5.0 DESIGN AND CONSTRUCTIONAL FEATURES

5.1 General

5.1.1 The switchboards shall consist of an assembly of a series of floor mounting, identical, metal clad, dead front type sheet steel panels of unitized design. The panels shall be placed side by side to form a compact assembly and shall be extensible on either side.

5.1.2 The complete assembly shall be dust, damp and vermin proof having minimum degree of protection equivalent to IP-52 as per IS/IEC:60947.

5.1.3 The frame work of the cubicles shall be of bolted/welded construction. The minimum thickness of sheet steel shall be 2 mm for load bearing members, 1.6 mm for non-load bearing members and 3 mm for base channel. The doors and covers shall be fabricated from cold rolled sheets. Suitable reinforcement, wherever necessary, shall be provided.

5.1.4 The door hinges shall be concealed type.

5.1.5 All external hardwares shall be cadmium plated. The hardwares for fixing the removable parts shall be provided with retaining devices.

5.1.6 The doors and the removable covers shall be provided with non-deteriorating neoprene gaskets. Gaskets without any discontinuity shall be preferred. Gaskets shall be held in position in groove, in shaped sheet steel work or these shall be of U type. Adhesive cement, if used, shall be of good quality so that the gaskets do not come off during service.

5.1.7 All the components shall be accessible for inspection and maintenance without the necessity for removal of the adjacent ones.

5.1.8 The layout of the component inside the module shall be liberal to facilitate maintenance and interconnecting wiring between the components shall not be subjected to any undue stresses at the bends.

5.1.9 Mounting height of components requiring operations and observation shall not be lower than 300 mm and higher than 1800 mm.

5.1.10 Inter panel barriers shall be provided.

5.1.11 All the live parts which are accessible after opening of front cover/cable alley cover/back cover shall be properly insulated or provided with insulating barrier to prevent accidental contact. Removal facility shall be provided for all such parts.

5.1.12 Adequate arrangement for earthing shall be provided to safeguard the operator or other personnel from electric hazards under all conditions of operation.

5.2 Panel Arrangement

The Switchboards shall be in fixed/draw out, single front execution, fully compartmentalised type and divided into distinct panels, each comprising of :

i) A completely metal enclosed bus-bars compartment running horizontally the top.
ii) Individual feeder modules.
iii) Enclosed vertical bus-bars serving all modules, in case of multi-tier panels.
iv) A vertical cable alley.
v) Separate horizontal enclosure for all auxiliary power and control buses.

5.3 Circuit Breaker Controlled Feeders

5.3.1 The panels housing circuit breaker feeders shall be in single front draw out execution. The incoming and bus coupler circuit breaker feeders shall be in single tier formation while the outgoing circuit breaker feeders may be in double tier formation.

5.3.2 A suitable barrier shall be provided between the circuit breaker and the associated control, protective and indication devices including instrument transformers.

5.3.3 All the protective relays and meters shall be flush mounted type. The relays and meters pertaining to a particular circuit breaker shall be mounted on the same panel. Where it is not possible to accommodate all the relays and meters in the same panel, one metering panel shall be provided adjacent to the circuit breaker panel exclusively for that feeder. Location of these in the adjacent panel of other feeders shall not be acceptable.

5.3.4 A spacious cable chamber suitable for accommodation, support and termination of required number of power cables shall be provided at the back. No bare bus-bars or live connection shall intrude into the cabling space.

5.3.5 The switchboard shall be provided with following inter locks and safety features:

i) It shall not be possible to open the compartment door unless the breaker is drawn to isolated position.

ii) The withdrawn and engagement of a circuit breaker shall not be possible unless it is in open position.

iii) The operation of a circuit breaker shall not be possible unless it is in fully service, test or isolated position.

iv) It shall not be possible to close the circuit breaker in service position unless all auxiliary and control circuits are connected.

v) A breaker of the lower rating shall be prevented from engaging with the stationary element of higher rating.

vi) Insertion of the manual mechanism shall render the motorised mechanism in operation.

vii) Circuit breaker ‘ON’, ‘OFF’ indication shall be provided at the back of each panel. Alternatively, alarm shall be provided in case panel back door is opened with breaker “ON”.

viii) Caution nameplate shall be provided at the back of incomer’s panels where terminals are likely to remain live and isolation is possible only from remote end.

ix) Automatic safety shutter, with Padlocking facility for locking in closed position, to completely cover the spouts for the bus-bars and cable connection when the breaker is withdrawn.

5.4 Switch/MCCB Controlled Feeders

5.4.1 The panels housing motor starter or other feeders shall be either fixed or draw out type in single front execution.

5.4.2 All components of one feeder shall be mounted on a rigid sheet steel chassis.

5.4.3 Each panel shall be divided into a number of modules in tier formation placed one above the other. These modules shall be closed on all sides.

5.4.4 The modules shall be so placed that largest one is placed at the bottom of the panel. Type modules shall be at least 300 mm from the base channel.

5.4.5 The number of modules shall be so decided that the cables in the cable alley are not over crowded. However the number of module in any panel shall not exceed six.

5.4.6 The minimum size of module shall be 300 mm and 200 mm for starter and switch fuse feeders respectively.

5.4.7 The minimum clear width of cable alley shall be 250 mm.

5.4.8 For MCC rated above 630 Amp. The incomer and bus coupler modules shall be located in individual single panel. For MCC rated for 630 Amp. and below the incomer and bus coupler modules shall be half the panel size.

5.4.9 The module door shall be so interlocked that it shall not be possible to open the door with switch in closed position and close the door unless the module is fully plugged in. Defeat interlock facility shall be provided.

5.5 Special Features of Draw out Modules

5.5.1 The module shall be fully draw out type with sheet steel chassis moving freely on the guides. Chassis of the same size shall be fully interchangeable.

5.5.2 The module shall have the following distinct mechanical positions:

i) Service -- In which both power and control contacts shall be made.

ii) Test -- In which power contacts shall be isolated but control contacts shall be made.

iii) Isolated -- In which both power and control contacts shall be Isolated.

Maintenance position shall be preferred.

5.5.3 Each position shall be clearly marked. Padlocking facility shall be provided to padlock the chassis in any of the position.

5.5.4 The movement of the chassis from one position to the other shall be controlled by using an appropriate racking mechanism. Stopper shall be provided to prevent over travel of the chassis beyond the isolated position.

5.5.5 The guiding system shall permit smooth movement of the module and the power and control contacts shall be self-aligning type so that accurate alignment of the contacts is ensured.

5.5.6 No wiring shall be taken to the door. Only the actuators of the push buttons and switches, lenses for the indicating lamps and Perspex cover for meters shall be mounted on the door.

5.5.7 The power contacts shall be of plug-in/stab-in type made of silver plated copper, spring loaded and of adequate current carrying capacity. The contacts shall be so designed that contact pressure is maintained both under normal and short circuit conditions.

5.5.8 The parting contacts, both on bus-bar side and outgoing cable side, shall always be copper to copper and both sides silver plated. A bimetallic strip shall be used where two dissimilar materials are in contact.

5.6 Bus-Bars and Connections

5.6.1 The bus-bars shall be for three phase and neutral. The main bus-bars and connections shall be made of electrolytic grade copper of rectangular cross-section. Auxiliary bus-bars for control supply, space heater supply etc. shall be made of electrolytic copper.

5.6.2 The horizontal bus-bars shall be insulated with heat shrinkable PVC sleeves of reputed make to protect against approach to live parts. The vertical bus-bars shall be sleeved or shrouded by barriers. Removable type insulating shrouds shall be provided for all joints of horizontal bus-bars.

5.6.3 The bus-bars shall be amply sized to carry the rated continuous current under the specified ambient temperature without exceeding temperature limits specified in IS: 8084. The thermal rating of the bus-bars shall be designed to withstand the system fault current for 1 second without exceeding the limiting temperature of 200ºC for bare Aluminium/Copper. Calculation for bus-bars sizing shall be furnished along with the offer.

5.6.4 Horizontal bus-bars shall be of the same cross-section through out. Stepped bus-bars shall not be acceptable.

5.6.5 The bus-bars shall be arranged and colour coded according to IS: 5578 / IS: 11353.

5.6.6 The bus-bar chamber shall be sufficiently spacious and shall have separate screwed covers for maintenance purpose.

5.6.7 The bus-bars shall be rigidly supported at equal intervals to withstand maximum short circuit stresses. The supports shall be of moulded construction with built-in anti-tracking barriers. The support materials shall be of DMC or fibreglass reinforced thermosetting plastic.

5.6.8 Bus-bar joints shall be between the two transporting sections only.

5.6.9 A minimum of two bolts shall be used in bus-bar joints. Only high tensile electric galvanized bolts, nuts and washers shall be used.

5.6.10 In case of Aluminium bus-bars, all joints shall be suitably treated to avoid oxidation of contact surfaces and bimetallic corrosion.

5.7 Earth Bus

A continuous earth bus of electrolytic grade copper, running along the entire length of the lower part of the switchboard shall be provided with lugs at two ends for external connections. The minimum size of earth bus shall be suitable for carrying three phase fault current for 1 sec.

5.8 Bus Duct

5.8.1 Suitable extension of bus-bars in proper phase sequence on the top, with the connecting bolts shall be provided where connection of transformer to switchboard is specified to be through bus duct.

5.8.2 Bus duct between two halves of a switchboard, if required, shall be supplied by the switchboard manufacturer. The bus-bars of interconnecting bust duct shall be similar to the main bus-bars of the switchboard and as specified above.

5.8.3 Bust duct between transformer and incoming breaker panel, if included in Vendor's scope, shall conform to ES-8062.

5.9 Clearances and Creepage Distances

5.9.1 The clearances and creepage distances shall not be lower than the values specified below:

i) Minimum clearance between two live conductors -- 20 mm

ii) Minimum clearance between live parts and accidentally dangerous part -- 20 mm

iii) Minimum creepage distance -- 28 mm

5.9.2 The clearances and creepage, as specified above, shall definitely be maintained in the bus-bar system. Provision of bus-bar insulation, separators or barriers shall not be considered to reduce the clearance from the values specified above.

5.9.3 At the termination points in the equipment e.g. switches, contactors, thermal relays etc. It is realized that above clearances may not always be possible to be maintained. All such points, where above clearances and creepage distances are not possible to be maintained, shall be insulated or taped.

5.10 Insulation

5.10.1 The insulation used shall be non-hygroscopic and may be of porcelain, epoxy resins or fibreglass moulded with plastic. It shall be of adequate electrical, mechanical and thermal strength to give trouble free service during normal operation and short circuit conditions.

5.10.2 The insulation shall be treated suitably to withstand the tropical conditions and atmospheric pollution.

5.11 Power Wiring

5.11.1 The connections from bus-bar to individual functional unit on the modules shall be of PVC insulated flexible copper cables or taped Copper/Aluminium strip.

5.11.2 The power wiring size shall be decided based on rating of the switch/breaker after using a rating factor of not more than 50% over the current rating in free air.

5.11.3 Power wiring size selected for breaker controlled module shall also be able to withstand full short circuit current for duration of 0.25 sec.

5.11.4 In any case minimum size of power wiring shall not be less than 4 sq. mm copper.

5.11.5 The size of connection from incomer to horizontal bus-bar and from horizontal bus-bar to bus-coupler shall not be less than the size adopted for horizontal bus-bar.

5.12 Control Wiring

5.12.1 The switchboard shall be completely factory wired and ready for external connections.

5.12.2 The wiring shall be carried out with flexible stranded PVC insulated copper conductor cables of 1100 Volt grade. The size of wires shall be as follows:

C.T. Circuit	--	2.5 sq. mm
V.T. and Control Circuits	--	1.5 sq. mm

5.12.3 All wiring shall be provided with dependent both ends marking as per IS: 5578. Numbered ferrules, reading from the terminals outwards, shall be provided at both ends of all wiring for easy identification. These shall be interlocking type plastic ferrules.

5.12.4 Control wiring circuits, fed from a supply common to a number of panels, shall be so protected that failure of a circuit in one panel does not effect the operation of the other panels.

5.12.5 The wiring to the equipment mounted on the doors shall be carried out with flexible multi strand copper conductor cable and so supported that on opening of the door there is no undue strain on wire leads.

5.12.6 The control cables shall be neatly arranged and property supported.

5.13 External Cable Termination

5.13.1 All power and control cables shall enter the switchboard from the bottom. Sufficient space shall be provided for ease of connection and termination of cables.

5.13.2 The type, number and sizes of cables shall be as indicated in Feeder details.

5.13.3 Compression type cable glands along with the cable lugs as required shall be provided for termination of cables.

5.13.4 The cable glands shall be of rolled Aluminium heavy duty double compression type and shall be mounted on a removable gland plate, provided at a minimum height of 75 mm from the bottom of the switchboard. Two number spare knockouts of size 20 mm shall also be provided on the gland plates for future use. Gland for termination of single core cables shall be nonmagnetic type.

5.13.5 For all power cables, crimped type Aluminium lugs for Aluminium cables and tinned Copper lugs for Copper cables shall be provided.

5.13.6 The terminal blocks shall be pressure clamp type up to 35 sq. mm cable sizes and bolted lug type for higher sizes of cables. These shall be protected type and rated for 1100 Volts service. The minimum current rating of terminal block shall be 16 Amp. The construction shall be such that after the connection of cables by means of lugs, necessary clearance and creepage distance are available.

5.13.7 Where more than two cables in parallel are required to be terminated, a system of bus links shall be provided with adequate clearance and spacing.

5.13.8 Suitable clamps to support the vertical run of cables shall be provided.

5.13.9 The terminal block shall be grouped according to circuit functions and suitably numbered. 20% extra terminals shall be provided in the terminal block.

5.13.10 For power connections, suitable marking on the terminals shall be provided to identify the phases.

5.14 Feeder Details

5.14.1 The requirements of incomer, bus coupler and outgoing feeders shall be as indicated in the single line diagram, feeder details and corresponding schematic diagrams.

5.14.2 Interlocks shall be provided between incomers and bus section panels. The interlocks shall be either electrical or mechanical type. In addition, arrangement for defeating the interlock shall also be provided to facilitate manual changeover.

5.14.3 Auto changeover scheme, wherever specified, shall be provided.

5.15 Dummy Panels

Dummy panels complete with bus-bar system in 400 mm width may be required for which unit price shall be indicated.

5.16 Control Power Supply

5.16.1 D.C. Power required for closing, tripping and indication of circuit breaker feeders shall be supplied at the bus coupler panel through two completely separate circuits by owner, one for tripping and other for closing and indication.

5.16.2 For receiving each external control supply, a double pole miniature circuit breaker shall be provided. This power shall be distributed inside the switchboard for each circuit breaker feeder having its MCB unit.

5.17 Space Heater Power Supply

5.17.1 Panel space heater shall be fed from a separate bus common for the whole board. This bus shall be fed from owner's supply for which a double pole MCB shall be provided in bus section panel.

5.17.2 Power supply for space heaters of motors shall be tapped from this bus by means of a MCB located in the motor feeder compartment. These MCBs shall be of triple pole and rated for 15 Amp.

6.0 COMPONENT DETAILS

Components of the switchgear shall ensure type of coordination 'C' as per IS:60947 (Part 4/ Section 1). Makes of all components shall be subject to owner's / consultant's approval

6.1 Circuit Breaker

6.1.1 The circuit breakers shall comply with the requirement of IS/IEC 60947.

6.1.2 All circuit breakers shall be of P2 (0-3 min - CO - 3 min - CO) category, capable of carrying the specified current at the site conditions and making/breaking of the system fault current.

6.1.3 Type test certificates from an independent testing authority shall be furnished along with the offer for each circuit breaker rating and type.

6.1.4 The circuit breakers controlling motors shall be suitable for DOL starting and stopping of induction motor a number of times.

6.1.5 The circuit breakers controlling capacitors shall be suitable for energizing and de-energizing the rated capacitor bank.

6.1.6 The circuit breakers shall be of the 3 phase, 4 pole horizontal draw out, horizontal isolation, air break type.

6.1.7 The circuit breaker shall be suitable for electrical or manual closing as specified. Manual operated breakers shall have independent manual spring closing mechanism. In case of electrically operated breaker, it shall have motor wound spring mechanism. In all cases tripping shall be by means of shunt trip coil.

6.1.8 All circuit breaker units of the same rating shall be physically and electrically interchangeable.

6.1.9 The circuit breakers shall be electrically and mechanically trip free and provided with anti-pumping feature.

6.1.10 Provision shall be made for slow closing for maintenance purposes. A suitable handle shall be provided one for each board for this purpose.

6.1.11 The circuit breakers shall have three positions i.e. service, test and isolated with the cubicle door closed. Necessary stoppers shall be provided to prevent the excessive movement of the breaker cradle than desired for the position. Service and test positions of the breaker shall have monitoring switch having 1NO+1NC contacts.

6.1.12 The circuit breaker shall be provided with emergency manual trip device, mechanical ‘ON’, ‘OFF’ and ‘ISOLATED’ position indicators and operation counter.

6.1.13 A maintenance truck/device for raising, lowering and withdrawal of the circuit breaker shall be supplied for each switch board.

6.1.14 The arc interrupting devices shall be capable of interrupting satisfactorily current from zero to the rated interrupting current when used on predominantly capacitive or inductive circuits, without requiring excessive maintenance of the contacts. The arc shall be restricted within the interrupting chamber and no emission of flame shall be allowed which may cause electrical breakdown or damage to insulation on the apparatus.

6.1.15 The main contacts shall be self aligning, adjustable and replaceable type.

6.1.16 The arcing contacts shall be easily accessible for maintenance and inspection and shall be easily replaceable type. They shall be provided with, contact face of special arc-resisting and non-pitting metal.

6.1.17 Mechanical safety interlock shall be provided for safe operation and movement of the breaker.

6.1.18 The circuit breakers shall be provided with minimum of four normally open and four normally closed auxiliary switch contacts, over and above those required for its own control scheme, for Owner’s use. The contacts shall be wired separately to the terminal board.

6.2 Moulded Case Circuit Breakers

6.2.1 The circuit breaker shall conform to IS/IEC 60947 and shall be of P2 category having rupturing capacity as per system requirement and mounted on a draw out chassis.

6.2.2 The circuit breaker shall be provided with spring assisted quick make quick break type manually operated trip free mechanism, mechanical 'ON', 'OFF' position indicators, thermal tripping devices of inverse characteristics, instantaneous short circuit tripping devices and necessary auxiliary and alarm switches. The MCCB Chassis shall be provided with service, test and isolated position and automatic safety shutter.

6.2.3 The thermal and short circuit tripping devices shall be adjustable type.

6.2.4 When used for motor circuits, shunt trip device shall be provided and the let through power of controlling MCCB shall be lower than the respective contactor.

6.2.5 In addition, under voltage trip shall be provided.

6.3 Switches

6.3.1 The switches shall be motor duty type AC 23 Category and shall comply with the requirements laid down in IS/IEC 60947. Switches up to 63 Amps shall be rotary type and those of 100 Amps. & above, link type.

6.3.2 'ON' and 'OFF' position of the switches shall be indicated on the module. Provision shall be made to lock the switch in the 'OFF' position.

6.3.3 The fixed contacts shall be shrouded type. All contacts shall be silver plated.

6.4 Fuses

6.4.1 The fuses shall be of non-deteriorating HRC cartridge link type and shall conform to IS: 13703. They shall be suitable for the load and service required in the circuit.

6.4.2 One fuse puller shall be supplied along with each board.

6.5 Air Break Contactors

6.5.1 The Air Break Contactors shall be of Category AC3/AC4, unless otherwise specified, conforming to IS: 60947 and flapper type.

6.5.2 The dropout voltage shall not exceed 65% of rated voltage.

6.5.3 Each contactor shall be provided with auxiliary contacts as required. The rating of the auxiliary contacts shall be 5 Amps. AC or 1 Amp DC at the specified control voltages. The spare auxiliary contacts shall also be wired up to the terminal blocks.

6.6 Bimetal Thermal Overload Relays

6.6.1 The contactor shall be provided with three pole bimetal thermal overload relays, unless other-wise specified. The bimetal relays shall be of suitable range, ambient temperature compensated and shall be separate mounting type. They shall be adjustable through graduated scale and shall be provided with changeover contact. Thermal relays having long time/current characteristics, operated through saturated C.T.s shall be supplied, wherever required.

6.6.2 Bimetal thermal relays shall conform to IS: 3231 and IS/IEC 60947 and shall have built-in single phasing preventor.

6.6.3 The bimetal relays shall be provided with a manual resetting device resetable after opening module door. Auto reset thermal relays are not acceptable.

6.7 **Current Transformers**

6.7.1 The current transformers shall conform to IS: 2705.

6.7.2 C.T.s shall be Class F insulated and vacuum impregnated or resin cast. The C.T.s shall be rigidly mounted and shall be easily accessible for maintenance and testing.

6.7.3 The short time thermal withstand ratings of C.T.s shall be same as the thermal withstand rating of the breakers.

6.7.4 The C.T.s output shall be minimum 15VA for breaker feeders and 7.5 VA for the other feeders per phase and in any case, the output shall be adequate for the protection and metering duties involved with sufficient margin. The C.T.s shall have the following accuracies for the various applications:

	Application	Class of accuracy as per IS: 2705
i)	For metering service	- 1
ii)	For use with protective relays	- 5P
iii)	For use with restricted earth fault and differential relays	- PS

6.7.5 The C.T. cores for metering and protection shall be separate.

6.7.6 The ratio of C.T.s shall be as specified in Feeder details.

6.7.7 All the C.T.s shall be provided with terminals and shorting links. One of the terminals of the C.T. shall be earthed. The polarity of the C.T.s shall be clearly marked.

6.7.8 Provision of Interposing C.T.s is not acceptable.

6.7.9 The C.T.s shall be capable of withstanding momentary open circuit on the secondary side without injurious effects.

6.8 **Voltage Transformers**

6.8.1 The V.T.s shall be Class F insulated and vacuum impregnated or resin cast conforming to IS: 3156.

6.8.2 The primary nominal voltage shall be equal to the system nominal voltage. The secondary terminal voltage shall be 110 V.

6.8.3 The primary and secondary winding shall be protected by HRC fuses in each phase except in the ground phase of the secondary side.

6.8.4 The V.T.s shall be mounted on separate withdrawable carriage. The accuracy Class of V.T.s shall be 1.

6.8.5 The rated output of each V.T. shall be adequate for the relays, meters and associated wiring connected to it and shall not be less than 50 VA per phase.

6.9 **Control Transformers**

These shall be air cooled Class F insulated and vacuum impregnated. The rating of control transformer shall be twice the hold on VA of all contactor/relays or 2.5 KVA whichever is high. It shall be free from hum and rigidly mounted. Epoxy cast transformers shall be preferred.

6.10 **Transformers for Kondorffer Starting**

These shall be three phase core type, Class F insulated and vacuum impregnated. Tapping at 90%, 80%, 70% & 60% shall be provided and terminals shall be brought out for easy change of tapping at site. The operating temperature shall not exceed 80ºC. The transformers shall be suitable for taking 7.5 times the specified full load current of the motor continuously for 120 secs.

6.11 **Relays**

6.11.1 All protective relays shall be of latest version, microprocessor based numerical type with communication port and interlinked with online energy management system. 100% redundancy shall be provided for communication.

6.12 **Timers**

The timers shall be electronic pneumatic or synchronous type with manual/auto reset features as per the functional requirements. The time delay shall be 'ON' delay or 'OFF' delay type as specified. The repeat accuracy shall be 0.5% or better.

6.13 **Single Phasing Preventor**

6.13.1 Single phasing preventor relay shall be of the current operated type, suitable for the system voltage. The relay shall not operate for normal system voltage but operate positively in the event of unbalanced voltage more than the normal. The relay shall not operate in case of total interruption of power.

6.13.2 The relay shall be fail safe, self reset type and provided with flag indication. The relay operation shall be independent of the motor rating, loading and speed.

6.14 **Instruments and Meters**

6.14.1 All instruments shall be flush mounting type with square face of 96 mm x 96 mm. They shall be tropicalized and dust tight.

6.14.2 Meters shall be digital multifunctional meters with communication port for energy management at remote location.

6.14.3 All ammeters and voltmeters, to be provided separately, shall have 0-90º scale and shall be moving iron spring controlled type of class 1.5 accuracy as per IS: 1248. The scale range of the ammeters and voltmeters shall be as indicated in the Feeder details.

6.14.4 In case of motor feeders, the ammeters shall be graduated uniformly upto C.T. primary current and with compressed end scale upto 6 times C.T. primary current. Red pointer shall be provided, which shall be adjusted at site for indicating full load current of the motor.

6.15 **Push Buttons and Control Switches**

6.15.1 The switches and push buttons shall conform to utilization category AC11/DC11 as per IS: 60947. The contact shall be rated to make, break and carry inductive current of 5 Amp at 415 V AC and 1 Amp at 220 V DC.

6.15.2 The control switches shall be spring return rotary type, unless otherwise specified and provided with pistol grip type handle. The control switches for circuit breakers shall be additionally fitted with lost motion devices and sequencing devices.

6.15.3 The selector switches shall be stay put rotary type and provided with oval shape handles.

6.15.4 The push buttons shall be of momentary contact spring loaded type with a set of normally close and open contacts. The push button for 'Start' shall be shrouded type and coloured green, stop push button shall be un-shrouded type and coloured red and

other push buttons shall be un-shrouded type coloured black. The fixing ring shall be metallic white.

6.15.5 Emergency stop push buttons, if specified, shall be lockable in pushed position.

6.16 **Miniature Circuit Breakers**

6.16.1 The miniature circuit breakers shall conform to IS: 8828 and shall be of duty category M-9.

6.16.2 It shall be provided with overload and short circuit protective devices in a heat resistant housing.

6.16.3 A certificate for short circuit rating and Current-Time tripping curve shall be furnished along with the offer.

6.17 **Signal Lamps**

6.17.1 Signal lamps shall be provided to indicate the various circuit conditions as shown in scheme drawings. The colour of the lamps for various functions shall be as follows :

Red -- Circuit breaker/switch/contactor closed.
Green -- Circuit breaker/switch/contactor open.
White -- Trip circuit healthy.
Amber -- Alarm and auto trip.
Blue -- Non-Trip

6.17.2 All lamps shall be of LED type with lumen output of 200 mili candela in axial direction.

7.0 ACCESSORIES

7.1 The supply shall include the following accessories:

-- Maintenance truck/device for raising, lowering and withdrawal of circuit breaker, if required.
-- Fuse puller.
-- Test plug for relays.
-- Test plug for kWh meters.

7.2 **Space Heater**

Each vertical section shall be provided with a thermostatically controlled space heater, rated for 240 V, 50 Hz and controlled through double pole miniature circuit breaker.

7.3 **Name Plates**

7.3.1 The switchboard shall have large name plate on the top indicating its Name, Designation and Code No.

7.3.2 Each feeder shall be provided with name plate. Each single front panel shall have name plate indicating panel number both in front and back.

7.3.3 All control switches, push buttons, lamps etc. shall have functional identification labels.

7.3.4 Name plate shall be of black Perspex with white engraving and of minimum 3mm thick.

7.4 Any other accessories required, but not specified, shall also be supplied to make the switchboard complete in all respects and ensure safe and proper operation.

8.0 PAINTING

8.1 The enclosure, after degreasing, pickling in acid, cold rinsing, phosphatising, passivating etc. shall be painted with two coats of anti-rust paint followed by two coats of anticorrosive paint.

8.2 Epoxy based paint shall be used.

8.3 All paints shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off, crinkle or be removed by abrasion due to normal handling.

8.4 Unless otherwise specified, the finishing shade shall be light grey having Shade No.631 as per IS: 5.

8.5 One litre of paint shall be supplied along with each board for touch up at site.

9.0 TESTS AND INSPECTION

9.1 All the switchboards shall be subjected to routine test as per IS: 8623 and their components as per relevant standards.

9.2 Additional tests, wherever specified, shall be carried out.

9.3 All the above tests shall be carried out in presence of Purchaser's representative. In addition, the equipment shall be subjected to stage inspection during process of manufacture at works and site inspection.

9.4 These inspections shall however, not absolve the vendor from their responsibility for making good any defect which may be noticed subsequently.

10.0 DRAWINGS AND DOCUMENTS

10.1 Drawings and documents as per Annexure-I shall be supplied, unless otherwise specified.

10.2 All drawings and documents shall have the following description written boldly:

-- Name of Client
-- Name of Consultant
-- Enquiry / Order Number with Project / Plant Name
-- Code No. & Description

11.0 SPARES

11.1 Commissioning Spares: Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for approval.

11.2 Spare Spares for 2 Years operation (Mandatory), as specified shall be supplied.

11.3 Recommend 2 years Operational Spares (other than mandatory spare) alongwith recommended quantity & item-wise unit price shall be furnished.

11.4 All spare parts shall be identical to the parts used in the equipment

12.0 PACKING

12.1 The board shall be properly packed before despatch to avoid damage during transport, storage and handling.

12.2 The packing box shall contain a copy of the installation, operation and maintenance manual.

12.3 A sign to indicate the upright position of the panels to be placed during transport and storage shall be clearly marked. Also proper arrangement shall be provided to handle the equipment.

13.0 DEVIATIONS

13.1 Deviations, if any, from this standard shall be clearly indicated in the offer with reasoning.

ANNEXURE - I

DOCUMENTATION FOR MEDIUM VOLTAGE SWITCHBOARDS

Sl.No.	Documentation Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheets	N	Y	Y
2.	Technical Particulars	N	Y	Y
3.	Feeder Details	N	Y	Y
4.	General arrangement and Foundation Drgs.	N	Y	Y
5.	Schematic and Wiring Diagrams	N	Y	Y
6.	Calculation for Bus-bar sizing	N	Y	N
7.	Terminal Arrangement Drgs.	N	Y	Y
8.	Illustrative and Descriptive Literature	N	N	Y
9.	Catalogues for bought out accessories.	N	N	Y
10.	Installation, Operation and maintenance manual.	N	N	Y
11.	Test Certificates			
	i) Type -- Switchboard	N	N	N
	-- Circuit Breaker	N	N	N
	-- MCCB's	N	N	N
	ii) Routine	N	N	Y
12.	Guarantee Certificates	N	N	Y
13.	Spare Parts List	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N – No

TECHNICAL SPECIFICATION

HIGH VOLTAGE SWITCH BOARDS

CONTENTS

1.0 SCOPE

1.1 This standard covers the technical requirements of design, manufacture, testing at works and delivery in well-packed condition of High Voltage Switch Boards.

1.2 This standard shall be read in conjunction with relevant part of Design Philosophy – Electrical , Schematic diagrams etc.

2.0 STANDARDS TO BE FOLLOWED

2.1 The design, manufacture and testing of the equipment shall comply with the latest issues of the following standard, unless otherwise specified. Equipment complying with equivalent IEC standards shall also be acceptable.

IS: 3427 A.C. Metal enclosed switchgear and control gear for rated voltages above 1 kV up to and including 52 kV.

IS: 13118 Specification for high voltage alternating current circuit breakers.

IS: 5578 Guide for marking of insulated conductors.

IS: 11353 Guide for uniform system of marking and identification of conductors and apparatus terminals.

IS: 10118 Code of Practice for selection, installation and maintenance of switchgear and control gear.

Various components housed in the switchboards shall conform to the Indian Standards Specification as mentioned against the component details or IEC Specifications.

2.2 The design and operational features of all the equipment offered shall also comply with the provisions of the latest issue of the Indian Electricity Rules and other Statutory Acts and Regulations. The supplier shall, wherever necessary, make suitable modifications in the equipment to comply with the above.

2.3 Wherever any requirement, laid down in this standard, differs from that in Indian Standard Specifications / IEC Specification, the requirement specified herein shall prevail.

3.0 SERVICE CONDITIONS

3.1 Ambient Conditions

These shall be as indicated in Design Philosophy – Electrical.

3.2 System Details

These shall be as indicated in Design Philosophy – Electrical.

4.0 OPERATING REQUIREMENTS

The switchboards shall be suitable for operating at the specified rating continuously, with the specified voltage and frequency variations under the ambient conditions, without exceeding the permissible temperature rise and without any detrimental effect on any part.

5.0 DESIGN AND CONSTRUCTIONAL FEATURES

5.1 General

5.1.1 The switchboards shall consist of an assembly of a series of floor mounting, identical, metal clad, cubicle type panels placed side by side to form a compact assembly and shall be extensible on either side.

5.1.2 The complete assembly shall be dust, damp and vermin proof having minimum degree of protection equivalent to IP4X as per IS/IEC:60529. However, in case some ventilation openings are to be provided, these may be permitted for equipment located indoors and such openings shall be covered by fine wire mesh ensuring minimum IP3X protection.

5.1.3 The framework of the cubicles shall be bolted / welded construction. The minimum thickness of sheet steel shall be 3 mm for base channel and 2 mm for other members. The doors and covers shall be fabricated from cold rolled sheet steel. Suitable reinforcement, wherever necessary, shall be provided.

5.1.4 The switchboard shall be mounted on the channel which shall be included in the vendor's scope.

5.1.5 Each cubicle shall be provided with front access door with handle lock and key for breaker compartment and a removable back cover. The door hinges shall be concealed type. Front doors of the panels shall mechanically stop in full open position to facilitate removal of breakers and for ease of maintenance.

5.1.6 All external hardwares shall be cadmium plated. The hardwares for fixing removable parts shall be provided with retaining devices.

5.1.7 The doors and the removable covers shall be provided with non-deteriorating neoprene gaskets. Gaskets without any discontinuity shall be preferred. Gaskets shall be held in position in groove, in shaped sheet steel work or these shall be U-type.

5.1.8 Each cubicle shall have separate compartment within the cubicle for circuit breaker, bus-bars, instrument transformers, metering and relaying devices and cable termination.

5.1.9 Inter-panel and inter-compartment fire resistant barrier shall be provided. Cast resin seal off bushing shall be provided in the bus compartment, through which connections to breaker compartment/cable compartment/bus compartment of adjacent panel shall be taken. Failure of one of the equipment shall not effect the equipment in the adjacent compartment.

5.1.10 All the components shall be accessible for inspection and maintenance without the necessity of removing the adjacent ones. Their mounting shall be accessible and ensure the necessary degree of safety.

5.1.11 The layout of the components inside the cubicle shall be liberal to facilitate maintenance and the interconnecting wiring between components shall not be subjected to undue stresses at the bends.

5.1.12 Mounting height of components requiring operation and maintenance shall not be lower than 300 mm and higher than 1800 mm.

5.1.13 All live parts which are accessible after opening of front and back door/cover shall be properly insulated or provided with insulating barrier to prevent accidental contact. Phase insulating barriers shall be provided between the breaker poles. Removal facility shall be provided for all such barriers.

5.1.14 Adequate arrangement for earthing shall be provided to safeguard the operator or other personnel from electric hazards under all conditions of operation.

5.1.15 The switchboard shall be provided with following interlocks and safety features:

i) The withdrawal and engagement of a circuit breaker shall not be possible unless it

is in open position.

ii) The operation of a circuit breaker shall not be possible unless it is in fully service, test or isolated position.

iii) It shall not be possible to close the circuit breaker in service position unless all auxiliary and control circuits are connected.

iv) A breaker of the lower rating shall be prevented from engaging with the stationary element of higher rating.

v) Insertion of the manual mechanism shall render the motorized mechanism inoperable.

vi) Circuit breaker “ON”, “OFF” indication shall be provided at the back of each panel.

vii) Caution name plate shall be provided at the back of incomer panels where terminals are likely to remain live and isolation is possible only from remote end.

viii) Automatic safety shutter, with padlocking facility for locking in closed position, to completely cover the spouts for bus-bars and cable connection when the breaker is withdrawn.

5.2 Bus-Bars and Connections

5.2.1 The bus-bars shall be for three phases. The bus-bars and connection shall be made of electrolytic grade copper of rectangular cross-section.

5.2.2 Bus-bars and connections shall be sleeved to protect against approach to live parts and to eliminate potential arcing points. Sleeving material shall have adequate electrical, thermal and mechanical properties to withstand impulse level, temperature rise during normal and short circuit condition and allow easy bending of bus bars.

5.2.3 The bus-bars shall be amply sized to carry the rated continuous current under the specified ambient temperature without exceeding the limits specified in IS: 8084. The thermal rating of the bus-bars shall be designed to withstand the system fault current for 3 seconds without exceeding the limiting temperature of 250ºC for bare copper. Calculation for bus-bar sizing shall be furnished along with the offer.

5.2.4 Horizontal bus-bars shall run in a separate compartment through the entire length of the board and shall be of same cross-section throughout. Stepped bus-bars shall not be acceptable.

5.2.5 The bus-bars shall be arranged and colour coded according to IS: 5578 & IS: 11353.

5.2.6 The bus-bars chamber shall be sufficiently spacious and shall have separate screwed covers for maintenance purpose. It shall be adequately ventilated and shall allow the escape of the hot gases.

5.2.7 The bus-bars shall be rigidly supported at equal intervals to withstand the stresses due to full short circuit and also to take care of thermal expansion.

5.2.8 A minimum of two bolts shall be used per bus-bar joint. Only high tensile electro galvanized cadmium plated bolts, nuts and washers shall be used. The washers shall be spring and plain type. The bus-bar supports shall be of molded construction with built-in anti-tracking barriers. The support materials shall be of DMC or fiber glass reinforced thermosetting plastic.

5.2.9 The bus-bars, both horizontal and vertical, shall be PVC sleeved. Insulating shrouds shall be provided for all joints of insulated bus-bars.

5.3 Earth Bus

A continuous earth bus of Aluminium running along the lower part of the switchboard shall be provided with two end terminals with lugs for external connection. The earth

bus shall be rated to carry three phase fault current for a period of 3 sec.

5.4 **Bus Duct**

5.4.1 Suitable extension of bus-bars in proper phase sequence on the top, with connecting bolts shall be provided where connections between transformer and switchboard or between two halves of the switchboard is specified to be through bus duct.

5.4.2 Bus duct between two halves of the switchboard, if required, shall be supplied by the switchboard manufacturer. The bus-bars of interconnecting bus duct shall be similar to the main bus-bars of switchboard as specified above and shall conform to IS: 8084.

5.4.3 Bus duct between transformer and switchboard, if included in vendor's scope shall conform to IS: 8084.

5.5 **Clearances and Creepage Distance**

The clearance and creepage distance shall be adequate to meet the BIL of the equipment.

5.6 **Insulation**

5.6.1 The insulation used shall be non-hygroscopic and shall be of porcelain, epoxy resins or fiber glass molded with plastic. It shall be of adequate electrical, mechanical and thermal strength to give trouble free service during normal operation and short circuit conditions.

5.6.2 The insulation shall be treated suitably to withstand the tropical conditions and atmospheric pollution.

5.7 **Control Wiring**

5.7.1 The switchboard shall be completely factory wired and ready for external connections.

5.7.2 The wiring shall be complete in all respect so as to ensure proper functioning of control, interlocking, protection, metering, indications and annunciations.

5.7.3 The wiring shall be carried out with flexible stranded PVC insulated copper conductor cables of 1100 Volt grade. The minimum size of wires shall be as follows:

C.T. Circuit	--	2.5 Sq. mm
V.T. and Control Circuits	--	1.5 Sq. mm

5.7.4 All wiring shall be provided with dependent both ends marking as per IS: 5578. Numbered ferrules, reading from the terminal outwards, shall be provided at both ends of all wiring for easy identification. These shall be interlocking type plastic ferrules.

5.7.5 Control wiring circuits, fed from a supply common to a number of panels, shall be so protected that failure of a circuit in one panel does not affect the operation of other panels.

5.7.6 The wiring to the equipment mounted on the doors shall be carried out with flexible multi-strand copper conductor cable and so supported that on opening of the door, there is no undue strain on wire leads.

5.7.7 The control cables shall be neatly arranged and properly supported.

5.8 **External Cable Termination**

5.8.1 All power and control cables shall enter the switchboard from the bottom on the back of the panel. Sufficient space shall be provided for ease of connection and termination of cables.

5.8.2 All power cables and control cables shall be of type, number and size as indicated in Feeder Details.

5.8.3 The termination arrangement for single core cables shall be such that so as to minimize flow of eddy current and heating due to eddy currents.

5.8.4 Heavy duty double compression type rolled Aluminium cable glands along with the cable lugs, as required shall be provided for termination of control cables and auxiliary power supply cables.

5.8.5 The cable glands shall be mounted on a removable gland plate, provided at a minimum height of 75 mm from the bottom of the switchboard. Two number spare knockouts of size 20 mm shall also be provided on the gland plate for future use.

5.8.6 Terminal blocks shall be provided at suitable locations inside the panels for termination of control and auxiliary power supply wiring. These terminal blocks shall be pressure clamp type up to 35 sq. mm cables and bolted lug type for higher sizes of cables. These shall be protected type and rated for 1100 Volt service. The minimum current rating of the terminal block shall be 16 Amp.

5.8.7 Where more than two cables in parallel are required to be terminated, a system of bus links shall be provided with adequate clearance and spacing.

5.8.8 The terminal block shall be grouped according to circuit functions and numbered suitably. 20% extra terminals shall be provided in the terminal block.

5.8.9 Suitable clamps to support the vertical run of cables shall be provided.

5.8.10 For power connections, suitable marking on the terminals shall be provided to identify the phases.

5.9 **Feeder Details**

5.9.1 The requirements of incomer, bus coupler and outgoing feeders shall be as indicated in the single line diagram, feeder details and corresponding schematic diagrams.

5.9.2 Non-paralleling interlocks shall be provided between incomers and bus section panels. The interlocks shall be either electrical or mechanical type. Arrangement for defeating the interlock shall also be provided.

5.9.3 Auto changeover scheme, wherever specified, shall be provided.

5.10 **Dummy Panels**

Dummy panels complete with bus-bar system in 400 mm width shall be required for which unit price shall be indicated.

5.11 **Control Power Supply**

5.11.1 D.C. power required for closing, tripping and indication shall be supplied at the bus coupler panel through two completely separate circuits by the owner, one for tripping and another for closing and indication for the whole board.

5.11.2 For receiving each external control power supply, a double pole miniature circuit breaker shall be provided. This power shall be distributed inside the switchboard for each feeder having its MCB unit.

5.12 **Space Heater Power Supply**

5.12.1 Panel space heaters shall be fed from a separate bus, common for the whole board. This bus shall be fed from owner's supply for which a double pole MCB shall be provided in bus section panel.

5.12.2 Power supply for space heaters of motors shall be tapped from this bus by means of miniature circuit breakers located in the motor feeder panels. These MCB's shall be of triple pole and rated for 15 Amp.

6.0 COMPONENT DETAILS

Makes of all components shall be subject to owner's / consultant's approval

6.1 Circuit Breakers

6.1.1 The circuit breakers shall comply with the requirements of IS: 13118.

6.1.2 All circuit breakers shall be of 0-3 min-CO-3 min-CO rated operating sequence capable of carrying the specified current at the site conditions and making/breaking of the system fault current.

6.1.3 Type test certificates from an independent testing authority shall be furnished along with the offer for each circuit breaker rating and type.

6.1.4 The circuit breakers controlling motors shall be suitable for DOL starting and stopping induction motor a number of times and shall have provision to limit over voltage to the value safe for motor insulation. Unless otherwise specified this value shall be taken as 2.5 times the rated voltage. The magnitude of the voltage surge produced by the breaker when switching off the smallest motor shall be indicated.

6.1.5 The circuit breakers controlling capacitors shall be suitable for energizing and de-energizing the rated capacitor bank.

6.1.6 The circuit breakers shall be of the 3 phase, single/double break, horizontal draw-out, vertical/horizontal isolation type. The medium of arc quenching shall be minimum Oil/Bulk oil/vacuum/SF6 as specified elsewhere.

6.1.7 The circuit breakers shall be suitable for electrical/manual closing as specified in Feeder details. Electrically operated circuit breakers shall preferably have motor wound spring closing mechanism with provision for manual closing arrangement. Manually operated circuit breakers shall have independent manual spring closing mechanism. In all cases tripping shall be by means of shunt trip coil.

6.1.8 All circuit breaker units of the same rating shall be physically and electrically interchangeable.

6.1.9 The circuit breakers shall be electrically and mechanically trip free and provided with anti-pumping feature.

6.1.10 The circuit breakers shall have three positions, i.e. service, test and isolated with the cubicle door closed. Necessary stoppers shall be provided to prevent the excessive movement of the breaker cradle than desired for the position. Service and test positions of the breaker shall have monitoring switch having 1NO+1NC contacts.

6.1.11 The circuit breakers shall be provided with emergency manual trip device, mechanical 'ON', 'OFF', 'ISOLATED' position and spring 'CHARGED', 'DISCHARGED' indicators and operation counter.

6.1.12 A maintenance truck/device, if required, for raising, lowering and withdrawals of the circuit breaker shall be supplied for each switchboard.

6.1.13 The arc interrupting devices shall be capable of interrupting satisfactorily current from zero to the rated interrupting current when used on predominantly capacitive or inductive circuits, without requiring excessive maintenance of the contacts. The arc shall be restricted within the interrupting chamber and no emission of flame shall be allowed which may cause electrical breakdown or damage to insulation on the apparatus.

6.1.14 Mechanical safety interlock shall be provided for safe operating and movement of the breaker.

6.1.15 The circuit breakers shall be provided with minimum of four normally open and four normally closed auxiliary switch contacts, over and above those required for its own control scheme, for owner's use. These contacts shall be wired separately to the terminal board.

6.1.16 The closing coil and other associated auxiliary relays shall operate satisfactorily at all voltages between 85% and 110% of the rated control voltage. The tripping coil and other associated relays shall operate satisfactorily at all voltages between 70% and 110% of the rated control voltage.

6.1.17 Cable earthing facility shall be provided in the circuit breaker for discharging of power cable through the circuit breaker contact with circuit breaker in drawn-out position. An integral earthing arrangement shall be preferred. In case the integral earthing arrangement is not feasible due to circuit breaker design, a separate earthing truck, which shall be inserted in place of circuit breaker, shall be provided per board.

6.1.18 Positive earthing of circuit breaker frame shall be maintained at every position of circuit breaker. The earthing contact shall be line/scrapping type and not of point type.

6.2 **Current Transformers**

6.2.1 The current transformers shall conform to IS: 2705.

6.2.2 C.T.s shall be class F insulated and vacuum impregnated or resin cast type. The C.T.s shall be rigidly mounted and shall be easily accessible for maintenance and testing.

6.2.3 The short time thermal withstand ratings of the C.T.s shall be same as the thermal withstand ratings of the breakers.

6.2.4 The C.T.s output shall be minimum 15 VA per phase and in any case, the output shall be adequate for the protection and metering duties involved with sufficient margin. The C.T.s shall have the following accuracies for the various applications:

	Application	Class of Accuracy as per IS: 2705
i)	For metering service	1
ii)	For use with protective relays	5 P
iii)	For use with restricted earth fault and differential relays	PS

6.2.5 The C.T. cores for metering and protection shall be separate.

6.2.6 The ratios of the current transformers shall be as indicated in Feeder details.

6.2.7 All the C.T.s shall be provided with terminals and shorting links. One of the terminals of the C.T. shall be earthed. The polarity of the C.T. shall be clearly marked.

6.2.8 Provision of interposing C.T. is not acceptable.

6.2.9 The C.T.s shall be capable of withstanding momentary open-circuit on the secondary side without injurious effects.

6.3 **Voltage Transformers**

6.3.1 The V.T.s shall be class F insulated and vacuum impregnated or resin cast type conforming to IS: 3156.

6.3.2 The primary nominal voltage shall be equal to the system nominal voltage. The secondary terminal voltage shall be $110 / \sqrt{3}$ V.

6.3.3 The rated output of each VT shall be adequate for the relays, meters and associated wiring connected to it with sufficient margin and shall not be less than 200 VA per phase.

6.3.4 The accuracy class of V.T.s shall be 1 as per IS: 3156.

6.3.5 The primary and secondary winding shall be protected by HRC fuses in each phase except in the grounded phase of the secondary side.

6.3.6 The V.T. shall be mounted on a with-drawable carriage. Shutters with padlocking facility, provided on high voltage sides, shall be so arranged that the live orifices are automatically closed when the V.T. is withdrawn.

6.3.7 Mechanical interlocking arrangement shall be provided so that the access to the high voltage fuse is possible only when the V.T. is fully withdrawn.

6.4 **Relays**

6.4.1 All protective relays shall be of latest version, microprocessor based numerical type with communication port and interlinked with online energy management system. 100% redundancy shall be provided for communication.

6.5 **Timers**

6.5.1 The timers shall be electronic, pneumatic or synchronous type with manual/ auto reset features as per the functional requirements. The timers shall be 'ON' delay or 'OFF' delay type as specified. The repeat accuracy shall be 0.5% or better.

6.6 **Instruments and Meters**

6.6.1 All instruments shall be flush mounting type with square face of 96 mm x 96 mm. They shall be tropicalized and dust tight.

6.6.2 Meters shall be digital multifunctional meters with communication port for energy management at remote location.

6.6.3 All ammeters and voltmeters, to be provided separately, shall have 0-90º scale and shall be moving iron spring controlled type of class 1.5 accuracy as per IS: 1248. The scale range of the ammeters and voltmeters shall be as indicated in the Feeder details.

6.6.4 In case of motor feeders, the ammeters shall be graduated uniformly upto C.T. primary current and with compressed end scale upto 6 times C.T. primary current. Red pointer shall be provided, which shall be adjusted at site for indicating full load current of the motor.

6.7 **Push Buttons and Control Switches**

6.7.1 The switches and push buttons shall conform to utilization category AC11/DC11 as per IS/IEC:60947. The contact shall be rated to make, break and carry inductive current of 5 Amps. at 415 V AC and 1 Amp. at 220 V DC.

6.7.2 The control switches shall be spring return rotary type, unless otherwise specified and provided with Pistol grip type handle. The control switches for circuit breakers shall be additionally fitted with lost motion devices and sequencing devices, if required.

6.7.3 The selector switches shall be stay put rotary type and provided with oval shape handles.

6.7.4 The push buttons shall be of momentary contact spring loaded type with a set of normally close and open contacts. The start push button shall be shrouded type and coloured green. The stop push button shall be un-shrouded type and coloured red and other push buttons shall be un-shrouded type and coloured black. The fixing ring shall be metallic white.

6.7.5 Emergency stop push buttons, if specified, shall be lockable in pushed position.

6.8 **Control Fuses**

6.8.1 The fuses shall be non-deteriorating HRC cartridge link type and shall conform to IS:

13703. They shall be suitable for load and service required in the circuit.

6.8.2 One fuse puller shall be supplied along with each board.

6.9 **Miniature Circuit Breakers**

6.9.1 The miniature circuit breakers shall conform to IS: 8828 and shall be of duty category M-9.

6.9.2 It shall be provided with overload and short circuit protective devices in a heat resistant housing.

6.9.3 Type test certificate for short circuit rating and current time tripping curve shall be furnished along with the offer.

6.10 **Signal Lamps**

6.10.1 Signal lamps shall be provided to indicate the various circuit conditions as shown in scheme drawings. The colour of the lamps for various functions shall be as follow:

Red	-	Circuit breaker 'ON'
Green	-	Circuit breaker 'OFF'
White	-	Trip circuit healthy
Amber	-	Alarm and auto trip
Blue	-	Non-Trip

6.10.2 The lamps shall LED type with lumen output of 200 millicandella in axial direction.

7.0 ACCESSORIES

7.1 The supply shall include the following accessories.

- Maintenance truck/device for raising, lowering and withdrawal of circuit breaker, if required.
- Earthing truck, in case the integral earthing arrangement is not feasible in the circuit breaker.
- Fuse puller.
- Test plug for relays.
- Test plug for kWh meters.
- Special tools and tackles, as required.

7.2 **Space Heater**

7.2.1 Each panel shall be provided with a thermostatically controlled space heater, rated for 240 V, 50 Hz and controlled through double pole miniature circuit breaker.

7.3 **Name Plates**

7.3.1 The switchboard shall have large name plate on the top to indicate its name and designation.

7.3.2 Each panel shall be provided with name plate both in front and back.

7.3.3 All control switches, push buttons, lamps etc. shall have functional identification labels.

7.3.4 Name plate shall be of black Perspex with white engraving and of minimum 3 mm thick.

7.4 Any other accessories required, but not specified, shall also be supplied to make the switchboard complete in all respects and ensure safe and proper operation.

8.0 PAINTING

8.1 The enclosure, after degreasing, pickling in acid, cold rinsing, phosphatising, passivating etc. shall be painted with two coats of anti-rust paint followed by two coals of anti-corrosive paint.

8.2 Epoxy based paint shall be used.

8.3 All paints shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off, crinkle or be removed by abrasion due to normal handling.

8.4 Unless otherwise specified, the finishing shade shall be light grey having shade No.631 as per IS: 5.

8.5 One litre of paint shall be supplied along with each board for touch up at site.

9.0 TESTS AND INSPECTION

9.1 All the switchboards shall be subjected to routine test as per IS: 3427 and their components as per relevant standards.

9.2 Additional tests, wherever specified, shall be carried out.

9.3 All the above tests shall be carried out in presence of purchaser's representative. In addition, the equipment shall be subjected to stage inspection during process of manufacture at works and site inspection.

9.4 These inspection shall, however, not absolve the vendor from his responsibility for making good any defect which shall be noticed subsequently.

10.0 DRAWINGS AND DOCUMENTS

10.1 Drawings and documents as per Annexure-I shall be supplied, unless otherwise specified.

10.2 All drawings and documents shall have the following description written boldly.

- Name of client
- Name of consultant
- Enquiry / Order Number with plant / project name
- Code No. and Description

11.0 SPARES

11.1 Commissioning Spares: Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for approval.

11.2 Spares for 2 Years operation (Mandatory), as specified shall be supplied.

11.3 Recommend 2 years Operational Spares (other than mandatory spare) alongwith recommended quantity & item-wise unit price shall be furnished.

11.4 All spare parts shall be identical to the parts used in the equipment

12.0 PACKING

12.1 The switchboard shall be properly packed before dispatch to avoid damage during transport, storage and handling.

12.2 The packing box shall contain a copy of the installation, operation and maintenance manual.

12.3 A sign to indicate the upright position of the panels to be placed during transport and storage shall be clearly marked. Also proper arrangement shall be provided to handle the equipment.

13.0 DEVIATIONS

13.1 Deviations, if any, from this standard shall be clearly indicated in the offer with reasoning.

ANNEXURE - I
DOCUMENTATION FOR HIGH VOLTAGE SWITCHBOARDS

Sl. No.	Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheets	N	Y	Y
2.	Technical Particulars	N	Y	Y
3.	Feeder Details	N	Y	Y
4.	General arrangement and Foundation Drawings	N	Y	Y
5.	Schematic/Wiring Diagrams	N	Y	Y
6.	Calculation for Bus-bar sizing	N	Y	N
7.	Terminal Arrangement Drawings	N	Y	Y
8.	Illustrative and Descriptive Literature	N	N	Y
9.	Catalogues for bought out accessories	N	N	Y
10.	Installation, Operation and maintenance manual	N	N	Y
11.	Test Certificates			
	i) Type - Switchboard	N	N	N
	- Circuit Breaker	N	N	N
	- MCB	N	N	N
	ii) Routine	N	N	Y
12.	Guarantee Certificates	N	N	Y
13.	Spare Parts List	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N – No

TECHNICAL SPECIFICATION

BUS DUCT

CONTENTS

1.0 SCOPE

1.1 This standard covers the technical requirements of design, manufacture testing at works and despatch in well packed condition of bus duct.

1.2 This standard shall be read in conjunction with relevant part of Design Philosophy - Electrical.

2.0 STANDARDS TO BE FOLLOWED

2.1 The design, manufacture and testing of the equipment covered by this standard shall comply with the latest issue of following Indian Standards unless otherwise specified. Equipment complying with equivalent IEC standards shall also be acceptable.

IS: 8084	-	Interconnecting bus-bars for A.C. Voltage above 1 KV up to and including 36 KV.
IS: 8623	-	Specification for low voltage switchgear and control gear assemblies.
IS: 5578	-	Guide for marking of insulated conductors.
IS: 11353	-	Guide for uniform system of marking and identification of conductors and apparatus terminals.

2.2 The design and operational features of all the equipment offered shall also comply with the provisions of the latest issue of the Indian Electricity Rules and other relevant Statutory Acts and Regulations. The supplier shall wherever necessary, make suitable modifications in the equipment to comply with the above.

2.3 Wherever any requirement, laid down in this standard differs from those in Indian Standard Specifications, the requirement specified herein shall prevail.

3.0 SERVICE CONDITIONS

3.1 Ambient conditions

These shall be as indicated in Design Philosophy - Electrical.

3.2 System Details

These shall be as indicated in Design Philosophy - Electrical.

4.0 OPERATING REQUIREMENTS

The bus duct shall be suitable for operating at the rated capacity continuously under the ambient conditions and with the voltage and frequency variations without exceeding the permissible temperature rise and without any detrimental effect on any part.

5.0 GENERAL DESIGN AND CONSTRUCTIONAL FEATURES

5.1 Enclosures

5.1.1 The sheet steel enclosure for enclosing and supporting the bus-bars shall be made out of 14 SWG sheet steel, bolted on the angle iron frame work.

5.1.2 The enclosure shall completely enclose the bus bars from all sides. It shall have degree of protection IP: 52 for indoor installation and IP: 55 with rain protection canopy for outdoor installation as per IS/IEC:60947. Where part of the bus duct is required for indoor installation and part for outdoor installation, the complete section shall be suitable for outdoor installation. Ventilation louvers, if necessary, shall be provided with fine wire mesh from inside, in that case the degree of protection shall be IP: 42. Neoprene gasket shall be provided on covers at joints.

5.1.3 Whether bus duct (with louvers) is installed outdoor or indoor, suitably rated space heater with thermostat control shall be provided at different locations inside the bus duct to avoid moisture condensation.

5.1.4 All external hardwares of diameter less than 8 mm shall be stainless steel and those of diameter 8 mm and above shall be mild steel cadmium plated or zinc passivated.

5.2 **Bus Bars and Connections**

5.2.1 The bus-bars in LV Bus duct shall be of three phase and neutral, non-segregated and air insulated type.

The bus-bars in HV Bus duct shall be of three phase, phase-segregated with insulating material.

5.2.2 The bus bars shall be amply sized to carry the rated continuous current under the specified ambient temperature without exceeding the temperature limits specified in IS: 8084. The bus bars shall be designed to withstand the system fault current for one second without exceeding the total temperature of 200ºC. Type test certificate of similar bus duct shall be furnished.

5.2.3 The bus-bars material shall be high conductivity Aluminium alloy conforming to grade E91E of IS: 5082/electrolytic grade copper.

5.2.4 The bus-bars shall be rectangular in shape and cross-sectional area of neutral bus-bars shall be half of phase bus-bars.

5.2.5 The sizes of bus-bars selected shall be subjected to approval by PDIL. The vendor shall furnish supporting calculations for bus-bars and enclosure sizes both under normal load and short circuit conditions as well as that of temperature rise along with the offer.

5.2.6 All the bus-bars shall be bare and without any painting. The bus-bars shall be arranged and provided with proper phase identification as per IS: 5578/11353.

5.3 **Joints and Bends**

5.3.1 Only lap joints shall be used for jointing the bus bars. The over lap shall be equal to the width of the bus bars.

5.3.2 The contact surfaces of the overlapping bus-bars shall be thoroughly cleaned followed by application of good quality electrical grease and bolted immediately. In case of Aluminium to copper joints, copper bus-bars in addition shall be preferably tinned.

5.3.3 The bolting schedule adopted shall ensure proper contact pressure. A minimum of two bolts shall be used per joint.

5.3.4 The contact pressure shall be 100-140 kg/cm^2. Only high tensile, zinc passivated or galvanized steel bolts shall be used along with large diameter flat washers of adequate thickness.

5.3.5 At the bends, the bus-bars shall bend at a radius of 2t where the ‘t’ is the thickness of the bus-bars and the radius is measured to the inside of bus-bars.

5.4 **Flexible Joints**

Flexible joints and connections shall consist of tinned laminated copper strips or Aluminium strips of required cross sectional area. Precautions as mentioned under 5.3.2 shall also be observed while marking joints with laminated copper plates. Filler plates of Aluminium as required shall be used.

5.5 **Expansion Joints**

Expansion joints, where necessary, to allow for longitudinal expansion and contraction of bus-bars and bus enclosures caused by temperature variation shall be provided.

5.6 **Bus Bar Supports**

5.6.1 The bus-bars shall be rigidly supported at equal intervals. The bus-bars supports shall be such that they withstand stresses to which they may be subjected under normal and short circuit conditions.

5.6.2 The supports shall be of moulded construction of fibre glass reinforced with thermosetting plastics or superior materials. The supports, where necessary, shall either have built-in anti-tracking barriers or painted with anti-tracking varnishes.

5.7 **Clearances and Creepage Distance**

5.7.1 The clearances and creepage distance shall not be lower than the values specified below for any part of the bus duct.

i)	Minimum clearance between two live parts	-	25 mm
ii)	Minimum clearance between a live part and accidentally dangerous part	-	25 mm
iii)	Creepage distance	-	30 mm

5.7.2 The clearances and creepage distance, as specified above, shall definitely be maintained throughout the bus bars system. Provision of bus-bar separators or barriers shall not be considered to reduce the clearances from the values specified above.

5.8 **Terminal Chambers at Switchgear and Transformer End**

5.8.1 The bus duct shall be suitable for bolting to the flanges provided at the transformer and switchgear end. The exact dimensions and details of these terminal chambers shall be made available at the time of execution.

5.8.2 Phase changeover arrangement wherever required shall be provided in one of the terminal chambers to connect the bus-bars between same phase terminals at switchgear and transformer ends.

6.0 ACCESSORIES

6.1 **Earthing**
Two continuous earth strips of Aluminium having minimum 300 sq. mm size shall be provided throughout the length of bus duct or shall be suitable for full short circuit fault current for 1 sec. whichever is more.

6.2 **Drain Plug**
Bus duct shall be provided with drain plug to remove condensed moisture when required.

6.3 **Fire Barriers**
Two sets of epoxy moulded fire barriers shall be provided on switchgear end as well as transformer end.

6.4 **Name Plates**

6.4.1 Each bus duct shall be provided with a name plate of stainless steel with letter embossed on them and located at convenient location.

6.4.2 The name plate shall contain all details as per IS: 8084.

6.5 **Hardware**
Required number of hardwares like bolts, nuts, plain washers, spring washers etc. shall be provided for jointing the bus duct with transformer as well as switchgears.

7.0 LAYOUT

7.1 The proposed bus duct routing between transformer and associated switchgear shall be as shown in the drawing enclosed with NIT. Where no layout drawing is enclosed, the

schedule of quantities shall be followed for bidding. However, the exact routing and details of switchgear and transformer end chambers shall be supplied at the time of order or drawing approval.

7.2 The successful vendor shall prepare final layout drawing for each bus duct with bill of materials and submit the same for PDIL/Purchaser's approval.

8.0 PAINTING

8.1 The enclosure after degreasing, pickling in acid, rinsing, phosphatising, passivating etc. shall be painted with two coats of anti-rust paint followed by two coats of anticorrosive paint.

8.2 Epoxy based paint shall be used.

8.3 All paints shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off, crinkle or be removed by abrasion due to normal handling.

8.4 Unless otherwise specified, the finishing shade shall be light grey having shade no. 631 as per IS: 5.

9.0 TESTS AND INSPECTION

9.1 The bus duct shall be subjected to routine tests as per relevant standard.

9.2 Wherever specified, temperature rise tests shall be carried out on a minimum 5 metre length bus duct of each rating.

9.3 The test shall be carried out in manufacturer's works in presence of purchaser's representative. In addition, the bus ducts shall be subjected to stage inspection at works and inspection at site for final acceptance.

9.4 These inspections shall, however, not absolve the vendor from his responsibility of making good any defect which may be noticed subsequently.

10.0 DRAWINGS AND DOCUMENTS

10.1 Drawings and documents as per Annexure - I shall be supplied, unless otherwise specified.

10.2 All drawings and documents shall have the following descriptions written boldly

- Name of client
- Name of consultant
- Enquiry / Order Number with plant / project name
- Code No. and Description

11.0 SPARES

11.1 Commissioning Spares: Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for approval.

11.2 Spare Spares for 2 Years operation (Mandatory), as specified shall be supplied.

11.3 Recommend 2 years Operational Spares (other than mandatory spare) alongwith recommended quantity & item-wise unit price shall be furnished.

11.4 All spare parts shall be identical to the parts used in the equipment

12.0 PACKING

12.1 The bus duct shall be properly packed before despatch to avoid damage during transport, storage and handling. It shall be wrapped in polythene bags to make it

waterproof. An additional wrapping with bitumen paper shall also be provided to make it completely water proof before the equipment is packed in wooden crates.

12.2 The packing box shall contain a copy of the installation, operation and maintenance manual.

13.0 DEVIATIONS

13.1 Deviations, if any, from this standard shall be clearly indicated in the offer with reasoning.

ANNEXURE - I

DOCUMENTATION FOR BUS DUCT

Sl.No.	Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	General arrangement for each bus duct showing the complete layout.	N	Y	Y
2.	Design calculations	N	Y	N
	a) Bus bars sizing			
	b) Flexible sizing			
	c) Temperature Rise			
	d) Support Span			
3.	Specification sheet & Technical Particulars	N	Y	Y
4.	Switchgear end termination details for each rating of bus duct.	N	Y	Y
5.	Transformer end termination details for each rating of bus duct.	N	Y	Y
6.	Assembly drawing of rigid bends.	N	Y	Y
7.	Assembly drawing of bends with flexible	N	Y	Y
8.	Assembly drawing of straight run	N	Y	Y
9.	Transposition chamber details	N	Y	Y
10.	Installation, operation & maintenance manual	N	Y	Y
11.	Test Certificates			
	i) Type	N	N	N
	ii) Routine & others	N	N	Y
12.	Guarantee Certificates	N	N	Y
13.	List of spare parts	N	N	N

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N - No

TECHNICAL SPECIFICATION

SHEET STEEL DISTRIBUTION BOARDS

CONTENTS

1.0 SCOPE

1.1 This standard covers the technical requirements of design, manufacture, testing at works and delivery in well-packed condition of Sheet Steel Distribution Boards.

1.2 This standard shall be read in conjunction with relevant part of Design Philosophy – Electrical.

2.0 STANDARDS TO BE FOLLOWED

2.1 The design, manufacture and testing of the equipment shall comply with the latest issue of the following Indian Standards, unless otherwise specified. Equipment complying with equivalent IEC standards shall also be acceptable.

IS: 8623	-	Specification for low voltage switchgear and control gear assemblies.
IS/IEC:60947	-	Specification for Low-voltage Switchgear and Control gear
IS: 5578	-	Guide for marking of insulated conductors.
IS: 11353	-	Guide for uniform system of marking and identification of conductors and apparatus terminals.
IS: 10118	-	Code of practice for selection, installation and maintenance of switchgear and control gear.

Various components housed in the distribution board shall conform to the Indian Standard Specification as mentioned against the component details.

2.2 The design and operational features of the equipment offered shall also comply with the provisions of the latest issue of the Indian Electricity Rules and other Statutory Acts and Regulations. The supplier shall, wherever necessary, make suitable modifications in the equipment to comply with the above.

2.3 Wherever any requirement, laid down in this standard, differs from that in Indian Standard Specification the requirement specified herein shall prevail.

3.0 SERVICE CONDITIONS

3.1 **Ambient Conditions**

These shall be as indicated in Design Philosophy – Electrical.

3.2 **System Details**

These shall be as indicated in Design Philosophy – Electrical.

4.0 OPERATING REQUIREMENTS

The distribution board shall be suitable for operating at the specified rating continuously with the specified voltage and frequency variations under the ambient conditions, without exceeding the permissible temperature rise and without any detrimental effect on any part.

5.0 DESIGN AND CONSTRUCTIONAL FEATURES

5.1 **General**

5.1.1 The distribution board shall consist of an assembly of a series of floor mounting, identical, metal clad, dead front type panels of unitized design. The panels shall be placed side by side to form a compact assembly and shall be extensible on either side.

5.1.2 The complete assembly shall be dust, damp and vermin proof having minimum degree of protection equivalent to IP-52 as per IS/IEC:60947.

5.1.3 The frame work of the cubicles shall be of bolted/welded construction. The minimum thickness of steel shall be 2 mm for load bearing members, 1.6 mm for non-load bearing members and 3 mm for base channel. The doors and covers shall be fabricated from cold rolled sheet steel. Suitable reinforcement, wherever necessary, shall be provided.

5.1.4 The door hinges shall be concealed type.

5.1.5 All external hardware shall be cadmium plated/zinc passivated. The hardware for fixing the removable parts shall be provided with retaining devices.

5.1.6 The doors and the removable covers shall be provided with non-deteriorating neoprene gaskets. Gaskets without any discontinuity shall be preferred. Gaskets shall be held in position in groove of shaped sheet steel work or these shall be of U type. Adhesive cement, if used, shall be of good quality so that the gaskets do not come off during service.

5.1.7 All the components shall be accessible for inspection and maintenance without the necessity for removal of the adjacent ones. In case of single front design all components shall be accessible from the front for maintenance and back opening doors/ openable covers for maintenance shall not be acceptable.

5.1.8 The layout of the components inside a module shall be liberal to facilitate maintenance and the interconnection of wiring between the components shall not be subjected to any undue stress at the bends.

5.1.9 Mounting height of components requiring operation and observation shall not be lower than 300 mm and higher than 1800 mm.

5.1.10 Inter panel barriers shall be provided.

5.1.11 Adequate arrangement for earthing shall be provided to safeguard the operator or other personnel from electric hazards under all conditions of operation.

5.2 Panel Arrangement

5.2.1 The distribution board shall be non-drawout type in single front configuration.

5.2.2 Each Panel shall have its horizontal bus-bar chamber running on the top with multi-tier module units in the centre and having vertical bus-bar chamber and cable alley on either side.

5.2.3 The modules shall be enclosed on all sides and shall be so arranged that larger ones are placed at the bottom portion of the panel. Fixed type modules shall be at least 300 mm from the base channel.

5.2.4 The number of modules in the panel shall not exceed six for motor starter feeders and eight for switch fuse/MCB/MCCB feeders. The minimum size of module shall be 300 mm and 200 mm for starter and switch fuse feeders. The incomer and bus coupler module sizes for ratings up to 400 A shall be half the panel size. For higher ratings they shall be housed in single panel.

5.2.5 The module door shall be so interlocked that it shall not be possible to open the door with switch in closed position. Defeat interlock facility shall be provided.

5.2.6 The relay, meters, switches and lamps shall be flush mounted. All components of one module shall be mounted on the same module on a rigid sheet steel chassis. A 20 mm dia. rotating knob on the door shall be provided for closing and opening.

5.3 Bus Bars and Connections

5.3.1 The bus-bar shall be suitable for the supply system. The bus-bar and connections shall be made of electrolytic copper or high conductivity aluminium alloy conforming to Grade E91E of IS: 5082.

5.3.2 The bus-bar shall be amply sized to carry the rated continuous current under the specified ambient temperature without exceeding the temperature of 90ºC. The bus-bars shall also be designed to withstand the system fault current for 1 second without exceeding the temperature of 200ºC for bare aluminium and 250ºC for bare copper. The

minimum acceptable size of bus-bars shall be 250 sq. mm (Al). Calculation for the bus-bar sizing shall be furnished along with the offer.

5.3.3 In case of double front arrangement of distribution boards, different sets of vertical bus-bars shall be provided. The vertical bus-bars shall be PVC sleeved or shrouded by insulating barriers which shall have cut-outs to permit entry of power wires. It shall be possible to remove the shroud for inspection and maintenance. Neutral-bars shall be provided in this chamber.

5.3.4 Horizontal bus-bars shall be of same cross-section through out. Stepped bus-bars shall not be acceptable.

5.3.5 All bus-bars shall be arranged and colours coded according to IS: 5578/11353.

5.3.6 The horizontal bus-bar shall run in a separate bus chamber located at the top shall have separate screwed cover for inspection purpose.

5.3.7 The bus-bars shall be rigidly supported at equal intervals to withstand maximum short circuit stresses. The supports shall be of moulded construction with built in anti tracking barriers. The support material shall be of fibre glass reinforced thermosetting plastic.

5.3.8 All joints shall be suitably treated to avoid oxidation of contact surfaces and bimetallic corrosion. A minimum of two bolts with spring washers shall be used for horizontal bus-bar joints.

5.3.9 Horizontal bus bars shall be insulated with heat shrinkable PVC sleeves of reputed makes. Insulating shrouds shall be provided for all joints of insulated bus-bars.

5.4 Clearance and Creepage Distances

5.4.1 The clearance and creepage distances shall not be lower than the values specified below :

i)	Minimum clearance between two live conductors	--	20 mm
ii)	Minimum clearance between live part and accidentally dangerous part	--	20 mm
iii)	Minimum creepage distance	--	28 mm

5.4.2 The clearances and the creepage, as specified above, shall definitely be maintained in the bus-bar system. Provision of bus-bar insulations, separator or barriers shall not be considered to reduce the clearance from the values specified above.

5.4.3 At the termination points in the equipment, e.g. switches, contactors, thermal relays, etc. it is realized that above clearance shall not always be possible to be maintained. All such points where above clearance are not possible to be maintained shall, therefore, be insulated or taped.

5.5 Insulation

5.5.1 The insulation used shall be non-hygroscopic and shall be of porcelain, Epoxy- resins or fibre glass moulded with plastic. It shall be of adequate electrical and mechanical strength to give trouble free service during normal operation and short circuit conditions.

5.5.2 The insulation shall be treated suitably to withstand the tropical conditions and atmospheric pollution.

5.6 Power Wiring

5.6.1 The connections from bus-bar including neutral to individual units on the modules shall consist of PVC insulated flexible copper cable or tapped copper strip.

5.6.2 The power wiring size shall be decided based on the rating of the switch, after using a rating factor of not more than 50% over the current rating in free air. In any case the minimum size of power wiring shall not be less than 4 sq. mm copper.

5.6.3 The size of connection from incomer to horizontal bus-bar and from horizontal bus-bar to bus coupler shall not be less than the size adopted for horizontal bus-bar.

5.7 **Control Wiring**

5.7.1 The switch board shall be completely factory wired and ready for external connections.

5.7.2 The wiring shall be carried out with flexible stranded PVC insulated copper conductor cables of 1100 Volt grade. The size of wires shall be as follows:

C.T. Circuit -- 2.5 sq. mm

V.T. and Control Circuits -- 1.5 sq. mm

5.7.3 All wiring shall be provided with dependent both end marking as per IS: 5578. Numbered ferrules, reading from the terminals outwards, shall be provided at both ends of all wiring for easy identification. These shall be interlocking type plastic ferrules.

5.7.4 Control wiring circuits, fed from a supply common to a number of feeders, shall be so protected that failure of a circuit in one feeder does not affect the operation of the other feeders.

5.7.5 The wiring to the equipment mounted on the doors shall be carried out with flexible multi strand copper conductor cable and supported so that opening of the door, there is no undue strain on wire leads.

5.7.6 The control cables shall be neatly arranged and properly supported.

5.8 **External Cable Termination**

5.8.1 All power and control cables shall enter the distribution board from the bottom. Sufficient space shall be provided for ease of connection and termination of cables.

5.8.2 All cables shall be of 1.1 KV grade PVC insulated armoured and PVC sheathed except for single core cable which shall be unarmoured. The number and sizes of cable shall be as indicated in Feeder details.

5.8.3 Compression type cable glands along with the cable lugs as required shall be provided for termination of cables.

5.8.4 The cable glands shall be of rolled Aluminium heavy duty double compression type and shall be mounted on a removable gland plate, provided at a minimum height of 75 mm from the bottom of the distribution board. Two numbers spare knockouts of size 20 mm shall also be provided on the gland plates for future use.

5.8.5 For all power cables crimped type aluminium lugs for aluminium cables and tinned copper lugs for copper cables shall be provided.

5.8.6 The terminal blocks shall be pressure clamp type up to 35 sq. mm cable and bolted lug type for higher sizes of cables. These shall be protected type and rated for 1100 Volts service. The minimum current rating of terminal block shall be 16 Amp. The construction shall be such that after the connection of cables by means of lugs, necessary clearance and creepage distance are available.

5.8.7 Where more than two cables in parallel are required to be terminated, a system of bus links shall be provided with adequate clearance and spacing.

5.8.8 Suitable clamps to support the vertical run of cables shall be provided.

5.8.9 The terminal block shall be grouped according to circuit functions and suitably numbered. 20% extra terminals shall be provided in the terminal block.

5.8.10 For power connections, suitable marking on the terminals shall be provided to identify the phases.

5.9 **Feeder Details**

5.9.1 The requirements of incomer, bus coupler and outgoing feeders shall be as indicated in the single line diagram, feeder details and corresponding schematic diagram.

5.9.2 The bus coupler shall be so located that it is possible to maintain half of the bus-bars while the other half is still alive. Complete segregation of bus-bar connections to bus coupler shall be provided.

5.9.3 Castle key type mechanical interlocks shall be provided between incomers and bus section modules to avoid paralleling of incomers. In addition padlocking facilities shall be provided in OFF position.

5.9.4 Single phase loads shall be distributed as far as possible on all the three phases.

6.0 COMPONENT DETAILS

The components shall conform to type of co-ordination C as per IS/IEC:60947. Makes of all components shall be subject to owner's / consultant's approval

6.1 **Moulded Case Circuit Breakers**

6.1.1 The circuit breaker shall conform to IS/IEC:60947 and shall be of P2 category having rupturing capacity as per system requirement.

6.1.2 The circuit breaker shall be provided with spring assisted quick make quick break type manually operated trip free mechanism, mechanical ON/OFF position indicators, thermal tripping devices of inverse characteristics, instantaneous short circuit tripping devices and necessary auxiliary and alarm switches. The MCCB cubicle shall be provided with service, test and isolated position and automatic safety shutter.

6.1.3 The thermal and short circuit tripping device shall be adjustable type.

6.1.4 When used for motor circuit shunt trip devices shall be provided and the let through power of controlling MCCB shall be lower than the respective contactor.

6.1.5 In addition, under voltage trip shall be provided, if specified.

6.2 **Switches**

6.2.1 The switches shall be Motor duty type AC23 category and shall comply with the requirements laid down in IS/IEC:60947. Switches up to 63 Amps shall be rotary type and those of 100 Amp and above shall be link type.

6.2.2 'ON' and 'OFF' positions of the switches shall be indicated on the panel. Provision shall be made to lock the switch in the 'OFF' position.

6.2.3 The fixed contacts shall be shrouded and the contacts shall be silver plated.

6.2.4 Two Pole switches shall also isolate the neutral circuit along with phase circuit.
4 Pole / 2 Pole switches shall be used for 3 Phase/1 Phase circuits respectively.

6.3 **Fuses**

The fuses shall be of non-deteriorating HRC cartridge link type and conform to IS: 13703. They shall be suitable for the load and the service required in the circuit.

6.4 **Air Break Contactors**

6.4.1 The Air Break Contactor shall be of AC3 category unless otherwise specified, conforming to IS/IEC:60947 and flapper type. Gravity operated contactors are not acceptable.

6.4.2 The dropout voltage shall not exceed 65% of rated voltage.

6.4.3 Each contactor shall be provided with auxiliary contacts as required. The rating of the auxiliary contacts shall be 5 Amps. AC or 1 Amp DC at the specified control voltages. The spare auxiliary contacts shall also be wired terminal block.

6.5 Bimetal Thermal Overload Relays

6.5.1 The contactor shall be provided with three pole bimetal thermal overload relays unless otherwise specified. The bimetal relays shall be of suitable range, ambient temperature compensated and shall be separate mounting type. They shall be adjustable through graduated scale and shall be provided with changeover contact.

6.5.2 Bimetal relays shall conform to IS: 3231 and shall have built in single phasing preventor.

6.5.3 The bimetal relays shall be provided with a manual reset device resetable after opening the cubicle door. Auto reset thermal relays are not acceptable.

6.6 Current Transformers

6.6.1 The current transformers shall conform to IS: 2705.

6.6.2 Current Transformers shall be Class-F insulated and vacuum impregnated. The Current Transformers shall be rigidly mounted and shall be easily accessible for maintenance and testing.

6.6.3 The Current Transformers shall be of 7.5 VA output. The output shall be adequate for the instrument and metering duties involved with sufficient margin. The Current Transformers shall have the accuracy Class-1 for the metering duty.

6.6.4 All the Current Transformers shall be provided with terminals and shorting links. One of the terminals of C.T. shall be earthed. The polarity of the C.T. shall be clearly marked.

6.6.5 The C.T.s shall be capable of withstanding momentary open-circuit on the secondary side without injurious effects.

6.7 Instruments and Meters

6.7.1 All instruments shall be flush mounting type with square face and shall be tropicalized and dust tight.

6.7.2 The size of the instruments shall be 96 mm x 96 mm for full and half size modules and 72 mm x 72 mm for lower size modules.

6.7.3 Dials shall be parallax free with scale marked in black on white background and shall be suitable for direct reading.

6.7.4 Zero adjusters shall be provided for operation from the front of the cases.

6.7.5 All ammeters and voltmeters shall have 0 - 240º scale moving iron spring controlled type and of Class 1.5 accuracy as per IS: 1248. The scale range of the ammeter and voltmeter shall be as indicated in the feeder details.

6.7.6 In case of motor feeders, the ammeter shall be graduated uniformly upto C.T. primary current and with a compressed end scale upto 6 times the C.T. primary current. Red pointer shall be provided, which can be adjusted at site for indicating full load current.

6.7.7 KWH meter shall be 3 phase 4 wire type. These shall conform to the requirements of relevant IS and shall be C.T. operated. The current coil shall be rated for 5 Amp.

6.7.8 All kWh meters shall be provided with test blocks for current and voltage coils for testing them at site without interrupting their recording while in service.

6.8 Push Button and Control Switches

6.8.1 The switches and push buttons shall conform to utilization category AC 11/DC 11 as per IS/IEC:60947 . The contact shall be rated to make, break and carry inductive current of 5 Amp. at 415 V AC and 1 Amp at 220 V DC.

6.8.2 The control switches shall be spring return rotary type unless otherwise specified and provided with pistol grip type handle. The control switches for circuit breakers shall be additionally fitted with lost motion devices and sequencing devices.

6.8.3 The selector switches shall be stay-put rotary type and provided with oval shape handles.

6.8.4 The push buttons shall be of momentary contact spring loaded type with a set of normally close and open contacts. The push button for 'Start' shall be shrouded type and coloured green, stop push button shall be un-shrouded type and coloured red and other push buttons shall be un-shrouded type coloured black. The fixing ring shall be metallic white.

6.8.5 Emergency stop push buttons, if specified, shall be lockable in pushed position.

6.9 **Miniature Circuit Breakers**

6.9.1 The miniature circuit breakers shall conform to IS: 13032 and shall be of duty category M-9.

6.9.2 It shall be provided with overload and short circuit protective devices in a heat resistant housing.

6.9.3 A certificate of short circuit rating and current time tripping curve shall be furnished alongwith the offer.

6.10 **Signal Lamps**

6.10.1 Signal lamps shall be provided to indicate the various circuit conditions as shown in scheme drawings. The colour of the lamps for various functions shall be as follows:

Red	--	Switch/Contactor closed.
Green	--	Switch/Contactor open.

6.10.2 The lamps shall be LED type having lumen output 200 milli candela in axial direction.

6.10.3 It shall be possible to remove the globe from outside for replacement of lamps.

7.0 ACCESSORIES

7.1 The supplier shall include the following accessories.

-- Fuse Puller.

-- Test plug for kWh meters.

7.2 **Space Heater**

Each vertical section shall be provided with a thermostatically controlled space heater, rated for 240 V, 50 Hz and controlled through double pole miniature circuit breaker.

7.3 **Name Plates**

7.3.1 The distribution board shall have large name plate on the top to indicate its name and designation.

7.3.2 Each feeder shall be provided with name plate. Each single front panel shall have name plate both in front and back.

7.3.3 All control switches, push buttons, lamps etc. shall have functional identification labels.

7.3.4 Name plate shall be of black perspex with white engraving and of minimum 3 mm thick.

7.3.5 Any other accessories required, but not specified shall also be supplied to make the distribution board complete in all respects to ensure safe and proper operation.

8.0 PAINTING

8.1 The enclosure after degreasing, pickling in acid, cold rinsing phosphatising, passivating etc. shall be painted with two coats of anti-rust paint followed by two coats of anticorrosive paint.

8.2 Epoxy based paint shall be used.

8.3 All paints shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off, crinkle or be removed by abrasion due to normal handling.

8.4 Unless otherwise specified, the finishing shade shall be light grey Shade No.631 as per IS: 5.

8.5 One litre of paint shall be supplied along with each board for touch up at site.

9.0 TESTS AND INSPECTION

9.1 The distribution boards shall be subjected to routine test as per IS: 8623.

9.2 Additional tests, wherever specified, shall be carried out.

9.3 All the above tests shall be carried out in presence of purchaser's representative. In addition, the equipment shall be subjected to stage inspection during process of manufacture at works and site inspection.

9.4 These inspections shall however, not absolve the vendor from his responsibility for making good any defect which shall be noticed subsequently.

10.0 DRAWINGS AND DOCUMENTS

10.1 Drawings and documents as per Annexure-I shall be supplied unless otherwise specified.

10.2 All drawings and documents shall have the following description written boldly:

- Name of client
- Name of consultant
- Enquiry / Order Number with plant / project name
- Code No. and Description

11.0 SPARES

11.1 Commissioning Spares: Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for approval.

11.2 Spare Spares for 2 Years operation (Mandatory), as specified shall be supplied.

11.3 Recommend 2 years Operational Spares (other than mandatory spare) alongwith recommended quantity & item-wise unit price shall be furnished.

11.4 All spare parts shall be identical to the parts used in the equipment

12.0 PACKING

12.1 The distribution board shall be properly packed before despatch to avoid damage during transport, storage and handling.

12.2 The packing box shall contain a copy of the installation, operation and maintenance manual.

12.3 A sign to indicate the upright position of the panels to be placed during transport and storage shall be clearly marked. Also proper arrangement shall be provided to handle the equipment.

13.0 DEVIATIONS

13.1 Deviations, if any, from this standard shall be clearly indicated in the offer with reasoning.

ANNEXURE - I

DOCUMENTATION FOR SHEET STEEL DISTRIBUTION BOARDS

Sl.No.	Documents	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheet	N	Y	Y
2.	Technical Particulars	N	Y	Y
3.	Feeder Details	N	Y	Y
4.	General Arrangement and Foundation Drawings	N	Y	Y
5.	Schematic Diagrams with Terminal arrangement drawings	N	Y	Y
6.	Calculation for Bus-bar sizing	N	Y	N
7.	Illustrative and Descriptive literature	N	N	Y
8.	Catalogues for bought out accessories	N	N	Y
9.	Installation, Operation and Maintenance Manual	N	N	Y
10.	Test Certificates			
	-- Type (for MCCB & MCB)	N	N	N
	-- Routine	N	N	Y
11.	Guarantee Certificates	N	N	Y
12.	Spare Parts List	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N - No

TECHNICAL SPECIFICATION

LIGHTING SUB DISTRIBUTION BOARDS

CONTENTS

1.0 SCOPE

1.1 This standard covers the technical requirements of design, manufacture, testing at works and delivery in well packed condition of lighting sub distribution boards.

1.2 This standard shall be read in conjunction with relevant part of Design Philosophy - Electrical.

2.0 STANDARDS TO BE FOLLOWED

2.1 The design, manufacture and testing of the equipment covered by this standard shall comply with the latest issue of the following Indian Standards. Equipment complying with equivalent IEC standards shall also be acceptable

IS/IEC:60947	-	Low voltage switchgear and control gear
IS: 8623	-	Specification for low voltage switchgear and control gear assemblies

2.2 The design and operational features of the equipment offered shall also comply with the provisions of latest issue of the Indian Electricity Rules and other relevant statutory acts and regulations. The supplier shall, wherever necessary, make suitable modification in the equipment to comply with the above.

2.3 Wherever any requirement, laid down in this standard, differs from that in Indian Standard Specifications, the requirement specified herein shall prevail.

3.0 SERVICE CONDITIONS

3.1 **Ambient Conditions**

These shall be as indicated in Design Philosophy - Electrical.

3.2 **System Details**

These shall be as indicated in Design Philosophy - Electrical.

4.0 OPERATING REQUIREMENTS

The lighting sub-distribution boards shall be suitable for operating continuously under the ambient conditions and with the voltage and frequency variations, without exceeding the specified temperature rise and without any detrimental effect on any part.

5.0 GENERAL DESIGN AND CONSTRUCTIONAL FEATURES

5.1 The lighting sub distribution boards shall be fabricated out of 2.5 mm thick cold rolled sheet steel and shall be suitable for mounting on wall/structure. These shall have dust and vermin proof construction conforming to IP-54 as per IS/IEC:60947. For outdoor installation, the enclosure shall conform to IPW-55. Suitable canopy made out of 2 mm thick Aluminium sheet shall be supplied along with the board.

5.2 The miniature circuit breakers shall be so mounted inside the enclosure that their operating knobs project outside for easy operation. The cut-out for the knobs on the enclosure shall be lined with gasket for dust proofness. For further protection against ingress of dust, the portion where the knobs have protruded out, shall be provided with another external front cover, internally hinged at the top, gravity operated and with a knurled knob at the bottom. The external cover shall be flushed with the main cover. Continuous neoprene gasket shall be provided to make the board completely dust and weather proof.

5.3 All external hard ware of diameter less than 8 mm shall be of stainless steel and those of diameter 8 mm and above shall be of mild steel cadmium plated or zinc passivated.

5.4 The sub-distribution boards to be located indoors shall have top entry arrangement for outgoing cables and bottom entry for incoming cable. However for outdoor locations, all cable entries shall be from the bottom only.

5.5 Three phase and neutral bus bar system of adequate size shall be provided to which all outgoing and incoming MCB's shall be connected.

5.6 The internal wiring shall be carried out by means of single core PVC insulated 2.5 sq. mm stranded copper conductor cables.

5.7 Two earthing terminals outside the board shall be provided.

5.8 Suitable label inscription consisting of black perspex with engraving for the board and circuit nos. of all outgoing feeders shall be provided. The label inscription of the board shall contain description and code no. The circuit nos. of outgoing feeders shall be serially indicated as 1L, 2L.....17L, 18L.

5.9 The board shall be complete with terminal block, cable glands, cable lugs and other accessories as specified.

6.0 SPECIAL FEATURES FOR FLAME PROOF LIGHTING SUB DISTRIBUTION BOARDS

6.1 The enclosure shall be in addition of flame proof execution as per IS: 2148.

6.2 The enclosure group and temperature class shall be as indicated in Design Philosophy – Electrical.

6.3 The enclosure shall be of cast iron/cast Aluminium alloy (4600 as per IS: 617).

6.4 Cables shall enter the terminal chamber through flame proof compression type cable glands. From terminal chamber to the main enclosure connection shall be made through bushings. Direct entry of external cables into the main enclosure shall not be accepted.

6.5 The sub-distribution board shall be of 6 way type.

6.6 Individual earth terminals shall be provided for the earth conductor of the outgoing cables beside the phase and neutral terminals.

6.7 The sub-distribution board must be certified by Central Mining Research Institute, Dhanbad or other statutory authority for use in specified hazardous area.

7.0 COMPONENT DETAILS

7.1 The lighting sub-distribution board shall be wired and have components as per SD-8083 (copy attached).

7.2 **Miniature Circuit Breaker (MCB)**

The MCB shall be of duty category M-9 and shall conform to IS/IEC:60898-1:2002. It shall be provided with overload and short circuit protective devices. MCB shall be of C Curve Type.

7.2.1 The incoming MCB's or switches shall be of triple pole and switched neutral type and outgoing MCB's of single pole and switched neutral type, single phase earth leakage protection in each phase of the incomer shall be provided.

7.3 **Terminal Block**

Pressure clamp type terminal blocks shall be provided both for incoming and outgoing cables. The rating of the terminal block shall be at least 1.5 times the rating of the MCB.

7.4 **Cable Glands**
Heavy duty double compression type Aluminium cable glands suitable for PVC insulated, armoured and PVC sheathed 1.1 KV grade incoming and outgoing cables shall be provided.

8.0 PAINTING

8.1 The enclosure after suitable pre-treatment shall be painted with two coats of anti rust paint followed by two coats or anticorrosive paint.

8.2 Epoxy based paint shall be used.

8.3 All paints shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off, crinkle or be removed by abrasion due to normal handling.

8.4 The finishing shade shall be light grey shade no.631 as per IS: 5.

9.0 TESTS AND INSPECTION

9.1 All the lighting sub-distribution boards shall be subjected to routine tests as per IS: 8623.

9.2 Additional tests, wherever specified, shall be carried out on one lighting sub-distribution board of each type.

9.3 The above mentioned tests shall be carried out in the manufacturer's works in the presence of purchaser's representative. In addition, the equipment shall be subjected to stage inspection at works and inspection at site for final acceptance.

9.4 The purchaser's inspection shall, however, not absolve the vendor from his responsibility for making good any defects which may be noticed subsequently.

10.0 DRAWINGS AND DOCUMENTS

10.1 Drawings and documents as per Annexure-I shall be supplied, unless otherwise specified.

10.2 All drawings and documents shall have the following description written boldly.

- Name of client
- Name of consultant
- Enquiry / Order Number with plant / project name
- Code No. and Description

11.0 SPARES

11.1 Commissioning Spares: Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for approval.

11.2 Spare Spares for 2 Years operation (Mandatory), as specified shall be supplied.

11.3 Recommend 2 years Operational Spares (other than mandatory spare) alongwith recommended quantity & item-wise unit price shall be furnished.

11.4 All spare parts shall be identical to the parts used in the equipment.

12.0 PACKING

12.1 The equipment shall be properly packed to safeguard against weather conditions and handling during transit. It shall be wrapped in polythene bags and an additional wrapping of bitumen paper shall also be provided to make it completely water proof before the equipment is packed in wooden crates.

12.2 The packing box shall contain a copy of the installation, operation and maintenance manual.

13.0 DEVIATIONS

13.1 Deviations, if any, from this standard shall be clearly indicated in the offer with reasoning.

ANNEXURE - I

DOCUMENTATION FOR LIGHTING SUB DISTRIBUTION BOARDS

SL.NO.	Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheet	N	Y	Y
2.	Technical particulars	N	Y	Y
3.	General arrangement Drgs.	N	Y	Y
4.	Certificate for flameproofness from statutory testing authority wherever applicable	N	N	Y
5.	Schematic diagram	N	Y	Y
6.	Descriptive literature of Various equipment	N	N	Y
7.	Guarantee certificate	N	N	Y
8.	Test certificate	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N - No

TECHNICAL SPECIFICATION
INDUCTION MOTOR

CONTENTS

1.0 SCOPE

1.1 This standard covers the technical requirements of design, manufacture, testing at works and delivery in well-packed condition of medium voltage and high voltage induction motors.

1.2 This standard shall be read in conjunction with relevant part of Design Philosophy - Electrical.

2.0 STANDARDS TO BE FOLLOWED

2.1 The design, manufacture and testing of the equipment covered by this standard shall comply with the latest issue of IS-325 and other relevant Indian Standards, unless otherwise specified. Equipment complying with equivalent IEC standards shall also be acceptable.

2.2 The design and operational features of the equipment offered shall also comply with the provisions of latest issue of the Indian Electricity Rules and other relevant Statutory Rules & Regulations. The supplier shall, whenever necessary, make suitable modification in the equipment to comply with the above mentioned rules.

2.3 Flame proof motors shall, in addition, comply with the requirements laid down in IS: 2148.

2.4 Increased safety motors shall, in addition, comply with the requirements laid down in IS: 6381.

2.5 Motors with type of protection “n” shall, in addition, comply with the requirements laid down in IS: 9628.

2.6 Wherever any requirement laid down in this standard differs from that in Indian Standard Specifications, the requirement specified herein shall prevail.

3.0 SERVICE CONDITIONS

3.1 Ambient Conditions

The ambient conditions shall be as indicated in the Design Philosophy - Electrical.

3.2 System Details

3.2.1 The details of power system to which the motors will be connected shall be as indicated in the Design Philosophy - Electrical.

3.2.2 The motors shall be suitable for connection to a power system where transient disturbances are very likely to occur. During the transient disturbances, voltage of the system may completely disappear and return in a short time with the motors still running and connected. Under this condition, the return of voltage may occur at such an instant that the induced e.m.f. in the motor is in phase with the applied voltage giving rise to current surges which may reach a value equal to 1.6 times the starting current and also cause transient torques of large magnitudes.

4.0 GENERAL DESIGN FEATURES

4.1 Enclosure

4.1.1 The enclosure of motors for indoor and outdoor services shall be IP-54 and IPW-55 respectively as per IS/IEC:60529, unless otherwise specified.

4.1.2 Motors for outdoor service shall be provided with special seals for the enclosure, joints, bearing housing, terminal boxes etc. so that no extra protective covering for ingress of water shall be required.

4.1.3 Vertical motors for outdoor installation shall be provided with a rain protective hood.

4.1.4 All external hardware shall be zinc passivated or cadmium plated.

4.1.5 The enclosure shall be provided with threaded metallic plug to permit drainage of condensed water from the inside.

4.2 **Cooling**

4.2.1 All motors shall be totally enclosed fan cooled conforming to IC-0141 as per IS: 6362 unless otherwise specified.

4.2.2 In case of CACA construction, the same shall conform to IC-0161 as per IS: 6362.

4.2.3 In case of CACW construction, the same shall conform to ICW 37A 91 as per IS: 6362.

4.2.4 Wherever service conditions are such that corrosive agents are present in the surroundings, the following materials of construction for cooling tubes shall be adopted, unless otherwise specified.

For CACA motor - Aluminium tubes having minimum thickness of 1.6 mm

For CACW motor - Low carbon alloy steel

4.2.5 In case of CACW motors, the cooling tubes and flanges shall also be suitable for the cooling water analysis. Trays shall be provided for collection of leaking water with arrangement for its drainage.

4.2.6 The cooling fans shall be suitable for bidirectional rotation of motors. These shall be fastened to the motor shaft by means of compensating rings or will be balanced independent of the motor. Guide key or reference points shall be supplied to prevent wrong assembly. The cooling air shall be sucked from the non-driving end.

4.2.7 The cooling fans shall be made of non-sparking materials such as cast Aluminium (LM-6 alloy) / cast iron.

4.3 **Direction of Rotation**

4.3.1 Motors shall be suitable for both directions of rotation. In case of any design limitation, the same shall be indicated in the offer.

4.3.2 In either case, a plate showing the direction of rotation corresponding to the phase terminal markings shall be fitted at the driving end shield of the motors.

4.4 **Stator**

4.4.1 The stator laminations shall be made from suitable magnetic sheet iron varnished on both sides. Where ventilation is required, these shall be arranged in suitable packs, each pack being separated by spacers to form ventilating ducts for circulation of air.

4.4.2 The slot shall be open type with coils so arranged that the coils can be easily removed for inspection and repair.

4.5 **Rotor**

4.5.1 The rotor shall be of squirrel cage construction, unless otherwise specified.

4.5.2 For small motors, the squirrel cage shall preferably be of pressure die-cast construction. For large motors, the rotor bars and the end rings shall be of copper or copper alloy.

The bars shall be firmly placed in slots to prevent vibration during start up / locked rotor condition. Conductor ends shall be securely fixed to the end rings using the latest brazing techniques. Retaining rings shall be provided for high speed machines for the end rings. The rotor cage shall be designed for the required starting and duty cycles.

4.5.3 Wherever wound rotor is specified, the windings shall have the same features as detailed for the stator windings. The rotor voltage shall not exceed the stator voltage.

4.5.4 The rotor shall be dynamically balanced and shall rotate perfectly with no preferential stop points. The rotor shall be constructed such as to allow the removal or addition of material for balancing.

4.5.5 The rotor shaft shall be electrically and magnetically so balanced that the induced shaft voltage does not exceed 200 millivolt. Otherwise the bearing housing at non-driving end shall be insulated for 2 KV.

4.6 **Windings and Insulation**

4.6.1 The motor coils shall be made out of insulated electrolytic grade copper conductor. Successive coils shall be connected by accessible joints, well brazed and finished smooth to prevent damage to insulation.

4.6.2 The motors shall be insulated assuming the power system neutral as isolated.

4.6.3 All motors shall be insulated with F insulation with tropical and fungicidal treatments.

4.6.4 Wherever class F insulation is specified, the windings shall be easily replaceable type and the temperature rise shall not exceed that of class B insulation.

4.6.5 The winding coils shall be dried, properly impregnated with suitable varnishes to withstand the site conditions and properly baked. At least two additional impregnations and baking shall be applied to the assembled stator coil, making a total of three impregnations and baking. Finally the windings shall be painted with special anti-acid and anti-alkali paints to withstand the site conditions.

4.6.6 The windings shall be well brazed and capable of withstanding thermally and mechanically the transient disturbances specified under clause 3.2.2.

4.6.7 Lead-in wire between the windings and the outside terminals shall be made through bushings in H.V. motors. For M.V. motors, heat resistant insulated conductors shall be used as lead-in wire.

4.6.8 The windings shall be star connected for high voltage motors and delta connected for medium voltage motors.

4.7 **Slip Rings and Brushes**

4.7.1 Slip rings shall be located in the non-driving side. The material of construction shall be copper alloy. The slip rings and the brush gear shall be cooled by the motor cooling fan.

4.7.2 For explosion proof motors, the slip rings and brush gear shall be housed in a flameproof housing. In case this is not possible, the housing shall be pressurised type with flameproof pressure switch for interlocking with the motor. In either case, glass covers shall be provided for inspection.

4.7.3 The starting rheostats shall be designed for intermittent duty and rated for 10 minutes. Where speed regulation is required, the rheostats and the controllers shall be suitable for such duty and be continuously rated. Auxiliary contacts shall be provided on the controllers for connections to the motor supply controls to prevent wrong operations during starting.

4.8 **Bearings**

4.8.1 All motors shall be provided with bearings suitable for the application. The bearings must be guaranteed to ensure a smooth operation and a life not shorter than 30,000 hrs.

4.8.2 Where external thrusts are specified, the motors shall be fitted with special roller thrust bearings capable of withstanding the specified thrust. In such cases, the guaranteed life of the bearings shall not be less than 20,000 hours.

4.8.3 The bearing housing shall be effectively sealed against ingress of dust and water and creep age of lubricants along the shaft.

4.8.4 The bearing shall be suitable for both directions of rotation of the motor.

4.8.5 All motors shall be provided with on-line grease lubrication arrangement for both DE and NDE side bearings except for motors of frame size 112 and less and flange mounted M.V. motors. The arrangement shall be complete with grease nipple and drain plug located at convenient locations.

4.8.6 All oil lubricated bearings shall be fitted with oil level indicator and resistance temperature detector/dial type thermometer with alarm and trip contacts.

4.8.7 Self cooled bearing system shall be preferred.

4.8.8 The manufacturer shall specify the type of lubricant and the time interval of lubrication for the bearings of each motor.

4.8.9 The bearing temperature shall not exceed 90ºC for grease lubricated bearings and 70ºC for oil lubricated bearings.

4.8.10 Wherever shaft end-play has been specified, the bearings shall be capable of providing the specified end-play.

4.9 **Terminal Box**

4.9.1 All the terminal boxes shall have identical degree of protection as that of the motor.

4.9.2 The power terminal box shall be mounted on the right hand side of the motor as viewed from the coupling end. For M.V. Motors, design of terminal boxes shall be such that it may be possible to arrange top/bottom/side entry of cables at site.

4.9.3 The power terminal boxes shall be as follows:

a) For H.V. motors - Phase segregated type capable of with standing the system fault level for 0.2 Sec. or more.

b) For M.V. motors - Manufacturer’s standard box with epoxy or SRBF moulded terminal board.

4.9.4 The mounting arrangement of power and neutral side terminal boxes for HV motors shall be identical so that it shall be possible to interchange the boxes at site.

4.9.5 In case of H.V. motors, all the six leads of the motors shall be taken out, three on one side and three on the other side to separate terminal boxes. However, neutral shorting link shall be provided on the neutral box for star connection.

4.9.6 In case of M.V. motors, all the six leads of the motors shall be taken out to a common terminal box. Shorting links for delta connections shall be provided in the terminal box for motors 112 frame and above.

4.9.7 For increased safety motors and for motors with type of protection “n”, the terminals shall be provided with positive locking device so that they do not become loose during normal operation.

4.9.8 The power terminal boxes shall have adequate clearances in between the terminals and also between the terminals and cable gland for proper termination of cables. Where more than one cable is required to be terminated in parallel, the spacing in the box shall be adequate for easy termination.

4.9.9 Separate terminal boxes shall be provided for connection of power, control and space heater cables.

4.9.10 All terminal boxes shall be complete with heavy duty double compression type cable glands and lugs/connectors to receive the external cables.

4.9.11 Where cross linked polyethylene cables are specified, the terminal box shall be suitably designed for proper termination of such cables.

4.9.12 The cable lugs shall be of tinned copper and suitable for crimping.

4.10 **Geared Motors**

Where geared motors are specified, the gears shall be oil lubricated, heavy duty as per AGMA class III and capable of transmitting the rated motor power continuously. They shall be capable of withstanding moderate shock loads having a service factor of 2 and the starting duties. They shall be silent and smooth in operation. Inspection glass shall be provided to indicate the oil level in the gear box.

5.0 PERFORMANCE

5.1 **Starting**

5.1.1 The motors shall be capable of being started direct-on-line, unless otherwise specified.

5.1.2 The starting torque of each motor shall be higher than the initial resisting torque of the driven load throughout the starting period even at a feeding voltage of 85% of the rated voltage for normal purpose motor and 80% of the rated voltage for special purpose motor.

5.1.3 The starting current of 415 V Motors shall not exceed the values indicated in IS: 12615. Also there shall be no further positive tolerance on the values of starting current.

The starting current of 11 KV & 3.3 KV motors shall not exceed 550% of FLC. No positive tolerance is acceptable over 550% FLC.

5.1.4 The motors shall be suitable for the following starting cycle:

a) With the motor at ambient temperature - 2 successive starts and 3rd start after 5 minutes.

b) With the motor at steady state load temperature - 1 immediate start and 2nd start after 5 minutes. This sequence shall be repeated in the next hour.

5.1.5 Speed switch shall be provided, wherever required, to fulfil the starting conditions.

5.2 **Locked Rotor Condition**

5.2.1 The locked rotor withstand time (t_E), under hot condition at 110% of rated voltage shall be more than the starting time of the motor coupled to the load even at the lowest stipulated starting voltage by 2 secs. for motors, having starting time up to 10 secs. and by 5 secs. for motors, having starting time more than 10 secs.

5.2.2 For increased safety motors, t_E under hot condition shall not be less than 10 secs. The value of t_E shall be determined in the presence of purchaser's representative unless test certificate from an independent testing authority is submitted for similar motors. The time t_E and the locked rotor current shall be stamped on the name plate as well as indicated in the test certificates.

5.2.3 For deciding the time t_E in all cases, the temperature of the insulated stator and rotor shall not exceed the value stipulated under clause no. 5.4.3.

5.3 **Running**

5.3.1 All motors shall be continuous maximum rated (S1 duty as per IS: 325), unless otherwise specified.

5.3.2 The motors shall be capable of delivering the rated output without exceeding the specified temperature rise under the system voltage and frequency variation conditions.

5.3.3 The motors shall be suitable for running at the rated load for 5 minutes duration at 80% voltage and for 1 Sec. duration at 70% voltage, without exceeding the specified temperature rise.

5.4 **Temperature Rise**

5.4.1 The total temperature of the stator winding under full load running condition shall not exceed the values permissible for the specified insulation class. For increased safety motors, the total temperature shall be 10ºC less than for normal motors.

5.4.2 For explosion proof motors, the maximum surface temperature shall not exceed the values applicable for temperature class of the hazardous gases / vapours present in the surrounding area. However for type 'n' motors, the maximum allowable temperature shall not exceed 200ºC.

5.4.3 In case of starting and locked rotor conditions stipulated under clause nos. 5.1.4 and 5.2.1 respectively, the maximum temperature in the rotor shall not exceed the following values:

For squirrel cage rotor	-	300ºC
For wound rotor	-	As applicable to the insulation class
For explosion proof motor	-	As per temperature class of the hazardous gases / vapours, without exceeding the above temperature as applicable

6.0 COUPLING DETAILS

6.1 Unless otherwise specified, all motors shall be coupled to the driven equipment through flexible coupling.

6.2 Normally the coupling half for the motor shaft shall be supplied by the driven equipment supplier. The coupling half shall be keyed on the shaft with a tapered joint or shrunk with a straight joint. For this purpose, the motor manufacturer shall coordinate all details of the coupling system with the driven equipment manufacturer, wherever required.

6.3 Where rigid coupling is specified, the motor shaft shall have the desired class of accuracy.

6.4 For all vertical flange mounted motors, the limitations on shaft extension, run out, perpendicularity and eccentricity, as required by the driven machine supplier shall be complied with by the motor supplier.

6.5 i) If the motor is to be coupled to a reciprocating pump or compressor requiring fluctuating torque, the motor supplier shall ensure that the inertia of the driving and driven machine assembly shall be such that the variation in the armature current shall not exceed ±66% of the rated current while delivering full load.

ii) The measurement of armature current shall be done with the oscillograph.

iii) The additional fly wheel, if any, shall be assembled at such a distance from the motor so as to allow easy inspection of the windings.

iv) All necessary coordination with driven equipment manufacturer shall be carried out by the motor manufacturer.

6.6 i) Wherever belt drive is specified, the motor supplier shall ensure that the shaft extension and the bearings are suitable for the duty specified.

ii) Unless otherwise specified, the slide rails for all belt driven motors shall be supplied by the motor manufacturer.

7.0 ACCESSORIES

The motors shall be complete with all the accessories.

7.1 Space Heaters

7.1.1 Space heaters rated for 240 V A.C. shall be provided to keep the winding dry for all high and medium voltage motors, except for motors rated below 30 KW which shall be suitable for space heating by connecting 24 V A.C to any of the two motor winding terminals.

7.1.2 The location of the space heaters shall be such as to allow easy access for inspection, maintenance and replacement.

7.2 Name Plates

7.2.1 The name plates shall be of stainless steel with letters embossed on them.

7.2.2 The name plate shall contain all the relevant details as per IS: 325 and in addition shall indicate the following:

i) The description and code no. of motor

ii) Degree of protection of enclosure

iii) Temperature rise of windings under running condition

iv) Designation of bearings

v) Recommended type of lubricant and interval of lubrication

vi) Direction of rotation

vii) Mounting Arrangement

7.2.3 Flameproof motors shall have additional name plate containing relevant particulars as per IS: 2148.

7.2.4 Increased safety motors shall have additional name plate containing relevant particulars as per IS: 6381.

7.2.5 Motors with type of protection “n” shall have additional name plate containing relevant particulars as per IS: 9628.

7.3 Embedded Temperature Detectors

7.3.1 All high voltage motors shall be provided with 6 nos. of evenly distributed embedded resistance temperature detectors for measurement of winding temperature. These shall be located in positions at which the highest temperatures are likely to occur.

7.3.2 In addition, the high voltage motors shall be provided with

i) 1 no. RTD for hot air temperature measurement

ii) 2 nos. RTDs (1 on each side) for bearing temperature measurement of oil lubricated bearings. For grease lubricated bearings, RTD shall be provided only where specified

7.3.3 These RTDs shall be of platinum having 100 ohm resistance at 0ºC and temperature coefficient as 3.850×10^{-3}.

7.3.4 The RTDs shall be 3 lead type having power frequency insulation level of 2KV.

7.3.5 The RTDs shall comply with the requirements laid down in IS: 2848.

7.4 **Dial Type Thermometers**

7.4.1 In high voltage motors, the measurement of hot air and bearing temperature (of oil lubricated bearings) by dial type thermometers shall be provided wherever specified.

7.4.2 The arrangement shall consist of a dial type of mercury-in-steel thermometer so mounted that its stem shall be located in the maximum temperature region.

7.4.3 The thermometer shall have two potential free contacts for alarm and trip.

7.4.4 All contacts shall be rated for 2 Amps. at 110 V D.C.

7.4.5 For bearing temperature measurement, separate thermometers shall be provided for each bearing.

7.4.6 For grease lubricated bearings, temperature measurement arrangement shall be provided only where specified.

7.5 **Oil Supply System**

7.5.1 For large sized motors, where forced oil lubrication system is considered, a common oil supply system for the motor and the driven equipment shall be provided by the driven equipment manufacturer.

7.5.2 However, the motor supplier shall quote separate price for the complete oil system of the motor.

7.5.3 The system shall be suitable for location near the motor.

7.5.4 The oil supply system for each motor shall include:

i) 2 Nos. 100% rated motor driven pumps with motors

ii) 1 No. oil tank complete with oil level gauge and thermometer

iii) 1 No. oil cooler

iv) 1 No. oil filter

v) 1 No. differential pressure switch for filter

vi) 2 Nos. pressure switches

vii) Necessary piping

viii) Necessary control and interlocks

8.0 VIBRATIONS

The motor vibrations measured at the bearings must not exceed the limits specified in IS: 12075.

9.0 NOISE LEVEL

The motor noise level shall not exceed 85 dB measured at a distance of 1 metre from the motor.

10.0 PAINTING

10.1 Enclosures of the motor and its accessories shall be painted with two coats of anti-rust paint and two coats of anti-corrosive paint after suitable pre-treatment.

10.2 Epoxy paint shall be used.

10.3 Unless otherwise specified, the finishing shade shall be light grey having shade No. 631 as per IS: 5.

11.0 TESTS AND INSPECTION

11.1 All motors shall be routine tested as per relevant standards.

11.2 Additional tests, wherever specified, shall be carried out on one motor of each rating.

11.3 For high voltage motors of each rating, polarization index test shall also be carried out.

11.4 All the above mentioned tests shall be carried out in the presence of purchaser's representative. In addition, the motor shall be subject to stage inspection at works and inspection at site for final acceptance.

11.5 These inspections shall, however, not absolve the vendor from their responsibility for making good any defects which may be noticed subsequently.

12.0 PACKING

12.1 The motors shall be properly packed to safeguard against weather conditions and handling during transit.

12.2 The shaft shall be properly clamped / supported.

12.3 Rust inhibiting agents shall be applied to fittings and sliding surfaces.

12.4 All flanges shall be closed with blanking plates to avoid entry of foreign materials.

12.5 The loose pieces of the motor / spare parts / Instruments shall be separately wrapped in moisture resistant paper and marked with identification marks and name plate of the corresponding motors.

12.6 The packing box / crate shall include a copy of installation, operation and maintenance manual.

13.0 DRAWINGS AND DOCUMENTS

13.1 Drawings and documents as per Annexure-I shall be supplied, unless otherwise specified.

13.2 All drawings and documents shall have the following descriptions written boldly:

- Name of client
- Name of consultant
- Enquiry / order number with plant / project name
- Motor Code No. and Description

14.0 SPARES

14.1 Commissioning Spares: Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for approval.

14.2 Spare Spares for 2 Years operation (Mandatory), as specified shall be supplied.

14.3 Recommend 2 years Operational Spares (other than mandatory spare) alongwith recommended quantity & item-wise unit price shall be furnished.

14.4 All spare parts shall be identical to the parts used in the equipment

15.0 DEVIATIONS

15.1 Deviations, if any, from this standard shall be clearly indicated in the offer with reasoning.

ANNEXURE - I

DOCUMENTATION FOR INDUCTION MOTORS

Sl. No.	Document Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheet and Technical Particulars	N	Y	Y
2.	Dimensional Drawings	N	Y	Y
3.	Drawings and data for air / water heat exchangers, if necessary	N	Y	Y
4.	Drawings and data for oil system, if necessary	N	Y	Y
5.	Characteristic curves			
	a) Thermal withstand curve	N	Y	Y
	b) Load Vs FL current	N	Y	Y
	c) Load Vs Efficiency	N	Y	Y
	d) Load Vs Power factor	N	Y	Y
	e) Load Vs Speed	N	Y	Y
	f) Voltage Vs Thermal Withstand time	N	Y	Y
	g) Starting current Vs Time	N	Y	Y
6.	Connection diagram for RTDs, thermometer etc.	N	Y	Y
7.	Terminal Box drawings	N	Y	Y
8.	Illustrative and Descriptive catalogues	N	N	Y
9.	Catalogues of bought out accessories	N	N	Y
10.	Spare parts list	N	N	Y
11.	Installation, Operation and Maintenance manual	N	N	Y
12.	Test certificates			
	a) Routine	N	N	Y
	b) Type	N	N	Y
	c) For enclosure	N	N	Y
13.	Guarantee Certificates	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N - No

TECHNICAL SPECIFICATION

INTERLOCKING SWITCH SOCKET AND PLUG

CONTENTS

1.0 SCOPE

1.1 The standard covers the technical requirements of design, manufacture, testing at works and delivery in well packed condition of interlocking switch socket and plug.

1.2 The standard shall be read in conjunction with relevant part of Design Philosophy - Electrical.

2.0 STANDARDS TO BE FOLLOWED

2.1 The design, manufacture and testing of the equipment covered by this standard shall comply with the latest issue of IS-4160/ IEC-309 and other relevant Indian Standards, unless otherwise specified. Equipment complying with equivalent IEC standards shall also be acceptable.

2.2 The design and operational features of the equipment offered shall also comply with the provisions of latest issue of Indian Electricity Rules and other statutory acts and regulations. The supplier shall, wherever necessary, make suitable modifications in the equipment to comply with the above.

2.3 Wherever any requirement, laid down in this standard differs from that in Indian Standard Specifications, the requirement specified herein shall prevail.

3.0 SERVICE CONDITIONS

3.1 Ambient conditions

These shall be as indicated in Design Philosophy - Electrical.

3.2 System details

These shall be as indicated in Design Philosophy - Electrical.

4.0 OPERATING REQUIREMENTS

The equipment shall be suitable for operating at the rated capacity continuously without exceeding the specified temperature rise and without any detrimental effect on any part.

5.0 GENERAL DESIGN AND CONSTRUCTIONAL FEATURES

5.1 The switch socket shall be heavy duty industrial type. The interlocking arrangement shall be such that it is not possible to insert or withdraw the plug with the switch in ‘ON’ position.

5.2 The switch sockets shall have dust, hose and weather proof construction conforming to IPW55 as per IS/IEC:60947 and shall be suitable for outdoor use without any extra protection. All jointing surfaces shall be smoothly machined and of sufficient width to prevent ingress or dust. Further the covers shall be provided with continuous gaskets made of neoprene to prevent ingress of dust and moisture.

5.3 The enclosure of switch sockets and plugs shall be of cast aluminium alloy 4600 and suitable for fixing on wall / structure.

5.4 The enclosure shall be largely dimensioned in order to avoid temperature rise inside it which may damage the insulating materials and gaskets employed therein.

5.5 The insulating materials used shall be non-hygroscopic, mould proof and treated with suitable varnish to withstand the ambient conditions.

5.6 All external hardware of diameter less than 8 mm shall be of stainless steel and those of diameter 8 mm or above shall be of mild steel cadmium plated or zinc passivated.

5.7 Suitable arrangement for looping of cables from one switch socket to the other shall be provided. For switch sockets rated above 63A, looping shall be done from busbars and for switch sockets rated 63A and below, looping may be done from terminal block. Necessary terminals, cable glands and lugs for looping shall be provided. Also one no. The readed plug for each switch socket shall be supplied loose.

5.8 All the relevant information shall be provided on engraved name plate made of aluminium.

5.9 The enclosure shall be provided with two earthing terminals outside the body.

6.0 SPECIAL FEATURES FOR FLAME PROOF SWITCH SOCKET AND PLUGS

6.1 The enclosure shall be in addition of flame proof execution as per IS: 2148.

6.2 The enclosure group and temperature class shall be as indicated in Design Philosophy - Electrical.

6.3 Cable shall enter the terminal chamber through flame proof compression type cable glands. From the terminal to the main enclosure, the connection shall be made through proper bushings. Direct entry of external cables into the main enclosure shall not be accepted.

6.4 An additional earthing terminal inside the terminal chamber shall be provided.

6.5 Switch socket, plug and cable glands must be certified by the Central Mining Research Institute, Dhanbad or any other statutory authority for use in the specified hazardous area.

6.6 Further interlocking shall be provided so that the contacts cannot be energised when the plug and socket are separated.

7.0 COMPONENT DETAILS

Makes of all components shall be subject to owner's / consultant's approval

7.1 Air Break Switches

7.1.1 The switches shall be quick make, quick break rotary type and of utilisation category AC-23 as per IS/IEC:60947.

7.1.2 Switches shall be hand operated from outside the cover. The switch handle shall remain fixed to the front cover while removing the front cover.

7.2 H.R.C. Fuses

7.2.1 The sockets shall be provided with link type HRC fuses.

7.2.2 The fuses shall be capable of withstanding a short circuit current of 50 KA and shall be delayed action type conforming to IS: 13703. These shall be mounted on a shrouded base.

7.3 **Socket Outlets**

7.3.1 The socket outlet shall be located in the lower part of the enclosure and shall be provided with a threaded aluminium cover attached to the body with G.I. chain, to protect the socket after extraction of the plug. Spring loaded automatic shutter shall not be acceptable.

7.3.2 The socket contacts shall maintain satisfactory spring pressure and contact with the corresponding plug under normal service conditions.

7.3.3 The socket contacts shall be sunk well below the surface of the socket- outlets so as to make it impossible to be touched unintentionally.

7.3.4 An earthing contact shall be provided in the socket outlet which shall ensure making and breaking respectively of its contact with the earthing pin of the plug before and after making and breaking of the corresponding current carrying contacts.

7.4 **Plugs**

7.4.1 The plugs shall be so constructed so that these can be easily fitted in to the socket outlets.

7.4.2 These shall be provided with knurled knob arrangement for screwing on the body of the socket so that it can be securely fixed on the top.

7.4.3 The plug base and cover shall be firmly secured to each other and shall be sufficiently robust in construction to withstand normal usage.

7.4.4 The plug pins shall preferably be of single part. The earthing pin shall be slotted with a single slot and shall be larger in dimension than other pins.

7.4.5 The plug and socket contacts shall be self aligning type with best electrical continuity.

7.4.6 The plug shall be provided with dust proof cable entry suitable for receiving TRS flexible heavy duty copper conductor cable of specified size. The arrangement shall be such that the conductors are relieved from strain including twisting where they are connected to the terminals and that the outer surface of the cable at the place of entry is not damaged.

7.4.7 Insulating barriers forming an integral part of the plug shall ensure separation of metals and bare flexible conductors at different potentials.

7.5 **Cable Termination**

7.5.1 Switch socket shall have cable termination arrangement on the upper part of the housing and shall be provided with side entries, one on either side, through heavy duty double compression type rolled aluminium cable glands suitable for 1.1 KV grade PVC insulated armoured and PVC sheathed cables of size.

7.5.2 The terminal blocks shall be pressure clamp type for switch socket rated up to 63A and bolted lug type for higher ratings. The terminals shall be rated for at least 1.5 times the switch rating.

8.0 PAINTING

8.1 The enclosure after suitable pre-treatment shall be painted with two coats of anti-rust paint followed by two coats of anti-corrosive paint.

8.2 Epoxy based paint shall be used.

8.3 All paints shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off, crinkle or be removed by abrasion due to normal handling.

8.4 The finishing shade shall be light grey shade no.631 as per IS: 5, unless specified otherwise.

9.0 TESTS AND INSPECTION

9.1 The switch sockets and plugs shall be subjected to routine tests as per IS-4160 and other relevant standards.

9.2 Wherever specified, additional tests shall be carried out on one switch socket and plug of each rating.

9.3 The tests shall be carried out in the manufacturer's works in the presence of purchaser's representative. In addition to the above tests, the equipment shall be subject to stage inspection at works and inspection at site for final acceptance.

9.4 These inspections shall, however, not absolve the vendor from their responsibility for making good any defect which may be noticed subsequently.

10.0 DRAWINGS AND DOCUMENTS

10.1 Drawings and documents as per Annexure-I shall be supplied, unless otherwise specified.

10.2 All drawings and documents shall have the following descriptions written boldly.

- Name of client
- Name of consultant
- Enquiry / Order Number with plant / project name
- Code No. and Description

11.0 PACKING

11.1 The switch socket and plug shall be properly packed to safeguard against weather conditions and handling during transit. It shall be wrapped in polythene bags and an additional wrapping of bitumen paper shall also be provided to make it completely water proof before the equipment is packed in wooden crates.

11.2 The packing box shall contain a copy of the installation, operation and maintenance manual.

12.0 SPARES

12.1 Commissioning Spares: Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for approval.

12.2 Spare Spares for 2 Years operation (Mandatory), as specified shall be supplied.

12.3 Recommend 2 years Operational Spares (other than mandatory spare) alongwith recommended quantity & item-wise unit price shall be furnished.

12.4 All spare parts shall be identical to the parts used in the equipment

13.0 DEVIATIONS

13.1 Deviations, if any, from this standard shall be clearly indicated in the offer with reasoning.

ANNEXURE – I

DOCUMENTATION FOR INTERLOCKING SWITCH SOCKET AND PLUG

Sl.No.	Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheet	N	Y	Y
2.	Technical Particulars	N	Y	Y
3.	General arrangement and foundation drawing	N	Y	Y
4.	Schematic / wiring diagram	N	Y	Y
5.	Illustrative and descriptive literature	N	N	Y
6.	Catalogue for bought out accessories	N	N	Y
7.	Installation operation and maintenance manual	N	N	Y
8.	Test Certificates			
	a) Type	N	N	Y
	b) Routine	N	N	Y
9.	Guarantee Certificate	N	N	Y
10.	Certificate of flameproofness from statutory testing authority wherever applicable.	N	N	Y
11.	Spare parts list with identification marks	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N - No

TECHNICAL SPECIFICATION

BATTERY CHARGER

CONTENTS

1.0 SCOPE

1.1 This standard covers the technical requirements of design, manufacture, testing at works and delivery in well packed condition of Battery Charger Units.

1.2 The standard shall be read in conjunction with relevant part of Design Philosophy - Electrical.

2.0 STANDARDS TO BE FOLLOWED

2.1 The design, manufacture and testing of the equipment covered by this specification shall comply with the latest issue of IS: 8623 Specification for low voltage switchgear and control gear assemblies and other relevant Indian Standards, unless otherwise specified. Equipment complying with equivalent IEC standards shall also be acceptable.

2.2 The design and operational features of the equipment shall also comply with provisions of the latest issue of the Indian electricity Rules and other relevant Statutory Acts and Regulations. The supplier shall, wherever necessary, make suitable modifications to comply with the above.

2.3 Wherever any requirement, laid down in this standard, differs from that in Indian Standard Specifications, the requirement specified herein shall prevail.

3.0 SERVICE CONDITIONS

3.1 Ambient Conditions

These shall be as indicated in Design Philosophy - Electrical.

3.2 System Details

These shall be as indicated in Design Philosophy - Electrical.

4.0 DESIGN AND OPERATIONAL REQUIREMENTS

4.1 The Battery Charger Unit and its components shall be suitable for operating at the specified rating continuously with the specified voltage and frequency variations under the ambient conditions without exceeding the temperature rise limits specified in relevant standards and without any detrimental effect on any part.

4.2 The battery charger board shall consist of two units as follows:

(a) Float cum load cum Boost Charger -- To supply continuous load and keep the battery in state in float mode. In Boost mode, for Initial charging of Battery and after power restoration subsequent to failure, to recharge the battery while simultaneously supplying load current.

(b) A stand by unit for (a) above.

4.3 The rated voltage of the float charger for lead acid battery shall be 2.2 Volt/ Cell and final charging voltage of the boost charger shall be 2.75 Volt/ Cell. The rated voltage of the float charger for Ni-Cd shall be minimum 1.4 Volt/ Cell and final charging voltage of the boost charger shall be minimum 1.7 Volt/ Cell. The rated output voltage of the charger under 4.2 (a) above shall be adjustable by ± 5% of the rated value manually.

4.4 Charging unit stated under 4.2 (a) above shall be fully automatic using silicon controlled rectifiers (SCR) common for Float and Boost service. Charger D.C. output voltage shall be maintained within ± 2% irrespective of the input supply variations and load variation of 0 to 100% by closed loop voltage feed back control system. The charger shall be provided with current limit feature.

4.5 The output voltage of the float charger shall be monitored and in case voltage falls below 90% of the rated voltage the stand by charger shall be automatically switched 'ON' with audio-visual alarm and annunciation. Time delay features shall be incorporated to avoid spurious changeover.

4.6 Boost charging shall be achieved through the same silicon controlled rectifier (SCR) which shall regulate the charger output automatically by current control closed loop system. Provision for manual adjustment of charger output shall also be made. Charger shall maintain its output current constant at starting rate/ finishing rate of battery charging current irrespective of variation in input supply and battery condition.

4.7 Transfer from float charging to boost charging and vice versa shall be automatic as per the battery charge condition.

4.8 During boost charging operation, arrangement shall be made so that DC power to load is not interrupted even if AC power fails during this operation. During Boost charge period, battery backup to load shall be arranged by a tapping from suitable point of the battery.

4.9 Suitable dropper diodes shall be provided to reduce the voltage across the load to 105% of the rated voltage at rated load current. When power supply to the charger fails, the dropper diodes shall be by-passed automatically through contactor so that full battery output voltage is available to the load.

4.10 Provision of suitable filters shall be made so that the ripple in output voltage shall not exceed 3% and 10% for float and boost charger respectively.

4.11 It shall be ensured that during boost charging, no over/under charging of cells takes place.

4.12 All the automatic features specified above shall also have provision of manual arrangement for control of charging rates and transfer from one charger to others.

4.13 Charger unit shall be provided with all required indication, metering, protection, control and alarm annunciation devices for safe and reliable operation and shall include at least as indicated in Annexure-I.

5.0 CONSTRUCTIONAL FEATURES

5.1 Each of the charger units shall be housed in separate metal clad cubicles of identical size suitable for floor mounting and arranged to form a compact switchboard.

5.2 The complete assembly shall be dust, damp and vermin proof type equivalent to IP-43 as per IS/IEC:60947. In case it is necessary to provide openings for ventilation, these shall be closed from inside by fine wire mesh. Forced ventilated panel shall not be acceptable.

5.3 The frame work of cubicles shall be of bolted/welded construction, fabricated out of cold rolled sheet steel of not less than 2 mm thickness. The thickness of base channel shall not be less than 3 mm, suitable reinforcement, wherever necessary, shall be provided.

5.4 Hinged doors shall be provided on both the front and back side for easy access. The door hinges shall be concealed type.

5.5 The doors and the removable covers shall be provided with non-deteriorating neoprene gaskets. Gaskets without any discontinuity shall be preferred. Gaskets shall be held in position in groove in shaped steel work or these shall be 'U' type. Only one joint per gasket shall be permitted. Adhesive cement, if used, shall be of good quality so that the gaskets do not come off during service.

5.6 The mounting of the components shall be such that these are accessible for checking and replacement without the necessity of removing the adjacent ones, at the same time ensuring necessary degree of safety.

5.7 It shall be possible to carry out maintenance of one charger when the other is in operation.

5.8 The meters, switches and lamps shall be flush mounted type. All components of one unit shall be mounted on the same unit.

5.9 All the live parts shall be insulated. Parts which can not be insulated shall be provided with insulating barriers. These barriers shall provide shielding of all live parts to prevent accidental contact when the door is open. However, for the parts requiring handling normally, such as fuses/lamps etc., separate barriers shall be provided. The barriers in all cases shall cover the cable lug portions and shall be firmly secured, stable and durable. It shall, however, be possible to remove such barriers, if required.

5.10 At the equipment termination points, insulated phase barriers, PVC bolt caps, PVC hoses or insulating ribs shall be provided.

5.11 The outgoing terminal blocks shall be shrouded type or provided with insulating barriers.

5.12 Adequate arrangement for earthing shall be provided to safeguard the Operator or other personnel from electric hazards under all conditions of operation.

5.13 **Clearances and Creepage**

The clearances and creepage distances shall not be lower than the values specified below:

i)	Minimum clearance between two live parts	:	20 mm
ii)	Minimum clearance between a live part & earth	:	20 mm
iii)	Minimum creepage distance	:	28 mm

5.14 **Insulation**

5.14.1 The insulation used shall be non-hygroscopic and may be of porcelain, epoxy resin or glass fibre moulded with plastic. It shall be of adequate electrical and mechanical strength to give trouble free service during normal operation and short circuit conditions.

5.14.2 The insulation shall be treated suitably to withstand the tropical conditions and atmospheric pollution as specified.

5.15 **Wiring**

5.15.1 The switch board shall be completely factory wired and ready for external connections.

5.15.2 The wiring shall be complete in all respect so as to ensure proper functioning of control, protection, interlocking and measurement.

5.15.3 The wiring shall be carried out with flexible stranded PVC insulated copper conductor cables of 1100 V grade of minimum 1.5 Sq.mm size.

5.15.4 All wiring shall be marked with dependent both ends marking as per IS: 5578. Numbered ferrules, reading from the terminals outwards, shall be provided at both ends for easy identification. These shall be interlocking type plastic ferrules.

5.15.5 The control cables shall be neatly arranged and properly supported on PVC wiring channel.

5.16 Cable Termination

5.16.1 The boards shall be designed for bottom entry of the power and control cables. Sufficient space shall be provided for ease of connection and termination of cable.

5.16.2 Provision for receiving one 415 V, 3 phase 4 wire incoming supply lines, one for each charger shall be made. However, DC output for battery and load shall be looped inside the panel and only one outgoing supply each for battery and load shall be provided.

5.16.3 The termination of cables shall be done through cable glands which shall be suitable for the cables.

5.16.4 Heavy duty double compression type rolled Aluminium cable glands shall be provided. The cable glands shall be mounted on a removable gland plate, provided at a minimum height of 75 mm from the bottom of the switchboard. Two spare knockouts of size 20 mm shall also be provided on the gland plate for future addition of control cables.

5.16.5 For all power cables, crimped type cable lugs of same material as of conductor shall be provided.

5.16.6 The internal power wiring shall be terminated in the terminal blocks for connection to the outgoing cables, These terminal blocks shall be pressure clamp type up to 35 Sq.mm, cable and bolted lug type for higher sizes of cables, These shall be protected type and rated for 1100 V service. The minimum current rating of terminal block shall be 16 Amp. The construction shall be such that after the connection of cables by means of lugs, necessary clearances and creepage distances are available.

5.16.7 Not more than two wires shall be connected to any terminal. If necessary a number of terminals shall be jumpered together to provide wiring points.

5.16.8 Wherever necessary, suitable clamps to support the vertical run of cables shall be provided.

5.16.9 The terminal blocks shall be grouped according to circuit functions and suitably numbered. 20% extra terminals shall be provided in the terminal block.

5.16.10 For power connection, suitable marking on the terminals shall be provided to identify the phases.

5.17 Earth Bus

5.17.1 A continuous earth bus of Aluminium of suitable size minimum 32 x 6 mm shall be run all over the length in the lower part of the board with two ends connected to the external earth terminals of the board.

6.0 COMPONENT DETAILS

6.1 Rectifier Transformer

This shall be double wound, air cooled, 3 phase type. Class 'F' insulating materials shall be used, with temperature rise limited to Class 'B'. The windings shall be vacuum impregnated.

6.2 **Thyristors and Diodes**

The thyristors and diodes shall be properly selected to have adequate safety margin. A factor of safety of minimum 4 shall be taken for voltage surges and 2 for current ratings. The thyristors and diodes shall be mounted on their respective heat sinks which shall preferably be made of extruded Aluminium properly machined and providing intimate contact with the stud for heat dissipation. Each thyristor/ diode shall be protected with properly designed snubber circuit.

6.3 **Air Break Switches**

The switches shall be heavy duty quick make, quick break type conforming to IS/IEC 60947. Switches shall be snap action rotary type. 'ON'-'OFF' position of the switch shall be boldly indicated. The handle of switches shall remain fastened to the door even when the door is opened after turning the switch 'OFF'. The AC input switch shall not be directly mounted on the door.

6.4 **Fuses**

For protection of thyristors/ diodes, semi-conductor fuses shall be provided. All other fuses shall be HRC cartridge link type. They shall be suitable for the load and service required.

6.5 **Contactors**

The contactor shall be air break type of category AC-3/ DC-1 as per IS/IEC 60947. DC contactor shall be provided with arc chutes and magnetic blow out coil. The contactors shall not drop out even when the coil voltage drops to 65% of rated voltage.

6.6 **Thermal Overload Relays**

Adjustable bimetal thermal overload relays shall be provided. The bimetal relays shall be ambient temperature compensated. The thermal relays shall be provided with a manual resetting device on the door.

6.7 All ammeters and voltmeters shall be class 1.5 as per IS 1248 and shall be flush mounted type of minimum size 96 x 96 mm. Ammeters and Voltmeters for A.C. service shall be of moving iron type and that for D.C. service shall be moving iron or moving coil type. Zero adjuster shall be provided for operation from the front of the cases.

6.8 **Printed Circuit Boards (PCBs)**

The PCBs shall conform to IS 7405. These shall be of fibre or epoxy glass moulded of minimum thickness 1.5 mm and shall have gold plated contacts and silver or nickel plated tracks. All PCBs shall be of plug-in type contained in a dust proof box. PCBs shall be self diagnostic type and shall be provided with status indication. Metering points shall be provided on each PCB and the PCBs shall be clamped in position so that vibration or long usage does not result in loose contacts.

6.9 **Timers**

The timers shall be electronic, pneumatic or synchronous type conforming to IS: 5834 with manual/auto reset features as per the functional requirements. The repeat accuracy shall be within 5%.

6.10 **Control and Selector Switches**

6.10.1 All the control and selector switches shall be of rotary type with thermal utilization category of AC 11 or DC 11 as per IS/IEC:60947.

6.10.2 The control switches shall be spring return type and provided with pistol grip type handles.

6.10.3 The selector switches shall be stay-put type and provided with oval handle.

6.11 **Signal Lamps**

6.11.1 Signal lamps shall be provided to indicate the various circuit conditions and these shall be placed at a suitable height. The colour of the lamps for various functions shall be as follows:

Red	--	Circuit 'ON'
Green	--	Circuit 'OFF'
Amber	--	Alarm and auto trip.

6.11.2 The lamps shall be LED type having lumen output of 200 millicandella in axial direction.

6.12 **Audio Visual Alarm Annunciation**

6.12.1 A solid state audio-visual alarm annunciation system shall be provided for the board. Audible annunciation shall be provided by means of hooter with provision of remote alarm and acknowledgment. Visual annunciation shall be provided by flashing of the respective facia window. The facia window shall have translucent glass or plastic cover with inscription in black letters. Each facia window shall be provided with two lamps connected in parallel. The cover plate of the facia window shall be flush with the panel and shall be capable of easy removal to facilitate replacement of lamps.

6.12.2 The following operating sequence shall be adopted for audio visual alarm and indication:

System Condition	Visual Signal	Audible Signal
Normal	OFF	OFF
Abnormal	Flashing	ON
Acknowledge	Steady ON	OFF
Return to normal	OFF	OFF
Test	Steady ON	ON

7.0 ACCESSORIES

The supply shall include the following accessories:

7.1 Space Heater

Each cubicle of the board shall be provided with a thermostatically controlled space heater, rated for 240 V, 50 Hz and controlled through double pole miniature circuit breaker. The space heater supply shall be tapped from incomer power supply.

7.2 Name Plates

7.2.1 The board shall have a large name plate on the top to indicate its name and designation.

7.2.2 Each cubicle shall be provided with a name plate.

7.2.3 All control switches, push buttons, lamps etc. shall have function identification labels.

7.2.4 Name plate shall be of black perspex with white engraving of minimum 3 mm thickness.

7.3 Fuse Puller

7.4 Any other accessories required but not specified shall also be supplied to make the board complete in all respects and ensure its safe and proper operation.

8.0 PAINTING

8.1 The enclosure after suitable pre-treatment shall be painted with two coats of anti-rust paint followed by two coats of anti-corrosive paint.

8.2 Epoxy based paint shall be used.

8.3 All paints shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off, crinkle or be removed by abrasion due to normal handling.

8.4 Unless otherwise specified the finishing shade shall be light grey having Shade No. 631 as per IS 5.

9.0 TESTS AND INSPECTION

9.1 The board shall be subjected to routine tests as per IS 8623 and other relevant standards. Heat run test, if required, shall be carried out.

9.2 Additional tests, wherever specified shall be carried out on one board of each rating.

9.3 All the above tests shall be carried out in presence of purchaser's representative. In addition, the equipment shall be subjected to stage inspection during process of manufacture at works and site inspection.

9.4 These inspections shall however, not absolve the vendor from his responsibility for making good any defects which may be noticed subsequently.

10.0 DRAWINGS AND DOCUMENTS

10.1 Drawings and documents as per Annexure-II shall be supplied unless otherwise specified.

10.2 All drawings and documents shall have the following description written boldly:

- Name of client
- Name of consultant
- Enquiry / Order Number with plant / project name
- Code No. and Description

11.0 SPARES

11.1 Commissioning Spares: Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for approval.

11.2 Spare Spares for 2 Years operation (Mandatory), as specified shall be supplied.

11.3 Recommend 2 years Operational Spares (other than mandatory spare) alongwith recommended quantity & item-wise unit price shall be furnished.

11.4 All spare parts shall be identical to the parts used in the equipment

12.0 PACKING

12.1 The board shall be properly packed before despatch to avoid damage during transport, storage and handling.

12.2 The packing box shall contain a copy of the installation, operation and maintenance manual along with one set of drawings.

12.3 A sign to indicate the upright position of the panels to be placed during transport and storage shall be clearly marked. Also proper arrangement shall be provided to handle the equipment.

13.0 DEVIATIONS

13.1 Deviations, if any, from this standard shall be clearly indicated in the offer with reasoning.

ANNEXURE - I

REQUIREMENT OF PROTECTIONS, METERING, CONTROL AND INDICATIONS / ANNUNCIATIONS FOR BATTERY CHARGER

Sl. No.	Description	To be mounted on		
		Float cum Load Charger	Standby Float cum Load Charger	Boost Charger
1	2	3	4	5
1.	**A.C. Input Side**			
	i) ON/OFF Switch	Yes	Yes	Yes
	ii) HRC Fuses	Yes	Yes	Yes
	iii) Contactor	Yes	Yes	Yes
	iv) Thermal O/L Relay	Yes	Yes	Yes
	v) Single phasing and Phase Reversal	Yes	Yes	Yes
	vi) Voltmeter with SS	Yes	Yes	Yes
	vii) Ammeter with SS	Yes	Yes	Yes
	viii) Signal Lamp (ON/OFF)	Yes	Yes	Yes
2.	**Rectifiers**			
	i) Semiconductor fuses	Yes	Yes	Yes
	ii) Filters with fuses	Yes	Yes	Yes
	iii) Surge Suppressors	Yes	Yes	Yes
3.	**DC Output Side**			
	i) ON/OFF Switch	Yes	Yes	Yes
	ii) HRC Fuses	Yes	Yes	Yes
	iii) Blocking Diodes	Yes	Yes	Yes
	iv) Voltmeter	Yes	Yes	Yes
	v) Ammeter	Yes	Yes	Yes
	vi) Signal Lamp (ON/OFF)	Yes	Yes	Yes
	viii) Charging Ammeter (on demand type)	Yes	Yes	Yes

Sl. No.	Description	To be mounted on		
		Float cum Load Charger	Standby Float cum Load Charger	Boost Charger
1	2	3	4	5
4.	**Common Items**			
	i) Droper Diodes	Yes		
	ii) Solid State facia annunciator for :	Yes	Yes	Yes
	-- Automatic changeover from one charger to another			
	-- Rectifier fuse failure in float/standby float/boost			
	-- Incoming supply failure float/standby float/boost			
	-- DC output under voltage			
	-- Earth fault			
	-- Single phasing and phase reversal			
	-- Filter fuse failure float/ standby float/boost			
	iii) Battery isolating switch and HRC fuses			Yes
	iv) Battery under voltage relay			Yes
	v) Battery earth fault relay			Yes
	vi) DC Contactor			Yes

NOTE: Any other components as required for satisfactory operation of the battery charger shall be provided.

ANNEXURE - II

DOCUMENTATION FOR BATTERY CHARGER

Sl.No.	Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheet	N	Y	Y
2.	Technical Particulars	N	Y	Y
3.	General arrangement drawings showing overall dimensions of the charger board and mounting details of various equipment inside the charger panel	N	Y	Y
4.	Foundation plan indicating certified dimensions, floor openings, weight, clearance etc.	N	Y	Y
5.	Schematic and Wiring Diagrams	N	Y	Y
6.	Descriptive literature of the charger and various components mounted in the panel.	N	N	Y
7.	Characteristics curves for the charger and all other static and control devices, relays etc.	N	N	Y
8.	Installation, Operation and Maintenance manual	N	N	Y
9.	Guarantee Certificates	N	N	Y
10.	Test Certificates	N	N	Y
11.	Spare parts list with identification marks	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N - No

TECHNICAL SPECIFICATION

BATTERY

CONTENTS

1.0 SCOPE

1.1 This standard covers the technical requirements of design, manufacture, testing at works and despatch in well packed condition of batteries and accessories.

1.2 This standard shall be read in conjunction with the relevant part of Design Philosophy - Electrical.

2.0 STANDARDS TO BE FOLLOWED

2.1 The design, manufacture and testing of the battery shall conform to the latest issue of the following standards:

IS: 1651	--	Stationary cells & batteries, lead-acid type (with tubular positive plate)
IS: 1652	--	Stationary cells & batteries, lead-acid type with plante positive plates.
IS: 10918	--	Vented type nickel cadmium batteries

All accessories shall also conform to the relevant Indian Standard. Equipment complying with equivalent IEC standards shall also be acceptable.

2.2 The design and operational features of the equipment offered shall comply with the provisions of the latest issue of the Indian Electricity Rules and other Statutory Acts and Regulations. The supplier shall, wherever necessary, make suitable modifications in the equipment to comply with the above.

2.3 Wherever any requirement, laid down in this standard, differs from that in Indian Standard specifications, the requirement specified herein shall prevail.

3.0 SERVICE CONDITIONS

3.1 Ambient Conditions

These shall be as indicated in Design Philosophy - Electrical.

3.2 System Details

These shall be as indicated in Design Philosophy - Electrical.

4.0 OPERATING REQUIREMENTS

The battery shall be able to deliver rated ampere hours when discharged at the 10 hours rate of discharge to a final voltage of 1.85 V per cell for Lead Acid and at the 5 hours rate of discharge to a final voltage of 1.1 V per cell for Ni-Cd battery under the ambient conditions indicated in Design Philosophy - Electrical.

5.0 GENERAL DESIGN AND CONSTRUCTIONAL FEATURES

5.1 The battery shall be of lead acid plante type and rated for 220V. Each battery bank shall consist of 110 number of cells.

5.2 Each cell shall be contained in a closed top container preferably transparent and unbreakable and shall incorporate positive plates, negative plates and separators of adequate dimensions. Lead acid battery shall be of plante plate type (positive plate).

5.3 The battery bank shall be complete with all necessary components such as lids, plugs, separators and buffers, inter-cell connectors, lead coated bolts and nuts, cell insulators etc.

5.4 The required quantity of electrolyte plus 10% extra quantity shall be supplied in suitable non-returnable containers along with the battery.

6.0 ACCESSORIES

The following accessories shall be supplied with each battery bank:-

(a)	1 Set	--	Battery Stand constructed out of teak wood without the use of any metal fastenings and coated with 3 coats of anti-acid paint. The stand shall be properly designed so that each cell shall be easily accessible for inspection, topping up etc. However, for Ni-Cd battery mild steel stand with alkali resistant paint may also be accepted
(b)	1 Set	--	Inter-row, inter-tier and inter-stand connectors and takeoffs. These shall be sized suitably to have adequate current carrying capacity and mechanical strength
(c)	1 Set	--	Cell Insulators
(d)	1 Set	--	Stand Insulators
(e)	1 No.	--	Centre zero cell testing voltmeter scaled 3-0-3 volts
(f)	2 Nos.	--	Syringe type Hydrometers for measuring the specific gravity of the electrolyte
(g)	2 Nos.	--	Gravity correction thermometers, mercury-in-glass type
(h)	1 Set	--	Connecting bolt wrenches
(i)	1 No.	--	Rubber syringe for tapping cells
(j)	1 No.	--	Wall mounting type teak wood holder for Hydrometer and Thermometer.
(k)	1 No.	--	Acid/Alkali resisting funnel.
(l)	1 No.	--	Acid/Alkali resisting jug.
(m)	1 Pair	--	Rubber gloves.
(n)	1 No.	--	Rubber Apron.

All other accessories, not specified above, but required for satisfactory operation and maintenance shall also be supplied.

7.0 TESTS AND INSPECTION

7.1 Type tests shall be carried out as per relevant standards on two cells in the presence of Purchaser's representative.

7.2 Acceptance tests shall be carried out as per relevant standards on each cell after installation at site.

7.3 In addition, the battery shall be subjected to stage inspection at works and inspection at site for final acceptance.

7.4 These inspections shall, however, not absolve the vendor from his responsibilities for making good any defect which may be noticed subsequently.

8.0 DRAWINGS AND DOCUMENTS

8.1 Drawings and documents as per Annexure-I shall be furnished by the Vendor unless otherwise specified.

8.2 All drawings and documents shall have following description written boldly:

- Name of client
- Name of consultant
- Enquiry / Order Number with plant / project name
- Code No. and Description

9.0 SPARES

9.1 Commissioning Spares: Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for approval.

9.2 Spare Spares for 2 Years operation (Mandatory), as specified shall be supplied.

9.3 Recommend 2 years Operational Spares (other than mandatory spare) alongwith recommended quantity & item-wise unit price shall be furnished.

9.4 All spare parts shall be identical to the parts used in the equipment

10.0 PACKING

The battery cells and accessories shall be properly packed to safeguard against weather conditions and rough handling. It shall be wrapped in polythene bags with an additional wrapping bitumen paper to make it completely water proof before it is packed in crates. The packing box shall contain a copy of the installation operation and maintenance manual.

11.0 DEVIATIONS

11.1 Deviations, if any, from this standard shall be clearly indicated in the offer with reasoning.

ANNEXURE – I

DOCUMENTATION FOR BATTERY

Sl. No.	Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheet	N	Y	Y
2.	Technical Particulars	N	Y	Y
3.	Dimensional drawings showing the cell arrangement on stand (Plan, front and side elevation) for each type of battery.	N	Y	Y
4.	Illustrative and descriptive literature giving the complete details of construction of battery	N	N	Y
5.	Operation and maintenance instructions	N	N	Y
6.	Test Certificates			
	-- Type	N	N	N
	-- Acceptance	N	N	Y
7.	Guarantee Certificates	N	N	Y
8.	Spare Parts lists	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N - No

TECHNICAL SPECIFICATION

CABLES

CONTENTS

1.0 SCOPE

1.1 This standard covers the technical requirements of design, manufacture, testing at works and dispatch in well packed condition of power and control cables.

1.2 The standard shall be read in conjunction with relevant part of Design Philosophy - Electrical and other relevant references as specified therein.

2.0 STANDARDS TO BE FOLLOWED

2.1 The design, manufacture and testing of cables covered by this standard shall comply with the latest issue of following Indian Standards, unless otherwise specified. Equipment complying with equivalent IEC standards shall also be acceptable.

IS: 1554 Part (I)	--	PVC insulated (heavy duty) electric cables for working voltages upto and including 1100 volts.
IS: 1554 Part (II)	--	PVC insulated (heavy duty) electric cables for working voltages from 3.3 KV upto and including 11 KV.
IS: 7098 Part (I)	--	Cross linked polyethylene insulated PVC sheathed cables for working voltages upto and including 1100 volts.
IS: 7098 Part (II)	--	Cross linked polyethylene insulated PVC sheathed cables for working voltages from 3.3 KV upto and including 33 KV
IS: 694	--	PVC insulated cables for working voltages upto and including 1100 volts
IS: 5831	--	PVC insulation and sheath of electric cables

2.2 The design and operational features of the cables offered shall also comply with the provisions of latest issue of the Indian Electricity Rules and other relevant Statutory Rules & Regulations. The supplier shall, whenever necessary, make suitable modification in the cables to comply with the above mentioned rules.

2.3 Wherever any requirement, laid down in this standard, differs from that in Indian Standard Specifications, the requirement specified herein shall prevail.

3.0 SERVICE CONDITIONS

3.1 Ambient Conditions

These shall be as indicated elsewhere in Design Philosophy - Electrical.

3.2 System Details

These shall be as indicated elsewhere in Design Philosophy - Electrical.

4.0 OPERATING REQUIREMENTS

The cables shall be suitable for operating continuously at the rated capacity as specified in relevant I.S. under the ambient conditions without exceeding the permissible temperature rise and without any detrimental effect on any part.

5.0 GENERAL DESIGN AND CONSTRUCTIONAL FEATURES

5.1 The design, manufacture and workmanship of cables shall be in accordance with the latest practice.

5.2 All materials to be used shall be new, unused and of the best quality.

5.3 **Conductors**

The power cables shall be of stranded Aluminium / copper round or shaped conductors and control cables shall be of annealed high conductivity stranded copper round conductors. The conductors shall comply with the requirements of IS: 8130.

5.4 **Insulation**

The conductor insulation shall be XLPE and shall comply with relevant IS.

5.5 **Fillers**

The cables shall have suitable fillers wherever required, laid up with conductors to provide substantially circular cross section before the inner sheath is applied.

5.6 **Inner Sheath**

Inner sheath, wherever applicable shall be ST1/ ST2 type compound applied by extrusion process except for paper cables for which it shall be of lead or lead alloy.

5.7 **Armouring**

All power and control cables shall be armoured. The single core cables shall be armoured with hard drawn Aluminium taps/ wires or any other suitable nonmagnetic material. All other cables shall have galvanized steel wire / strip armouring.

5.8 **Outer Sheath**

The outer sheath shall be ST1/ ST2 type compound applied by extrusion process and suitable to withstand atmospheric pollution, resistance to termites, fire retardant and coloured black.

5.9 **Screening**

Screening over conductor and insulation shall be provided as per relevant standard unless specified otherwise. The screening for control cables if specified shall be of aluminium, mylor or equivalent and provided with tinned drain wire which shall be continuous and permanently connected to the screen.

5.10 **Identification**

The individual cores of cables shall be coloured as per relevant IS. Where it is not possible to distinguish the cores by colour, coloured strip shall be applied on the cores or core nos. shall be marked on each core at regular intervals. All cables shall carry the manufacturer's name or trade mark, the cable size, voltage rating and year of manufacture at intervals not exceeding 100 meters. Running meter markings shall also be provided throughout the length of the cable.

5.11 **Dimension**

The overall dia. and dia. under armour of the cables shall be indicated by the vendor in the technical particulars. These shall be guaranteed with a tolerance of ± 5% but not exceeding 2 mm.

5.12 The cut ends of the cables shall be sealed by means of non-hygroscopic materials.

6.0 SPECIAL PURPOSE CABLES

6.1 **Flame Retardant Low Smoke Cables**

Flame retardant low smoke cables shall have outer sheath of PVC having following values.

- Minimum oxygen index - 29%
- Minimum temperature index - 250ºC
- Maximum acid gas generation - 20%
- Maximum smoke density rating - 60%

6.2 **Heat Resistant Cables**

Heat resistant cables shall be of silicon rubber insulated laid circular with asbestos worming and overall glass fibre braided and varnished. Silicon rubber insulating compound shall conform to IS: 6380 and the constructional features shall conform generally to IS: 9968.

7.0 CABLE DRUM

7.1 The cables shall be supplied in non-returnable wooden drums (or steel drums if specified) of heavy construction. The wood used for construction of the drums shall be properly seasoned, sound and free from defects.

7.2 Cables shall be supplied in specified drum lengths. Where no such indication is given, standard drum lengths may be offered.

7.3 The tolerance on each drum of cable shall not exceed ± 2.5%. However, no negative tolerance on HV cables is acceptable.

7.4 All cable drums shall have stencilled data as per relevant IS as well as the purchaser's order no., item no. & drum no.

8.0 TESTS AND INSPECTION

8.1 The following tests shall be carried out on the cables as per relevant IS.

i) Routine Tests - On all cables
ii) Acceptance tests - On representative length of each size
iii) Type tests - Wherever specified on one cable drum of each size

8.2 In addition, the following tests shall be carried out on all fire retardant low smoke cables as per IS or as per the following standards:

i) Oxygen and temperature index test as per ASTM-D-2863

ii) Acid gas emission test as per IEC-754 Part-I

iii) Smoke density test as per ASTM-D-2843

iv) Flammability test as per IEC-332 Part-I or IS-10810

8.3 All the above mentioned tests shall be carried out in the presence of purchaser's representative. In addition, the cables shall be subjected to stage inspection at works and inspection at site for final acceptance.

8.4 These tests and inspections shall, however, not absolve the vendor from their responsibility for making good any defect which may be noticed subsequently.

9.0 DRAWINGS AND DOCUMENTS

9.1 Drawings and documents as per Annexure-I shall be supplied, unless otherwise specified.

9.2 All drawings and documents shall have the following descriptions written boldly.

- Name of client
- Name of consultant
- Enquiry / Order Number with plant / project name
- Code No. and Description

10.0 DEVIATIONS

10.1 Deviations, if any, from this standard shall be clearly indicated in the offer with reasoning.

ANNEXURE - I

DOCUMENTATION FOR CABLES

Sl. No.	Document Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheet	N	Y	Y
2.	Technical Particulars	N	Y	Y
3.	Illustrative and Descriptive catalogues	N	N	Y
4.	Installation, Termination and Jointing Instructions	N	N	Y
5.	Test certificates			
	a) Routine	N	N	Y
	b) Type	N	N	Y
6.	Guarantee Certificates	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N - No

TECHNICAL SPECIFICATION

PREFABRICATED LADDER TYPE CABLE RACKS

CONTENTS

1.0 SCOPE

1.1 This standard covers the technical requirements of design, fabrication, testing at works and delivery in well-packed condition of prefabricated ladder type cable racks.

1.2 The standard shall be read in conjunction with Drawing Nos. PDS: E 530 to 538 (9 Sheets).

2.0 STANDARDS TO BE FOLLOWED

2.1 The design, manufacture and testing of the cable racks covered by this standard shall comply with the latest issue of following and other relevant Indian Standards, unless otherwise specified. Equipment complying with equivalent IEC standards shall also be acceptable.

IS: 733	--	Wrought aluminium and aluminium alloy bars, rods and sections for general engineering purposes
IS: 2629	--	Recommended practice for hot dip galvanising on iron and steel
IS: 4759	--	Hot dip zinc coatings on structural steel and other allied products

2.2 Wherever any requirement, laid down in this standard, differs from that in Indian Standard Specifications, the requirement specified herein shall prevail.

3.0 GENERAL DESIGN AND CONSTRUCTIONAL FEATURES

3.1 Ladder type cable racks shall be fabricated as per attached Drawing Nos. PDS: E 530 to PDS: E 538 (9 Sheets).

3.2 Cable racks and accessories such as coupler plate, tees, bend, elbows etc. shall be fabricated from 3 mm thick mild steel galvanised sheet or 4 mm thick aluminium 19000 H2 alloy sheet extrusion conforming to designation No. 64430 and condition WP as per IS: 733.

3.3 G.I. racks and accessories shall have zinc coating of 800 gm/sq. metre applied by hot dip galvanising process. Galvanising shall be uniform, adherent, smooth and free from defects.

3.4 The finished rack and accessories shall be free from sharp edges and corners, burrs and un-evenness. Stepped arrangement of bending is not acceptable. The channel members in the bending shall have uniform curvature and shall be made out of single piece.

3.5 The racks shall be supplied in minimum length of 2.4 metre.

3.6 Each straight length and bend shall be supplied with two coupling plates fitted at each side channel at one end. The coupling plates shall be supplied with bolts, nuts and washers fitted at the other four holes for fixing to adjoining member.

3.7 Coupling plate shall be designed to permit longitudinal adjustment upto ± 10 mm and skew upto 10º.

3.8 Clamping arrangement as per attached drawings shall be provided for fixing the rack with the cross support as required.

3.9 All the bends, tees and junctions shall be made sufficiently rigid by providing suitable reinforcement on rungs as required.

3.10 The rungs shall be connected to the side channels by continuous welding alongwith three sides of rung. Aluminium rack shall be welded by TIG welding process.

3.11 All hard wares such as nuts, bolts, washers and crank bolts shall be cadmium plated.

3.12 Tolerances in various dimension shall be follows:

Length	--	± 5 mm
Width	--	± 2 mm
Height	--	± 1 mm
Bend	--	± 1 mm
Thickness	--	± 0.2 mm

Positive tolerance on total quantity upto ± 5% is acceptable. However, negative tolerance on total quantity is not acceptable.

4.0 MARKING

The packing shall be clearly marked on the outside (on top side & ends) in indelible ink with the following minimum details:

-- Part No.
-- Size of Tray (Length x Width x Height)
-- No. of Tray / Section, Total Weight
-- Material Specification
-- Client's Name
-- Purchase Order No.
-- Manufacturer's Name

5.0 TESTS AND INSPECTION

5.1 Following tests shall be carried out on prefabricated cable racks:

Visual inspection and checking for

i) Quality and thickness of raw material
ii) Dimensions as per drawing.
iii) Quality of welding (before galvanising for G.I. racks)
iv) Preparation of metal surfaces (for G.I. racks).

5.2 After galvanising, G.I. cable racks shall be subjected to following tests as per IS:4759.

i) Mass of galvanising coating -- At any location the thickness of zinc coating shall not be less than 90 micron. However, average thickness of zinc coating shall not be less than 113 micron.

ii) Uniformity of galvanising coating.

iii) Adhesion of galvanising coating.

iv) 3 samples from each lot shall be taken for testing.

v) From each lot and size of rack, measure length of 10 trays and average length to be multiplied by number of trays to arrive for total length.

5.3 All the above tests shall be carried out in the manufacturer's works in the presence of Purchaser's representative. In addition to the above tests, the cable racks and its accessories shall be subjected to stage inspection at works and inspection at site for final acceptance.

5.4 These tests and the Purchaser's inspection shall, however, not absolve the vendor from their responsibility for making good any defect which may be noticed subsequently.

6.0 DRAWINGS AND DOCUMENTS

6.1 Drawings and documents as per Annexure-I shall be supplied, unless otherwise specified.

6.2 All drawings and documents shall have the following descriptions written boldly.

- Name of client
- Name of consultant
- Enquiry / Order Number with plant / project name
- Code No. and Description

7.0 DEVIATIONS

7.1 Deviations, if any, from this standard shall be clearly indicated in the offer with reasoning.

ANNEXURE - I

DOCUMENTATION FOR PRE-FABRICATED LADDER TYPE CABLE RACKS

Sl. No.	Document Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Illustrative and Descriptive catalogues	N	N	Y
2.	Installation, Termination and Jointing Instructions	N	N	Y
3.	General Arrangement Drawings, showing details of rack, coupling pieces, fasteners, etc.	N	Y	Y
4.	Test certificates	N	N	Y
5.	Guarantee Certificates	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N - No

TECHNICAL SPECIFICATION

LOCAL CONTROL STATION

CONTENTS

1.0 SCOPE

1.1 This standard covers the technical requirements of design, manufacture, testing at works and delivery in well-packed condition of Local Control Stations.

1.2 This standard shall be read in conjunction with relevant part of Design Philosophy - Electrical and other relevant references as specified therein.

2.0 STANDARDS TO BE FOLLOWED

2.1 The design, manufacture and testing of the equipment covered by this standard shall comply with the latest issue of IS/IEC:60947 and other relevant Indian Standards, unless otherwise specified. Equipment complying with equivalent IEC standards shall also be acceptable.

2.2 The design and operational features of the equipment offered shall also comply with the provisions of latest issue of the Indian Electricity rules and other relevant statutory Acts and Regulations. The supplier shall, wherever necessary, make suitable modification in the equipment to comply with the above.

2.3 Wherever any requirement, laid down in this standard differs from that in Indian Standard Specifications, the requirement specified herein shall prevail.

3.0 SERVICE CONDITIONS

3.1 Ambient Conditions

These shall be as indicated elsewhere in Design Philosophy - Electrical.

3.2 System Details

These shall be as indicated elsewhere in Design Philosophy - Electrical.

4.0 OPERATIONAL REQUIREMENTS

This equipment and associated components shall be suitable for operating satisfactorily under the specified ambient and system conditions.

5.0 GENERAL DESIGN AND CONSTRUCTIONAL FEATURES

5.1 The Control Stations shall be suitable for control voltage not exceeding 500V, 50 Hz AC or 220V D.C.

5.2 The enclosure shall be of die cast Aluminium alloy LM-6. As an alternative to cast Aluminium, fibre glass enclosure is also acceptable.

5.3 The equipment shall have dust, hose and weather proof construction equivalent to IPW-55 as per IS/IEC:60947. These shall be suitable for outdoor location without any additional protection or cover.

5.4 A rain-hood shall be offered as an additional item. It shall be made of 14 gauge Aluminium sheet bent to shape. In case of fibre glass enclosure, these can be made of fibre glass.

5.5 All external hardware of diameter less than 8 mm shall be of stainless steel and those of diameter 8 mm and above shall be of mild steel cadmium plated or zinc passivated. For fibre glass enclosure Nylon PVC bolts of diameter 8 mm may be used.

5.6 The control station shall preferably be with bolted cover. The bolts for retaining the cover in position shall be provided with 10 mm dia. stainless steel and these shall be so arranged that they do not pierce into the door gasket.

5.7 All the components shall be mounted on a base plate inside the enclosure. Necessary actuating system for control switch, push button, non yellowing acrylic/ glass cover for ammeter and indication lamps shall be provided on the front cover. No wiring shall be carried out on the front cover.

5.8 The layout of components in the control station shall be liberal and standardised.

5.9 All mating surfaces shall be smoothly machined and shall be of sufficient width of at least 6 mm. The covers shall be provided with continuous gasket made of neoprene or synthetic rubber to prevent ingress of dust and moisture. The gasket shall be held in position in groove provided in the enclosure and shall be pressed all around uniformly by suitably shaped projection of the door. Gaskets simply glued to the surface are not acceptable.

5.10 The enclosure shall be suitable for mounting on wall or on steel structure. 4 Nos. holes suitable for 12 mm bolts shall be provided outside the enclosure for fixing the control stations.

5.11 The internal wiring shall be carried by means of single core PVC insulated 1.5 sq. mm stranded copper conductor cable. All termination shall be made with crimping type proper size lugs and shall be properly ferruled.

5.12 The control stations shall be completely factory wired and ready for external cable connection.

5.13 For easy identification, numbering ferrules shall be provided on all wiring at both ends i.e. equipment end and terminal block end. Terminals for external wiring shall be numbered

5.14 The enclosure shall be provided with two earthing terminals with studs of 8 mm. dia. projecting outside the enclosure for connection to earth. These terminals shall not pierce through the enclosure and shall be marked with earthing symbol.

5.15 Each control station shall be provided with minimum 2 mm thick stainless steel name plates or consisting of black Perspex with white engraving indicating the code number and description of the equipment controlled by it. Similar labels shall be provided for all indication lamps, push buttons and control switches. The name plate and label shall be fixed with screws only.

6.0 SPECIAL FEATURES FOR FLAME PROOF LOCAL CONTROL STATION

6.1 The enclosure shall be in addition, of flameproof execution as per IS: 2148.

6.2 The control stations shall be suitable for hazardous area of enclosure group and temperature class as indicated in Design Philosophy - Electrical.

6.3 Cables shall enter the terminal box through flame proof cable gland. From the terminal chamber to the main enclosure, the connections shall be made through proper

bushings. Direct entry of external cables into the main enclosure shall not be accepted. All entries shall be provided with stainless steel inserts.

6.4 An additional earthing terminal inside the terminal chamber shall be provided.

6.5 Local control stations and cable gland must be certified by the Central Mining Research Institute, Dhanbad or any other statutory authority for use in the specified hazardous area.

7.0 COMPONENT DETAILS

7.1 Trip-Neutral-Close Switch

TRIP-NEUTRAL-CLOSE switch shall be double pole, 3 position, pistol grip, rotary type having self spring return feature to neutral position. The contacts shall be of phosphor bronze and shall be provided with two breaks in series. Mechanical sequence device to prevent two successive movements to the same position shall be fitted. The switch shall be capable of being padlocked in the 'TRIP' position.

7.2 'Auto-Manual' Switch

'Auto-Manual' switch shall be single pole stay put type having three positions "AUTO-OFF-MANUAL". Provision shall be made to padlock the switch in the "OFF" position.

7.3 Selector Switch / Lock Service Switch

These shall be single pole stay put type having two position with a pistol grip handle and capable of being padlocked in one of the position.

7.4 All the switches shall be rotary type with snap or wiping action contact and having a set of normally open and closed contacts in each position. All switches shall be provided with pistol grip handle.

7.5 'Off-Auto-On' Switch

7.5.1 'OFF-AUTO-ON' switch shall be in minimum three stack configuration, each stack having three positions with spring return from 'ON' to 'Auto' position and lockable in 'OFF' position by means of padlock.

7.5.2 The switch shall have sliding contact between 'AUTO' and 'ON' position. In 'OFF' position the contact shall be completely broken from 'AUTO' position.

7.6 Push Buttons

These shall be spring loaded, with a set of normally closed and open contacts. The push buttons for 'start' shall be shrouded type and coloured green while 'stop' push buttons shall be un-shrouded type and coloured red. Provision shall be made to padlock the 'stop' push button in 'OFF' position. The fixing ring shall be metallic white. An oil proof rubber cap shall preferably be provided.

7.7 The switches and push buttons shall conform to utilization category AC11/ DC11 as per IS/IEC:60947. The contact shall be rated to make, break and carry inductive current of 5 Amp. at 415 V AC and 1 Amp of 220V DC. The contact arrangement shall be as shown in the terminal drawings. Built in locks instead of padlocking are not acceptable.

7.8 **Indication Lamps**

7.8.1 LED type indication lamps shall be provided to indicate the various circuit conditions as shown in the terminal drawings.

7.8.2 The LEDs shall provide good illumination through a viewing angle of 180º. The LEDs shall have lumen output of 200 milli Candella in the axial direction.

7.8.3 The colour of the LED indication for various functions shall be as follows:-

RED : For 'ON' Indication
GREEN : For 'OFF' Indication
WHITE : For "Ready for Service" Indication

7.9 **A.C. Ammeters**

The ammeter shall be flush mounting, moving iron spring controlled type, of accuracy class 1.5 as per IS:1248, with square face of minimum size 72 mm x 72 mm having scale range 0-240º. The ammeter shall be provided with uniform scale up to CT primary current and compressed end scale up to 6 times the CT primary current. Adjustable red pointer shall be provided to indicate the full load current of the motors. Zero adjusters shall be provided for operation from the front of the meter. All ammeters shall be operated through 1Amp. CTs only.

7.10 **D.C. Ammeters**

The D.C. ammeter shall be shunt operated. These shall be moving coil or moving iron type of accuracy class 1.5 as per IS: 1248.

7.11 **Terminal Blocks**

All control stations shall be provided with terminal blocks. Terminal blocks shall be located at a minimum distance of 50 mm from the bottom of the enclosure. The terminal blocks for the control station shall be suitable for conductor sizes of 2.5 mm^2. These shall be of pressure clamp type design mounted on the base channel. The minimum rating of terminal block shall be 16 Amp.

7.12 **Cable Glands**

The cables for the external connections, shall enter the terminal chamber through heavy duty double compression type rolled Aluminium cable glands suitable for 2.5 sq. mm PVC insulated, armoured, and PVC sheathed copper conductor 1.1 KV grade cables. The number and cores of control cables shall be as per requirement. The cable gland shall be fitted in a threaded hole.

8.0 PAINTING

8.1 The enclosure after suitable pre-treatment shall be painted with two coats of anti-rust paint followed by two coats of anticorrosive paint.

8.2 Epoxy based paint shall be used.

8.3 All paints shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off, crinkle or be removed by abrasion due to normal handling.

8.4 Unless otherwise specified, the finishing shade shall be of light grey having shade no. 631 as per IS: 5.

9.0 TESTS AND INSPECTION

9.1 All equipment shall be routine tested as per relevant standards.

9.2 Additional tests, wherever specified, shall be carried out.

9.3 All the above mentioned tests shall be carried out in the presence of purchaser's representative. In addition, the equipment shall be subjected to stage inspection at works and inspection at site for final acceptance.

9.4 These inspections shall, however, not absolve the vendor from their responsibility for making good any defect which may be noticed subsequently.

10.0 DRAWINGS AND DOCUMENTS

10.1 Drawings and documents as per Annexure-I shall be supplied, unless otherwise specified.

10.2 All drawings and documents shall have the following descriptions written boldly.

- Name of client
- Name of consultant
- Enquiry / Order Number with plant / project name
- Code No. and Description

11.0 SPARES

11.1 Commissioning Spares: Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for approval.

11.2 Spare Spares for 2 Years operation (Mandatory), as specified shall be supplied.

11.3 Recommend 2 years Operational Spares (other than mandatory spare) alongwith recommended quantity & item-wise unit price shall be furnished.

11.4 All spare parts shall be identical to the parts used in the equipment

12.0 PACKING

12.1 The local control stations shall be properly packed to safeguard against weather conditions and handling during transit. It shall be wrapped in polythene bags and an additional wrapping of bitumen paper shall also be provided to make it completely water proof before the equipment is packed in wooden crates.

12.2 The packing box shall contain a copy of the installation, operation and maintenance manual.

13.0 DEVIATIONS

13.1 Deviations, if any, from this standard shall be clearly indicated in the offer with reasoning.

ANNEXURE - I

DOCUMENTATION FOR LOCAL CONTROL STATIONS

Sl. No.	Document Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheet	N	Y	Y
2.	Technical Particulars	N	Y	Y
3.	General Arrangement Drawings	N	Y	Y
4.	Schematic Diagrams	N	Y	Y
5.	Illustrative and Descriptive catalogues	N	N	Y
6.	Catalogues of bought out accessories	N	N	Y
7.	Spare parts list	N	N	Y
8.	Installation, Operation and Maintenance manual	N	N	Y
9.	Test certificates			
	a) Routine	N	N	Y
	b) Type (only for flameproof equipment)	N	N	Y
	c) For enclosure	N	N	Y
10.	Guarantee Certificates	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N - No

TECHNICAL SPECIFICATION

JUNCTION BOX

CONTENTS

1.0 SCOPE

1.1 This standard covers the technical requirements of design, manufacture, testing and inspection at works and delivery in well packed condition of junction boxes.

1.2 This standard shall be read in conjunction with relevant part of Design Philosophy - Electrical and other relevant references as specified their in.

2.0 STANDARDS TO BE FOLLOWED

2.1 The design, manufacture and testing of the equipment covered by this standard shall comply with the latest issue of relevant Indian standards unless otherwise specified. Equipment complying with equivalent IEC standards shall also be acceptable.

2.2 Flameproof & increased safety junction boxes shall in addition, comply with the requirement as laid down in IS: 2148 & IS: 6381 respectively.

2.3 The design and constructional features of the junction boxes offered shall also comply with the provision of latest issue of the Indian Electricity Rules and other relevant Statutory Rules & Regulations. The supplier shall, whenever necessary, make suitable modification in the equipment to comply with the above mentioned rules.

2.4 Wherever any requirement laid down in this standard differs from that in Indian Standard specifications, the requirement specified herein shall prevail.

3.0 SERVICE CONDITIONS

3.1 Ambient Conditions

These shall be as indicated in Design Philosophy - Electrical.

3.2 System Details

The details of power supply system shall be as indicated in Design Philosophy – Electrical.

4.0 GENERAL DESIGN & CONSTRUCTIONAL FEATURES

4.1 The junction boxes shall be dust and weather proof and suitable for installation outdoors without extra protection. The degree of protection shall be IP-55 as per IS/IEC:60529.

4.2 The junction boxes shall be of die cast aluminium alloy LM-6 with domed / suspension covers.

4.3 The casting of the junction boxes and their cover shall be pressure die cast. The casting shall be uniform and free from blow holes. All mechanical surfaces shall be free from burrs, dents and internal roughness.

4.4 All external hardware of diameter less than 8 mm shall be of stainless steel and those of diameter 8 mm and above shall be of mild steel cadmium plated or zinc passivated. For fibre glass enclosure Nylon PVC bolts of diameter 8 mm may be used.

4.5 The clearances and creepage distances shall be maintained inside the junction boxes as per relevant Indian standard.

4.6 The junction boxes shall be suitable for wall / structure / ceiling mounting and necessary arrangement for mounting the same shall be provided.

4.7 The junction boxes shall be provided with continuous gasket made of neoprene or synthetic rubber to prevent ingress of dust. The gasket shall be held in position in groove provided in the enclosure and shall be pressed all around uniformly by suitably shaped projection of the door. Gaskets simply glued to the surface are not acceptable.

4.8 The junction boxes housing terminal block shall be moulded type made of DMC / Fibre glass. Threaded terminals shall be made of brass (nickel plated or tinned) and provided with two tightening threaded nuts and four washers all made of brass (nickel plated or tinned). The terminals shall have two shorting links each horizontally placed connecting three terminals.

4.9 The terminal block shall be fitted with junction boxes base by means of 2 nos. 1/2” long nickel plated brass screws.

4.10 The junction boxes shall be provided with two nos. external earthing terminals and 1 no. internal earthing terminal.

4.11 All live parts inside the junction boxes shall be insulated and shall withstand a test voltage of 2.5 KV for 1 minute.

4.12 The junction boxes shall be provided with heavy duty double compression type rolled Al cable glands to suit the cable entries.

4.13 Threaded blanking plugs shall be provided for junction boxes to plug out the entries not in use as indicated in bill of quantities enclosed.

4.14 The junction boxes shall be provided with a blank stainless steel tag plate fastened to the junction box top cover with two stainless steel screws. The plate shall be at least 25 mm wide, 100 mm long and 1 mm thick.

4.15 For flameproof / increased safety junction boxes, the manufacturer shall submit copies of test certificates from statutory authorities clearly stating that the junction boxes as well as cable glands / blanking plugs are suitable for hazardous area.

4.16 **15 Amp. Junction Box**

4.16.1 The junction boxes shall be 4 way dome cover type.

4.16.2 The dimensions of the junction boxes with their cover and accessories shall be generally as per PDS: E-547.

4.16.3 The junction boxes housing terminal block shall be moulded type made of DMC / Fibre glass as per Drg. no. PDS: E-557.

4.17 **63 Amp. Junction Box**

4.17.1 The junction boxes shall be 3 / 4 way dome cover type.

4.17.2 The minimum internal diameter of the box shall be 240 mm.

5.0 SPECIAL FEATURES FOR JUNCTION BOXES FOR HAZARDOUS AREA

5.1 For increased safety junction boxes, the terminals shall be provided with positive locking device against loosening.

5.2 The enclosure shall be in addition, of increased safety execution, Exe, as per relevant standard and shall be suitable for installation in classified hazardous area.

5.3 The junction boxes shall be liberally dimensioned in order to avoid temperature rise inside the enclosure which may damage the insulating materials or gaskets employed therein.

5.4 Cables shall enter the terminal box through increased safety compression type cable glands. From the terminal chamber to the main enclosure, the connections shall be made through proper bushings.

5.5 An additional earthing terminal inside the terminal chamber shall be provided.

5.6 The junction boxes shall be provided with Brass-Nickel plated shorted links. The terminal block shall be made of non-hygroscopic compound. Bakelite / Hylam shall not acceptable.

5.7 All screws / bolts and nuts shall be of stainless steel.

5.8 Junction boxes and cable glands must be certified by Statutory Authorities for use in the specified hazardous area. Equipments certified by overseas authorities shall obtain certificate of compliance / letter of opinion from respective statutory authorities.

5.9 Duly wired prototype samples for junction boxes shall be submitted for scrutiny as and when called for.

5.10 Type Test certificates for increased safety type junction boxes and cable glands along with blanking plugs shall be supplied.

6.0 PAINTING

6.1 Epoxy based electrostatic powder coating paint shall be provided on exterior surface while the interior of junction boxes shall be painted with anti-condensate paint. The painting shall be able to withstand corrosive atmosphere.

6.2 Unless otherwise specified, the finishing shade shall be grey having shade no. 632 as per IS-5.

6.3 The terminal block of junction boxes shall be painted with Red, Yellow, Blue & Black colour for phase indication.

7.0 TESTS AND INSPECTION

7.1 The junction boxes shall be routine tested as per relevant standards.

7.2 Additional tests, wherever specified, shall be carried out on one unit of each rating.

7.3 The procedure & extent of the physical checks, routine & type test shall be governed by Quality Assurance Plan mutually agreed and approved by Inspection Authority.

7.4 All the above mentioned tests shall be carried out in the presence of purchaser's representative. In addition, the equipment shall be subjected to stage inspection at works and inspection at site for final acceptance.

7.5 These inspections shall, however, not absolve the vendor from their responsibility for making good any defect which may be noticed subsequently.

8.0 PACKING

Each junction box and cable gland shall be suitably packed and protected from damage due to transportation, loading and unloading. Threaded fittings shall have plastic caps to protect the threading.

9.0 DRAWINGS AND DOCUMENTS

9.1 Drawings and documents as per Annexure-I shall be supplied, unless otherwise specified.

9.2 All drawings and documents shall have the following descriptions written boldly:

- Name of client
- Name of consultant
- Enquiry / order number with plant / project name
- Motor Code No. and Description

10.0 SPARES

10.1 Commissioning Spares: Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for approval.

10.2 Spare Spares for 2 Years operation (Mandatory), as specified shall be supplied.

10.3 Recommend 2 years Operational Spares (other than mandatory spare) alongwith recommended quantity & item-wise unit price shall be furnished.

10.4 All spare parts shall be identical to the parts used in the equipment.

11.0 DEVIATIONS

11.1 Deviations, if any, from this standard shall be clearly indicated in the offer with reasoning.

ANNEXURE - I

DOCUMENTATION FOR JUNCTION BOXES

Sl. No.	Document Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheet	N	Y	Y
2.	Technical Particulars	N	Y	Y
3.	Certified dimensional drawing, including mounting details	N	Y	Y
4.	Drawing showing constructional details	N	Y	Y
5.	Illustrative and Descriptive catalogues	N	N	Y
6.	Spare parts list	N	N	Y
7.	FLP/Exe certificates for junction boxes and terminals conforming to IEC/ISS (CMRI, CCE, DGFASLI and BARC for terminals)	N	N	Y
8.	Certificate for weather proof construction for junction boxes as per IPW-55	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N - No

TECHNICAL SPECIFICATION

ELECTRICALS FOR OVERHEAD CRANES & HOISTS

CONTENTS

1.0 SCOPE

1.1 This standard covers the technical requirements of design, engineering, manufacture, testing at works, supply at site, erection, site testing and commissioning of the complete electrical equipment and accessories as required for the overhead travelling crane and hoists.

1.2 This standard shall be read in conjunction with relevant mechanical specifications, other relevant standards / specifications.

1.3 The scope of work shall include but not limited to the following items:

i) Drive motors
ii) Starting resistors (in case of slip ring motors)
iii) Power control panel
iv) Control stations
v) Limit switches
vi) Electromagnetic brakes
vii) Power and control cables with accessories
viii) Earthing of all equipment
ix) All other items, not specified but, required for safe and proper operation

1.4 The owner shall provide one no. medium voltage feeder for each crane / hoist and terminate the feeder cable in an isolator located at one end of the bay at a height of 1.5 m from the operating floor. The vendor shall indicate the exact power requirement (running and peak) to enable the owner to size and provide the power supply feeder.

1.5 Further distribution of power from this isolator onwards shall be in the vendor's scope.

2.0 STANDARDS TO BE FOLLOWED

2.1 The design, manufacture, testing and installation of the equipment shall comply with the latest issue of IS-6547, IS-807 and other relevant Indian Standard specifications and codes of practices. Equipment complying with equivalent IEC standards shall also be acceptable.

2.2 The equipment and installation shall also comply with the provisions of latest issue of Indian Electricity rules and other statutory acts and regulations.

2.3 Wherever any requirement, laid down in this standard, differs from that in Indian Standard Specification, the requirement specified here-in shall prevail.

3.0 SERVICE CONDITIONS

3.1 Ambient Conditions

These shall be as indicated in Design Philosophy - Electrical.

3.2 System Details

These shall be as indicated in Design Philosophy - Electrical.

3.3 The owner shall provide only three phase power at the specified medium voltage. For lighting, control and plug supply the vendor shall provide necessary single phase step-down transformers.

3.4 All the electrical equipment shall be so designed that enable the crane / hoist to operate at its rated capacity and specified duty cycle with the system variation under the ambient conditions without exceeding the permissible temperature rise and without any detrimental effect on any part.

4.0 GENERAL DESIGN AND CONSTRUCTIONAL REQUIREMENTS

4.1 The electrical system and installation shall be designed as per latest practice to provide maximum reliability, flexibility, safety to personnel and equipment and ease of operation and maintenance.

4.2 All equipment shall have adequate and standard ratings as per ISS.

4.3 All electrical equipment to be located in indoor plant area shall be enclosed in dust, damp and vermin proof enclosure equivalent to IP-54 as per IS/IEC:60529.

4.4 Equipment to be located outdoor shall be weather proof and have IPW-55 protection as per IS/IEC:60529 and shall also be provided with canopy as far as practicable.

4.5 The equipment to be located in hazardous area shall have additional protection as follows:

a) Zone – I All the equipment shall be in flameproof execution.

b) Zone – II The equipment producing sparks under normal operation shall be in flameproof execution and others shall be in increased safety execution.

The equipment shall be suitable for the enclosure group and temperature class as indicated in Design Philosophy - Electrical. The equipment selected shall conform to relevant Indian Standard Specification and must be certified by Central Mining Research Institute, Dhanbad or any other statutory authority for use in the specified hazardous area.

4.6 The pendant push button shall be light weight enclosure of aluminium/ polypropylene etc. In case of hazardous areas, the loop between the pendant push button and the crane control panel shall be made intrinsically safe by using suitable isolators. Alternatively certified flame proof components and increased safety terminals can be hosed in the hose proof aluminium / polypropylene enclosure.

4.7 Special care shall be taken to ensure that the parts to be opened for inspection and maintenance retain their dust tightness even after repeated opening and closing operations.

4.8 All mating surfaces shall be properly machined. Neoprene gaskets shall be used for dust and weather proofing. The gaskets shall be without any discontinuity.

4.9 Only non-hygroscopic materials shall be used for insulation. All insulation shall be specially impregnated to withstand ambient conditions and atmospheric pollution.

4.10 All live parts shall be adequately protected to prevent inadvertent or accidental contact.

4.11 The minimum clearance and creepage distance of M.V. equipment shall be 20 and 28 mm respectively and shall be positively maintained after connections.

4.12 All external hardware of diameter less than 8 mm shall be of stainless steel and those of diameter 8 mm and above shall be of mild steel cadmium plated or zinc passivated.

4.13 Earthing terminals complete with sockets and identification marks shall be provided on the enclosure of all electrical equipment. The number of terminals shall be two for equipment rated above 240V and one for those rated 240V and below. Additional internal earthing arrangement shall be provided for flameproof equipment.

4.14 All equipment shall be provided with stainless steel name plates containing the particulars as per relevant IS along with the description and code nos. of equipment

4.15 All the electrical equipment shall be provided with separate terminal box, heavy duty double compression type rolled aluminium cable glands, proper crimping lugs and anti-vibration type terminals suitable for the cable sizes required.

4.16 Enclosure for limit switches, pendant push button, junction boxes and magnets etc. shall be of cast aluminium. Enclosure for control panel, transformer and resistors may be of sheet steel. The thickness of the sheet steel for the enclosure shall not be less than 2.5 mm. All enclosures shall be suitably painted to withstand atmospheric pollution as mentioned in the Design Philosophy - Electrical.

4.17 The doors or inspection covers shall be provided with threaded knobs or butterfly nuts made of plated carbon steel. Copper or copper alloys shall not be used outside the enclosures.

4.18 To facilitate maintenance and testing of all electrical equipment:

a) Disconnecting links shall be provided where necessary.

b) All cable lugs and terminals shall be numbered in a permanent form corresponding to the wiring diagram.

c) Easy access and adequate working space shall be provided around all motors, panels, limit switches etc. safety railing shall be provided, where necessary.

5.0 EQUIPMENT SPECIFICATION

5.1 Power Connection

5.1.1 The main supply shall be obtained by flexible cable or otherwise as per requirement.

5.1.2 In case of overhead bare conductors, they shall be of copper and mounted on side of the crane bridge. Four number of gunmetal type current collector with renewable carbon inserts shall be used for power connection. One end of the bare conductor shall be connected to the owner's isolator by means of fixed cable.

5.1.3 In case of flexible cable arrangement, the cable shall be connected at one end of the crane and the other end to owner's isolator. The cable shall be hung at intervals by festooned type arrangement.

5.1.4 In either case the power fed to the trolley shall be by means of flexible cables fixed and supported by festooned arrangement.

5.1.5 The arrangement of fixing and supporting the flexible cables shall be such that the cable is not damaged due to repeated travelling of the crane and trolley. Supporting G.I. wire shall be provided, wherever required.

5.1.6 The collector rollers and shoes shall be designed to avoid sparking.

5.2 Power Control Panel

5.2.1 The panel shall house all the necessary electrical equipment for distribution of power and control of individual equipment / circuit.

5.2.2 The panel shall be totally enclosed, floor mounting, dead front, free standing type in cubicle construction.

5.2.3 The panel shall house the following:

i) For incoming supply

- Triple pole switch fuse units
- Supply 'ON' signal lamps (LED Type)

The above switch shall cut off all power driven and associated equipment on the crane except lighting and plug supply circuits.

ii) For motors

- Reversing type starter with necessary contactors and timers.
- Other controlling relays and devices.

iii) For lighting, control and plug supply

- Single phase transformers
- Isolating switch fuse units on primary and secondary sides.

5.2.4 All switches shall be motor duty type (AC 23) and rated for 1.5 times of the full load current of the circuit. The incoming switch shall be interlocked with the panel door.

5.2.5 All contactors shall be air break type and of AC4 utilization categories. The thermal rating of the contactor shall be 1.5 times the full load current of the circuit.

5.2.6 The power contactors shall be interlocked electrically and mechanically so that there shall be no possibility of simultaneous operation of two contactors for the same motor.

5.2.7 Electrical interlock shall be provided between main hoist and micro hoist motors.

5.2.8 All thermal overload relays shall have in-built single phasing feature and ambient compensated, separately mounting and hand reset type. The reset push bottom for thermal overload relays shall be provided on the cover of the control panel so that it is possible to reset the relay from outside without opening the cover of the panel. Also indication shall be provided for hoisting/travel motors tripping on overload.

5.2.9 The panel shall be installed on properly levelled base frame fabricated out of channels of suitable size.

5.3 Motors

5.3.1 The design and specification of all motors shall comply with requirements stated elsewhere in the specifications.

5.3.2 The power rating of the motors shall be 25% higher than the design requirement of the driven equipment, under the specified service and duty conditions.

5.3.3 All motors shall preferably be of squirrel cage type and so designed that smooth acceleration or deceleration of the load is possible without any jerks. Further a maximum displacement of 2 mm when starting and stopping the motor in quick succession shall be guaranteed.

5.3.4 The motors for main hoist and micro hoist shall be suitable for intermittent duty type S4 with 60% C.D.E. and 300 starts / stops per hour. The motors for long travel and cross travel shall be suitable for S2 duty for 60 minutes.

5.3.5 The motors shall be so located that all parts are accessible for inspection and maintenance without affecting normal ventilation.

5.4 Brakes

5.4.1 The brakes for each motor shall be suitable for duties as specified below:

a) Main / Micro hoist S4 duty

b) Long / cross travel S2 duty

5.4.2 The coil of the brake shall be wound with fibre glass covered annealed copper conductor suitable for class H application. An additional covering with glass taps shall be provided over the coil. The maximum temperature of the coil for continuous operation shall be limited to 140º C. The coil shall be vacuum impregnated.

5.4.3 For other design details refer mechanical engineering standard.

5.5 Limit Switches

5.5.1 Limit switches of both shunt and series type shall be used in control and power circuit.

5.5.2 These shall be heavy duty type and of sturdy construction in cast aluminium enclosure.

5.5.3 The mode of operation of these limit switches shall be positive and direct acting type.

5.5.4 The contacts shall be rated 50% more than the required current ratings.

5.5.5 The width of the roller of limit switches shall be sufficient to avoid slippage of contact with the striker.

5.5.6 The striker provided for operating these limit switches shall have rubber padding on surface which will make contact with roller to actuate it. The limit switches and its roller should be designed to withstand the frequent impact pressure.

5.5.7 Switches in which the contacts are operated by spring or gravity or both on the withdrawal of a chain or similar devices, shall not be used.

5.6 Transformers

5.6.1 These shall be of dry type, class H insulated, air cooled, double wound and mounted inside the panel.

5.6.2 The transformers shall be provided with switch fuse unit on their primary side of suitable rating. One side of secondary windings of the transformers shall be earthed and other shall be provided with fuse of suitable rating.

5.7 The rating of the transformers shall be at least 2.5 times the continuous load.

5.8 **Junction Box**

5.9 Junction boxes shall be of cast aluminium construction and adequately sized to enable easy termination of cables.

5.10 **Hand Lamps**

5.10.1 Provision shall be made in the crane for use of hand lamps by installing 2 nos. 24 volts, 2 pin metal clad switch sockets. One of the sockets shall be on the bridge (outside the panel) and the other on the trolley.

5.10.2 The transformer primary and secondary voltage shall be 250V and 25V respectively.

6.0 CABLES, CABLE TERMINATION AND CONNECTIONS

6.1 The cables used for fixed wiring shall be 1.1 KV grade PVC insulated armoured and PVC sheathed overall, and shall conform to IS: 1554 Part-I.

6.2 The flexible cable used for power supply to crane and also for interconnection of equipment mounted on moving and fixed part of the crane shall be 1.1 KV grade heavy duty type.

6.3 All cables shall be properly laid and supported with adequately sized aluminium clamps at 500 mm interval.

6.4 Cable entry on all electrical equipment e.g. panels, motors, limit switches, brakes, junction boxes etc. shall be through double compression type rolled aluminium cable glands.

6.5 The internal power wiring of panels shall be carried out by PVC insulated stranded copper flexible cable.

6.6 The wiring shall be arranged in a neat fashion and supported on PVC channel or PVC stand of screw support.

6.7 For equipment mounted on the doors, the wiring shall be carried out with flexible stranded copper cables in such a way that no strain is put on the wires and equipment when the door is opened for inspection and maintenance.

6.8 External looping of wires shall be done through separate dust tight junction boxes.

6.9 The sizes of power cables to be used shall be subject to owner's approval. The minimum size of power and control cables shall be 16 sq. mm (Al) & 2.5 sq. mm (Cu) respectively.

7.0 EARTHING

7.1 The earthing of all electrical equipment shall be carried out in accordance with IS: 3043.

7.2 The enclosures of electrical equipment shall be connected to an aluminium earth ring on the crane which in turn shall have effective electrical connection with the bridge.

7.3 The crane bridge shall be earthed through the bridge travel runway rails on both sides which in turn shall be earthed to owner's earth ring located on the ground floor.

7.4 Further the power supply cable for the crane shall have an additional conductor for earth connection. Both sides of this conductor shall be earthed.

7.5 All earth conductors shall be of aluminium.

7.6 This size of earth conductor shall be equal to half the size of the power conductor subject to a minimum size of 10 sq. mm.

8.0 CONTROL DESK / CONTROL STATION

8.1 The crane shall be controlled either from the floor by means of a pendant control station or from bridge mounted control desk as indicated in the mechanical data sheet.

8.2 In either case, the units shall have the following control devices:

- Main off push button with padlocking arrangement.
- Indication lamps for supply 'ON'
- Control push buttons, as specified in the mechanical data sheet.
- All other devices required for safe and proper operation of the crane / hoist.

8.3 All push buttons shall be momentary contact type, coloured as per IS: 6875 and have 1 NO and 1 NC contacts.

8.4 The bridge mounted control desk, where specified, shall be of totally enclosed and dust tight construction. All controlling equipment shall be mounted on the top. It shall be located at most convenient location to allow movement of the operator. The installation shall be equipped with adjustable chair, fan, light and main isolating switch.

8.5 The pendant control station, where specified, shall be in a single enclosure and in totally enclosed dust light execution. The unit shall be suspended and supported from the bridge platform by flexible steel wire rope. The connection shall be made with a multi core flexible copper conductor cable and shall have 20% spare cores. One core shall be provided for earth connection of the circuit.

9.0 PAINTING

Enclosures of all electrical equipment shall be painted with two coats of epoxy based primers after suitable pre-treatment. Two coats epoxy based paint of approved colour shall be provided.

10.0 TESTS AND INSPECTION

10.1 All equipment shall be routine tested as per relevant Indian Standard Specifications.

10.2 Additional tests, wherever specified, shall be carried out on one equipment of each rating.

10.3 All the above mentioned tests shall be carried out in presence of owner's representative.

10.4 The owner's inspection shall, however, not absolve the vendor from his responsibility for making good any defects which may be noticed subsequently.

10.5 Despatch of materials shall be subject to written consent of owner or his representative.

11.0 INSTALLATION, TESTING AND COMMISSIONING

11.1 The vendor shall undertake installation of all electrical equipment in accordance with latest code of practices, in conformity with recommendation of the respective equipment manufacturer, drawings approved by the owner or owner's representative, direction of Engineer-in-charge, statutory regulations and to the entire satisfaction of the owner.

11.2 The vendor shall arrange all the necessary erection tools and tackles, testing and measuring instruments and shall supply the required erection materials including structural steel.

11.3 Following tests shall be specifically conducted before commissioning in presence of owner's representative. All the test results shall be recorded and submitted to the owner.

i) Insulation test.

ii) Continuity test.

iii) High voltage test.

iv) Simulation test.

12.0 DRAWINGS AND DOCUMENTS

12.1 Drawings and documents as per Annexure-I shall be supplied unless otherwise specified.

12.2 All drawings and documents shall have the following description written boldly :

- Name of client
- Name of consultant
- Enquiry / Order Number with plant / project name
- Code No. and Description

13.0 SPARES

13.1 Commissioning Spares: Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for approval.

13.2 Spare Spares for 2 Years operation (Mandatory), as specified shall be supplied.

13.3 Recommend 2 years Operational Spares (other than mandatory spare) alongwith recommended quantity & item-wise unit price shall be furnished.

13.4 All spare parts shall be identical to the parts used in the equipment.

14.0 DEVIATIONS

14.1 Deviations, if any, from this standard shall be clearly indicated in the offer with reasoning.

ANNEXURE - I

DOCUMENTENTATION FOR ELECTRICALS FOR OVERHEAD CRANES & HOISTS

Sl. No.	Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification sheet and technical particulars	N	Y	Y
2.	Composite schematic diagram	N	Y	Y
3.	Dimensional drawing showing the mounting details and general arrangement for the following equipment			
	a) Motors	N	Y	Y
	b) Power control panel	N	Y	Y
	c) Control station	N	Y	Y
	d) Limit switches etc.	N	Y	Y
4.	Down shop lead and power supply arrangement with civil scope.	N	Y	Y
5.	Inter-connection with terminal diagram and cable details	N	Y	Y
6.	Operating and maintenance instruction manual	N	N	Y
7.	Catalogues of bought out items	N	N	Y
8.	Test certificates	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N - No

i) The tenderer shall also quote for any other spares as deemed necessary to be kept in stock for stipulated time.

TECHNICAL SPECIFICATION

HIGH VOLTAGE VARIABLE FREQUENCY DRIVE SYSTEM

CONTENTS

1.0 SCOPE

1.1 The scope of this specification is to define the minimum technical requirements for the design, manufacture, testing and supply of High Voltage, AC Variable Frequency Drive system. The VFD system shall be complete with Squirrel Cage Induction Motor/ Synchronous Motor as specified in data sheet, Converter, Converter input transformer, drive output transformer, DC link reactor with associated auxiliaries, harmonic filters and field mounted local motor control panel.

1.2 The Vendor shall be responsible for engineering and functioning of the complete system, meeting the intent and requirement of this specification and data sheets. This shall include but not be limited to inverter sizing, transformer sizing, transformer impedance selection, vector group, input and output harmonic filter design and sizing, output dv/dt filter sizing, motor cable selection and motor sizing/selection.

1.3 This specification applies to drive systems having converter input voltage above 1000 V AC and up to and including 11OOOV AC.

2.0 CODES AND STANDARDS

2.1 The equipment shall comply with the requirements of latest revision of the following standards issued by BIS, unless otherwise specified:

IS:325	Three-phase Induction Motors
IS:3700	Essential Ratings and Characteristics of Semiconductor Devices
IS:3715	Letter symbols for semi-conducting devices
IS:4411	Code of designation of semi-conducting devices
IS:5001	Guide for preparation of drawings of semiconductor devices and Integrated Circuits
IS:5469	Code of practice for the use of semiconductor Junction Devices
IS:14901	Semi-conductor devices- Discrete devices & Integrated Circuits
IS:15880	Three Phase Cage Induction motors when fed from IGBT Converters Application Guide
IS:8789	Values of Performance characteristics for Three Phase induction motor
IS: 12615	Energy Efficient Induction Motors - Three Phase Squirrel Cage
IS:12729	Common specification for High-Voltage Switchgear and Control gear standards
IEC:60 146-1-3	Semiconductor Convertors general requirements and line commutated convertors-Transformer & reactors
IEC:61800	Adjustable speed electrical power drive systems
IEEE:519	Recommended Practices and requirements for Harmonics Control in Electrical power system

2.2 In case of imported equipment, standards of the country of origin shall be applicable, if these standards are equivalent or stringent than the applicable Indian standards.

2.3 The equipment shall also conform to the provisions of Indian Electricity rules and other statutory regulations currently in force in the country.

2.4 In case Indian standards are not available for any equipment, standards issued by IEC/BSNDE/IEEE/NEMA or equivalent agency shall be applicable.

2.5 In case of any contradiction between various referred standards/specifications/data sheet and statutory regulations the following order of priority shall govern:

- Statutory regulations

- Data sheets
- Job specification
- This specification
- Codes and standards

3.0 GENERAL REQUIREMENTS

3.1 The offered equipment shall be brand new with state of art technology and proven field track record. No prototype equipment shall be offered.

3.2 Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment for at least 15 years from the date of supply

3.3 Vendor shall give a notice of at least one year to the end user of equipment before phasing out the product/spares to enable the end user for placement of order for spares and services.

3.4 Vendor shall ensure proper co-ordination with the driven equipment supplier in selection/sizing of offered variable frequency drive system.

4.0 SITE CONDITIONS

4.1 The drive system shall be designed to operate under specified site conditions as specified in the data sheets. If not specifically mentioned therein, a design ambient temperature of 50°C.and an altitude not exceeding 1000 metres above mean sea level shall be considered.

4.2 The AC drive shall be installed indoors in a non-hazardous, air-conditioned or pressurized room, as specified in data sheet. Transformer installation (outdoor/ indoor) shall be as indicated in datasheet. Motor shall be installed outdoors in safe or hazardous area as specified in datasheet.

4.3 All the equipment shall be designed for continuous duty as per nameplate rating under the specified ambient conditions.

5.0 DESIGN AND FABRICATION REQUIEMENTS

5.1 Performance Requirement

5.1.1 The system shall be energy efficient, designed as standard product and shall provide very high reliability, high power factor, low harmonic distortion and low vibration/ wear / noise. It shall be easy to install in minimum time and expense and no special tools shall be required for routine maintenance.

5.1.2 The system shall be designed to deliver the motor input current and torque for the complete speed torque characteristics of the driven equipment, with input supply variation of ±10% and frequency variation of ±3%. The system shall be suitable for the load characteristics and the operational duty of the driven equipment. It shall be capable of withstanding the thermal and dynamic stresses and the transient mechanical torque, resulting from short-circuit.

5.1.3 The drive system shall be designed to operate in one or more of the following operating modes as to suit characteristics of the driven equipment or specified in the data sheet:

a. Variable torque changing as a function of speed i.e. Speed squared
b. Constant torque over a specific speed range
c. Constant power over a specific speed range where the torque decreases when speed Increases

d. Any other as specified in data sheet

5.1.4 The drive controller shall be equipped with microprocessor based digital regulator with programmable functions. The power control regulator logic shall provide for an acceleration/deceleration current limit curve and shall be capable of field adjustments without shutting the system down. Linear acceleration and deceleration shall be separately programmable from 0.1 to 20 seconds.

5.1.5 The System shall be suitable for single quadrant operation and the speed variation shall be with range 10-100 % unless otherwise specified in data sheet with speed set accuracy of ±1% of rated maximum speed and steady state regulation of±0.5% of rated speed.

5.1.6 The total harmonic distortion (THD) of the voltage and current at inverter output shall be as per IEC 61800 and same shall be considered in the design of the motor. The dv/dt limits & Vpeak shall also be as per IEC-61800-2.

5.1.7 Harmonics at the supply side of the drive system at primary of the main input transformer shall be restricted within the maximum allowable levels of current and voltage distortion as per recommendations in the latest edition of IEEE-519. The vendor shall perform design calculation for harmonic filter system considering VFD connected to the power system and including the supply of harmonic filters along with all accessories which shall be installed at owner's power system unless otherwise specified. These harmonic studies shall be conducted with maximum and minimum system fault level, cable capacitance, system equipment reactance etc. The studies shall highlight but not be limited to maximum load current, expected resonant frequencies, need of harmonic filters, sequence of switching of filters, voltage wave form, rating of equipments/ feeder for feeding filters from owner's switchgear etc.

5.1.8 Unless otherwise specified, the overload capacity of the controller shall be 150% of rated current of motor for one minute for constant torque applications, and 110% of rated current for one minute for variable torque applications at rated voltage. If the motor load exceeds the limit, the drive shall automatically reduce the frequency and voltage to the motor to guard against overload. If load demands exceed the current limit for more than 1 minute, the drive shall shutdown to prevent over heating of the motor and damage to the drive.

5.1.9 During operation, the system shall be capable of developing sufficient torque under all load conditions to respond to a 20% alteration in speed set point within a time limit upto 60 seconds.

5.1.10 The integrator action of the speed set point alteration shall be independently adjustable for both an upward and a downward alteration. The minimum time interval between set point adjustments by the distributed control system shall be considered as 10 seconds.

5.1.11 The drive shall trip in case the speed exceeds 105%of the maximum operational speed or reduces to 95% of the minimum operational speed for more than 10 seconds.

5.1.12 Maximum noise level from the drive at 1-meter distance, under rated load with all normal cooling fans operating shall not exceed 85 dBA.

5.1.13 Variable frequency drive shall be arranged so that it can be operated in an open circuit mode, disconnected from the motor for start up adjustments and troubleshooting/ maintenance.

5.1.14 Voltage at motor neutral shall be maintained at ground potential for the total operating condition.

5.2 Control Requirement

5.2.1 The system shall operate on constant V/f supply with required voltage boost capability in low frequency mode of operation.

5.2.2 Short time voltage dips up to 20% of nominal voltage (e.g. in case of a large motor start up connected to the same bus as VFD) shall not cause the control system to stop functioning and shall not trip the drive system.

5.2.3 The system shall also be equipped with a momentary powerloss ride through feature which will restart the system in case of voltage dip over 20% or power interruptions for less than 2 seconds, with recovery of the voltage to its nominal value .. The drive shall have the facility to block this feature, if required by the operator. Upon restart, the converter shall be capable of synchronizing onto a rotating motor and develop full acceleration torque within 10 seconds.

5.2.4 The system shall be suitable for number of starts as per attached specification for High Voltage Motors.

5.2.5 The power controller shall be controlled to always start the motor in the forward direction. Logic shall be provided to prevent the motor from being started in the reverse direction.

5.2.6 The drive motor shall be speed controlled corresponding to 4-20mA or 0-10 V reference input signal. Unless otherwise specified, upon complete loss of the user's speed reference signal, the drive shall automatically run at constant speed as at 80-100% of the last speed reference available prior to the loss of signal.

5.2.7 It shall be possible to vary the speed of the drive in either manual or auto mode. Auto/Manual selection shall be from VFD panel unless otherwise specified.

a. With the selector switch in "manual" mode, the operator shall be able to set the speed through key pad (mounted on front of the drive panel) or from speed increase/decrease push buttons (from the field). Motor operated potentiometer shall be provided as a speed set point device.

b. With the selector switch in "auto" mode, speed of the motor shall be controlled from a 4-20 mA signal, from owner's PLC/DCS (Process Control) system. Necessary equipment required for interfacing with PLC/DCS shall also be provided in the VFD panel.

c. Local/Remote selector switch shall be provided in local control station (in Field). With the selector switch in "Local" mode, the operator shall be able to start and set the speed through local control station (in Field). With the selector switch in "Remote" mode, speed of the motor shall be controlled either from VFD panel or from Owner's PLC/DCS as explained in a) and b) above.

5.2.8 The required provision for the interface with remote PLC/DCS located at control room shall be either through hardwired connection (with potential free contacts and transducers as described elsewhere in this specification) or through serial communication link as defined in the datasheet.

5.2.9 Drive system shall have provision for interface with upper level automation such as Substation monitoring system or electrical control system in case specified in the data sheet/job specification.

5.2.10 The closed loop control feed back for the drive system having out put transformer shall be tapped from the secondary side of the output transformer.

5.3 Panel Construction

5.3.1 The panel shall include suitable semi conducting power devices (Diodes/IGBT/IGCT/ IEGT/SGCT) modules with protective devices, reactors (if required) , filters, control circuit, control accessories, indication and annunciation etc. The construction of the panel shall provide effective protection against electromagnetic emissions and shall meet the design requirement of relevant standards.

5.3.2 Upstream breaker 'ON/OFF/TRIP' indications and remote breaker closing and trip push buttons shall be provided on the front door.

5.3.3 Safety Interlock shall be provided so that power cabinet can't be opened unless the upstream breaker is disconnected, safety-grounding switch is closed and DC link capacitor is discharged. Power source breaker can only be closed once the earthing switch is open and panel door is closed with lock defeat facility.

5.3.4 The drive shall be suitably housed in sheet steel panels and shall be fabricated using cold rolled sheet steel. The sheet steel used for the panel shall be of minimum 2 mm CRCA. The panel shall be suitable for indoor installation, if not otherwise specified. The panel shall be free standing with degree of enclosure protection as IP-31. Maximum and minimum operating height shall be 1900 mm and 300 mm respectively.

5.3.5 Bolted un-drilled gland plate shall be provided at bottom. Clamp type terminals shall be used for connection of all wires up to 10 mm^2, and terminal for higher sizes shall be bolted type suitable for cable lugs. Minimum space for power cable termination shall be 600mm clear from bottom of the cable gland plate.

5.3.6 Bus bars shall be of electrolytic copper/aluminium, sleeved, color coded separately for AC and DC system. All the live parts shall be sleeved / shrouded to ensure complete safety to personnel intending to carry out routine inspection by opening the panel doors. All the equipment inside the panel and on the doors shall be provided with suitable nameplate.

5.3.7 All the switches, component and accessories which are essential for normal and emergency operation shall preferably be mounted on the door and shall be operable externally. All the analogue instruments, where provided, shall be switchboard type, back connected & of size 96x96mm. Scale shall have red mark indicating maximum permissible operating rating.

5.3.8 Each panel shall be provided with illuminating lamp/11 W CFL with switch and fuse. 5/15A, 240V power socket with switch and fuse shall be provided. Each panel shall have space heater with switch fuse and variable setting thermostat.

5.3.9 Copper earth bus of min. 30x6 sq.mm. upto short circuit withstand capacity of 31.5kA and 50x6 sq.mm. for a short circuit withstand capacity above 31.5kA shall be provided in the panel with provision for connection to owner's plant earth grid. All the non-metallic components/parts shall be connected to the main earth bus bar. Separate earth bus bar and stud for electronic control system if required shall be provided.

5.3.10 All panels shall be of same height so as to form a uniform line-up, to give good aesthetic appearance.

5.3.11 All the control wiring shall be enclosed in plastic/ metal channel. Each wire shall be identified at both ends by self-sticking wire marker tapes or PVC ferrules. Power and control wiring inside the panel shall be done with BIS approved, PVC insulated, fire retardant, low smoke, copper conductor wire 1.5mm^2 size wire shall normally be used provided the control fuse rating is 10 Amps or less and 2.5 $mm^{2,}$ size for control fuse rating above 16 A for electrical

circuits and 0.5mm^2 for electronic circuits. All wires shall be ferruled and terminals shall be properly numbered, minimum 20% spare terminals shall be provided.

5.3.12 All electronic modules and components shall be accessible from front of panel only. Modular assemblies for both the system control electronic equipments and power electronic equipments shall be used.

5.3.13 Low voltage compartment and cabling shall be electrically and physically separated from the high voltage compartment.

5.3.14 DC link capacitor and pre-charging & discharging circuit shall be preferably mounted in the rear of the panel.

5.3.15 Suitable eyebolts/ lifting clamps/ strap & cradle arrangement shall be provided for lifting of the panel/shipping section. The bolts, when removed shall not leave any opening in the panel.

5.3.16 Acrylic type transparent insulating material shall be used for covering live components.

5.3.17 Drive keypad, operator control panel required for control, monitoring and measurements shall be supplied and installed outside the panel on the front door. It shall be accessible for operation without opening the front door and shall be non-removable type.

5.3.18 All equipment shall be complete with cable glands, lugs etc. and cable glands shall be single or double compression type for indoor and outdoor equipment respectively. Cable glands shall also be suitable for the hazardous area application if specified in data sheet.

5.4 Cooling

5.4.1 The drive panel shall be naturally cooled or water cooled type as per manufacturer's standards. However, it is preferred to have natural air cooled system. If unavoidable, forced type-cooling system shall be provided. Cooling system shall include well-dimensioned panel, adequate cooling airflow path, modular cooling fan and if necessary, panel cooling fan or water-cooling system shall be considered. Vendor shall ensure that the panel dimensions and flow paths have been designed for continuous running at the specified ambient without overheating. For fan cooled drives, redundant ventilating fans (N+ 1) shall be provided. In case redundant cooling fan is not possible to be mounted in the panel, same shall be supplied loose.

5.4.2 For water-cooled drives, entire cooling system including but not limited to heat exchanger, flow and pressure meters and pumps shall be in vendor's scope. The system shall be provided with closed circuit water cooling system, requiring only make up water required for topping up. The cooling water pumps, in case provided, shall have 100% redundancy. Water quality/characteristics shall be as defined in the data sheet and selected cooling water system components/material shall be suitable for the same. Adequate safety measures shall be incorporated in water cooled drives such that no leakage is there which results in malfunctioning of electronic devices. Proper segregation between water cooling system and other equipment shall be provided. It is preferred that cooling cabinet panel shall be separated from the main panels.

5.4.3 Necessary starters shall be provided within the VFD panels for the Ventilation fans, Cooling Water circulation pumps, any other auxiliary motor etc. The system provided shall be interfaced with drive starting and shutdown so that safety interlocks such as start permit from cooling system to drive and trip signal from cooling system to drive in case of cooling system failure etc., are incorporated in the overall sequence logic.

5.4.4 MCB for motor space heater, auxiliary power supply if required for local panel, drive panel space heater etc. shall be included and mounted in easy accessible location.

5.5 Equipment/ Component Specification

5.5.1 Motor

The motor shall be designed, constructed and tested in accordance with the latest revision of Specification /data sheet for High Voltage Induction / Synchronous Motor, in addition to the following requirements:

a. The motor shall be suitable for operation with a solid-state power supply consisting of an adjustable frequency inverter for speed control.

b. The motor shall be suitable for the current waveforms produced by the power supply including the harmonics generated by the drive.

c. The motor shall be designed to operate continuously at any speed over the range (10-100%) of rated speed unless otherwise specified in data sheet.

d. The permitted voltage variation should take into account the steady state voltage drop across the AC drive and all other system components upstream of the motor.

e. Motors required to be transferred to DOL by-pass mode shall be rated for specified variations in system line voltage and frequency. Starting current of motor in DOL bypass mode shall be limited to value specified in motor specifications, unless otherwise specified in datasheets.

f. The motor shall be constructed to withstand torque pulsations resulting from harmonics generated by the solid-state power supply.

g. The motor insulation shall be designed to accept the applied voltage waveform, within the Vpeak and dv/dt limits as per IEC-61800-4 and necessary co-ordination between the VPD manufacturer & motor manufacturer W.r.t. incorporation of VPD output parameter in the design of motor shall be carried out.

h. The drive manufacturer shall be solely responsible for proper selection of the motor for the given load application and the output characteristics ofthe drive.

i. Motors shall be provided with Resistance Temperature Detectors (RTDs).

5.5.2 Converter Transformer/ Output transformer

a. The converter transformer shall be dry type or oil filled type as specified in the data sheet. In case of the dry type transformer, it shall be mounted in the drive system panel unless specified otherwise in the datasheet. Offered transformer shall be as per enclosed Specifications/data sheet.

b. The impedances of converter input transformers with more than one secondary windings for 12/18/24/36 pulse systems shall be selected to ensure equal load/current sharing between the secondary windings, the converters and the motor windings under all operational conditions including starting and restarting.

c. Drive out put transformer considered only for the purpose of meeting standard rated motor voltage i.e. 3300, 6600V, 11000V shall not be provided unless otherwise agreed between purchaser and the manufacturer.

5.5.3 Power Converter

a. The static power converter shall consist of a line side power converter for operation as a rectifier and a load side power converter for operation as a fully controlled inverter. Power converter shall be fast switching, most efficient and low loss type.

b. Adequate short circuit and over voltage protection shall be provided for the converter and inverter system.

c. All power converter devices shall include protective devices, snubber networks and dv/dt networks as required.

d. The current rating of the converter's semi-conductor components shall not be less than 120% of the nominal current flowing through the elements at full load of the VFD through the entire speed range.

e. All power diodes shall be of silicon type with minimum V_{BO} rating as 2.5 times the rated operating voltage.

f. The power converter circuit shall be designed so that motor can be powered at its full nameplate rating continuously without exceeding its rated temperature rise due to harmonic currents generated by the inverter operation.

g. The conversion devices and associated heat sinks shall be assembled such that individual devices can be replaced without requiring the use of any special precautions/tools.

h. The cooling system of the electronic components, if provided, shall be monitored and necessary alarms shall be provided to prevent any consequential damage to the power control devices.

i. Offered system shall also take into account the distance between Drive panel and motor and system shall include all material and accessories to make system suitable for a distance of 350m unless otherwise specified in the data sheet.

5.5.4 DC Link Reactor

a. Smoothing reactors for the DC link shall be designed to sufficiently decouple the rectifier and inverter portion of the converter and to limit fault currents in this circuit.

b. Unless otherwise specified, the reactor shall be air-cooled or fan cooled type located within the panel.

c. Reactor shall be suitable for operation with the non-sinusoidal current wave shapes and DC components under all operational conditions of the system without exceeding its temperature limits.

5.5.5 Output Filter

VFD output current waveform should be inherently sinusoidal at all speeds, with harmonic limits as specified in this specification. Output filter shall be provided, if required. Output filter capacitors shall be provided with discharge circuits to ensure that all residual stored charge is reduced to less than 50 V DC within 300 seconds after a loss of AC voltage. All capacitor shall be maintenance-free and self-healing type.
The VFD system shall inherently protect motor from high voltage dv/dt stress, independent of cable length to motor. Output filter shall be an integral part of the VFD system and included within the VFD enclosure.

5.5.6 Bypass Feature

a. Bypass feature along with motor protection relay and output side isolator/breaker shall be provided by purchaser unless otherwise specified in the datasheet. All necessary interlocks as required for safe and reliable operation of VFD system along with bypass feeder and output side isolator/breaker provided by Purchaser shall be provided in VFD system.

b. Bypass starter shall be in separate compartment and switching scheme shall be such that in case of drive mal-operation, the motor could be taken on bypass control manually, while the drive could be attended independently. Suitable interlock shall be provided such that bypass mode and VFD mode shall not operate simultaneously.

5.5.7 Local Motor Control Station

a. The local motor control station, to be installed in the field near the motor shall conform to the attached specifications. Components and accessories that are required in the local motor control station may be mounted on the local field mounted panel envisaged for the driven equipment.

b. Meters in the local control station shall be suitable for 4-20mA transducer outputs and shall be calibrated for the actual motor current. Further, for drives with bypass facility, the meters shall be capable of reading bypass mode full load and starting currents as well as the VFD mode drive current.

5.6 Protection, Control, Metering, Indication and Annunciation

5.6.1 The system vendor shall provide all the necessary system control, protection, alarm and metering equipment for the entire drive system and its auxiliary equipment.

5.6.2 Automatic sequence control shall include start-up of cooling system, auxiliary system of the motor, interlock checking, automatic start and run-up of drive, planned and emergency shutdown. The same shall be processed through microprocessor-based system.

5.6.3 Operator Control Panel

a. Each drive shall be equipped with a front mounted operator control console consisting of a backlit alphanumeric display and a keypad with keys for parameterization and adjusting parameter which shall not be limited to Start/Stop, Local/Remote, Auto/Manual, Increase/Decrease, menu navigation and protection and measurement parameter selection, etc.

b. All parameter names, fault messages, warnings and other information shall be displayed in complete English words or standard English abbreviations to allow the user to understand the display without the use of a manual or cross-reference table. This shall also be used for the modification of all electrical values, configuration parameters, drive menu parameters, application and activity function access, faults, local control, adjustment storage, self test and diagnostics. Keypad shall be operable with password for changing the protection setting, safety interlock etc. However, the parameters such as measurements, setting, mode of drive etc. shall be allowed to be viewed without any password.

c. Operator console shall have facility/ port to connect external hardware such as Laptop etc. Console shall have facility to upload and download all parameter settings from one drive to another identical drive for start-up and operation.

d. Drive system control shall also have facility to receive tripping signal from upstream breaker for tripping and also provision for closing upstream breaker after all required process parameters are achieved.

e. User-friendly software for operation and fault diagnostic shall be loaded in the drive system panel before commissioning.

5.6.4 Protective Features

The system shall incorporate adequate protective features, properly coordinated for the drive control and for the motor but not limited to the following:

I. Incoming line surge protection
II. Under / Over voltage protection
III. Phase loss protection.
IV. Programmable over current protection and under load protection.
V. Inverter Fault.
VI. Over frequency/Over speed of motor
VII. Ventilation loss (In case same is not provided, drive shall generate an over temperature fault alarm and suitable sensors, as required for same, shall be provided).
VIII. Over temperature of equipment.
IX. Specific motor protection, including motor winding, bearing temperatures, over current, overload, negative phase sequence and earth fault protections etc.
X. System earth fault protection.
XI. Excitation system protection for synchronous motor
XII. Over and under frequency, rotor earth fault (if applicable), field failure protection for synchronous motor
XIII. Additional protection, if any for the drive system

5.6.5 Control

The following controls shall be provided as a part of the Operator Control Panel or through separate switches.

I. Start/Stop
II. Speed control (Raise/Lower)
III. Forward/Reverse (if specified)
IV. Auto/Manual /Test mode
V. Local/Remote
VI. Emergency stop
VII. Start/Stop for bypass starter (where specified)
VIII. Trip-Remote Breaker
IX. Excitation control system for synchronous motors
X. Sequential switching of filters

5.6.6 **Indications**

Vendor shall provide indications as required for normal operation and for ease of maintenance, which shall not be limited to the following indications.

I. Motor running
II. Motor stopped
III. VFD System Fault
IV. System ready to start
V. AC mains ON
VI. Motor over speed

VII. Rectifier output 'ON'
VIII. Motor zero speed
IX. Remote breaker trip
X. Excitation system healthy for synchronous motors

Above indications may be provided as a part of the operator control panel, i.e. door mounted keypad or through hardwired LEDs. LEDs provided for indication shall be cluster type with adequate brightness and minimum 2 Nos LEDs chips per light. LEDs shall be connected in parallel and each LED chip having diameter not less than 3mm.
Potential free contacts for items i to iv shall be wired separately for remote indications in DCS system.

5.6.7 Metering

Digital display of the following parameters shall be as a part of the Operator Control Panel, selectable by the operator.

I. Output voltage
II. Output current-VFD model Bypass mode
III. Output frequency
IV. Drive thermal state
V. Motor speed
VI. Motor energy meter
VII. Hour Run
VIII. Voltage and current meter for excitation system of synchronous motor
IX. KVAR, power factor meter for synchronous motors
X. Necessary transducer shall be provided with 4-20mA output for indicating motor
XI. speed and motor current in DCS unless otherwise specified for other parameters.

5.7 Fault Diagnostic

Fault diagnostic shall be built into the system to supervise the operation and failure of the system. The information regarding failure of any of the system including, shutdown of the system, shall be available for a period of minimum 4 days (96 hours) after a shutdown, even though no supply would be available to the system. The system may be totally de-energized for maintenance or otherwise. It shall be possible to retrieve the record of events prior to tripping of the system or de-energisation. Auxiliary supply to the system components or to the electronics (firmware) for the diagnostics / display shall be taken care by the manufacturer for this purpose.

5.8 External Power supply for auxiliary and Control Circuit

Auxiliary power supply for devices external to VFD module, space heater supply for Motor, VFD panel space heater, auxiliary power supply for transformers, cubicle 11W CFL lamps, indicating lamps, digital meters (Ammeter, Speedometer) etc. shall operate on 240 volts single phase AC supply provided by purchaser.
All control circuit shall operate at maximum voltage of 240V AC or 220V DC unless otherwise specified in the datasheet.
Vendor shall include supply of all control transformers, protective devices, associated accessories etc. and any other control supply voltage required for the system shall be derived by the vendor from the power supply made available by purchaser.

5.9 Reliability Features

The expected lifetime of the drive system shall be min. 20 years. The system including all individual components forming part of the system shall have an availability of minimum 0.997 and a minimum MTBF of 4 years.

5.10 Maintenance features

The controller design shall incorporate the following maintenance features:

Modular construction

All components shall be easily accessible.

Standard diagnostics to aid maintenance personnel. These shall include LED or alphanumeric displays, test or measurement points.

5.11 Painting

5.11.1 After preparation of the under surface, the panel shall be spray painted with two coats of epoxy based final paint or shall be powder coated. The colour shade of final paint shall be as RAL 7032, unless specified otherwise. Panel finish shall be free from imperfections like pinholes, orange peels, runoff paint, etc.

5.11.2 All unpainted steel parts shall be zinc passivated, cadmium plated or suitably treated to prevent rust and corrosion. If these parts are moving elements, then these shall be greased.

6.0 INSPECTION, TESTING AND ACCEPTANCE

6.1 During fabrication, the drive shall be subject to inspection by PDIL / Owner, or by an agency authorized by the Owner, to assess the progress of work, as well as to ascertain that only quality raw material is used.

6.2 All tests shall be carried out at the manufacturer's works under his care and expense. The tests shall be witnessed by an inspector of PDIL/Owner or of an agency authorized by the owner. Prior notice of minimum 4 weeks shall be given to the inspector for witnessing the tests.

6.3 All Routine & Type Tests shall be conducted as per the NIT for HV variable frequency drive as per IEC 61800-4. Moreover, combined test for VFD and motor at vendor's works shall be carried out.

6.4 String Test with driven equipment

If a string test with driven equipment is specified in the data sheet of the driven equipment, it shall be carried out with the job equipment.

7.0 SPARES

7.1 Commissioning Spares: Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for approval.

7.2 Spare Spares for 2 Years operation (Mandatory), as specified shall be supplied.

7.3 Recommend 2 years Operational Spares (other than mandatory spare) alongwith recommended quantity & item-wise unit price shall be furnished.

7.4 All spare parts shall be identical to the parts used in the equipment

8.0 DRAWINGS

8.1 Vendor shall submit to Purchaser, for approval, before completion of manufacturing and assembly of equipment following drawings and literature.

(i) Installation and maintenance manual including trouble-shooting chart.
(ii) Panel drawings and cable schedule
(iii) Block diagram and control logic.

9.0 CERTIFICATION

The motors and associated Variable frequency drive system equipment shall have test certificates issued by recognized independent test house (CIMFRI BASEEFA/ LCIE/UL/FM or equivalent). All indigenous motors shall conform to Indian Standards and shall be certified by Indian testing agencies. All motors (indigenous and imported) shall also have valid statutory approvals as applicable for the specified hazardous location. All indigenous flameproof motors shall have valid BIS license and marking as required by statutory authorities.

Also the motor nameplate shall clearly indicate that the motor is suitable for operation with variable frequency drive along with VFD make and model number.

10.0 PACKING AND DESPATCH

All the equipment shall be divided in to several shipping sections for protection and ease of handling during transportation. The equipment shall be properly packed for selected mode of transportation i.e. ship/rail or trailer. The equipment shall be wrapped in polyethylene sheets before being placed in wooden crates/cases to prevent damage to the finish. Crates/cases shall have skid bottoms for handling. Special notations such as 'Fragile', 'This side up', 'Weight', 'Owner's particulars', 'PO nos.' etc., shall be clearly marked on the package together with other details as per purchaser for scrutiny. The equipment may be stored outdoors for long periods before installation. The packing shall be completely suitable for outdoor storage, in areas with heavy rains/high ambient temperature.

TECHNICAL SPECIFICATION

MEDIUM VOLTAGE VARIABLE FREQUENCY DRIVE SYSTEM

CONTENTS

1.0 SCOPE

1.1 The scope of this specification is to define the minimum technical requirements for the design, manufacture, testing and supply of Medium Voltage, AC Variable Frequency Drive system. The VFD system shall be complete with Squirrel Cage Induction Motor/ Synchronous Motor as specified in data sheet, Converter, Converter input transformer, drive output transformer, DC link reactor with associated auxiliaries, harmonic filters and field mounted local motor control panel.

1.2 The Vendor shall be responsible for engineering and functioning of the complete system, meeting the intent and requirement of this specification and data sheets. This shall include but not be limited to inverter sizing, transformer sizing, transformer impedance selection, vector group, input and output harmonic filter design and sizing, output dv/dt filter sizing, motor cable selection and motor sizing/selection.

1.3 This specification applies to drives connected to line voltage up to 1000 V, AC.

2.0 CODES AND STANDARDS

2.1 The equipment shall comply with the requirements of latest revision of the following standards issued by BIS, unless otherwise specified:

IS:325	Three-phase Induction Motors
IS:3700	Essential Ratings and Characteristics of Semiconductor Devices
IS:3715	Letter symbols for semi-conducting devices
IS:4411	Code of designation of semi-conducting devices
IS:5001	Guide for preparation of drawings of semiconductor devices and Integrated Circuits
IS:5469	Code of practice for the use of semiconductor Junction Devices
IS:14901	Semi-conductor devices- Discrete devices & Integrated Circuits
IS:15880	Three Phase Cage Induction motors when fed from IGBT Converters Application Guide
IS:8789	Values of Performance characteristics for Three Phase induction motor
IS: 12615	Energy Efficient Induction Motors - Three Phase Squirrel Cage
IS/IEC:60947	Low Voltage Switchgear and Control gear
IEC:60 146-1-3	Semiconductor Convertors general requirements and line commutated convertors-Transformer & reactors
IEC:61800	Adjustable speed electrical power drive systems
IEEE:519	Recommended Practices and requirements for Harmonics Control in Electrical power system

2.2 In case of imported equipment, standards of the country of origin shall be applicable, if these standards are equivalent or stringent than the applicable Indian standards.

2.3 The equipment shall also conform to the provisions of Indian Electricity rules and other statutory regulations currently in force in the country.

2.4 In case Indian standards are not available for any equipment, standards issued by IEC/BSNDE/IEEE/NEMA or equivalent agency shall be applicable.

2.5 In case of any contradiction between various referred standards/specifications/data sheet and statutory regulations the following order of priority shall govern:

- Statutory regulations
- Data sheets
- Job specification
- This specification
- Codes and standards

3.0 GENERAL REQUIREMENTS

3.1 The offered equipment shall be brand new with state of art technology and proven field track record. No prototype equipment shall be offered.

3.2 Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment for at least 15 years from the date of supply

3.3 Vendor shall give a notice of at least one year to the end user of equipment before phasing out the product/spares to enable the end user for placement of order for spares and services.

3.4 The vendor shall be responsible for design, engineering and manufacturing of the complete VFD system to fully meet the intent and requirements of this specification and attached data sheets.

4.0 SITE CONDITIONS

4.1 The AC drive system shall be designed to operate under specified site conditions as specified in the data sheets. If not specifically mentioned therein, a design ambient temperature of 50°C.and an altitude not exceeding 1000 metres above mean sea level shall be considered.

4.2 The AC drive shall be installed indoors in a non-hazardous, air-conditioned or pressurized room, as specified in data sheet.

4.3 All the equipment shall be designed for continuous duty as per nameplate rating under the specified ambient conditions.

5.0 DESIGN AND FABRICATION REQUIEMENTS

5.1 Performance Requirement

5.1.1 The system shall be energy efficient, designed as standard product and shall provide very high reliability, high power factor, low harmonic distortion and low vibration/ wear/noise. It shall be easy to install in minimum time and expense and no special tools shall be required for routine maintenance.

5.1.2 The system shall be designed to deliver the motor input current and torque for the complete speed torque characteristics of the driven equipment, with input supply variation of ±10% and frequency variation of ±3%. The system shall be suitable for the load characteristics and the operational duty of the driven equipment. It shall be capable of withstanding the thermal and dynamic stresses and the transient mechanical torque, resulting from short-circuit.

5.1.3 The drive system shall be designed to operate in one or more of the following operating modes as to suit characteristics of the driven equipment or specified in the data sheet:

a. Variable torque changing as a function of speed i.e. Speed squared
b. Constant torque over a specific speed range
c. Constant power over a specific speed range where the torque decreases when speed Increases
d. Any other as specified in data sheet

5.1.4 The drive controller shall be equipped with microprocessor based digital regulator with programmable functions. The power control regulator logic shall provide for an acceleration/deceleration current limit curve and shall be capable of field adjustments without shutting the system down. Linear acceleration and deceleration shall be separately programmable from 0.1 to 20 seconds.

5.1.5 The System shall be suitable for single quadrant operation and the speed variation shall be with range 1:100 unless otherwise specified in data sheet with speed set accuracy of ±1% of rated maximum speed and steady state regulation of±0.5% of rated speed.

5.1.6 The total harmonic distortion (THO) of the voltage and current at inverter output shall be as per IEC 61800 and same shall be considered in the design of the motor. The dv/dt limits & Vpeak shall also be as per IEC-61800-2.

5.1.7 Harmonics at the supply side of the drive system at primary of the main input transformer shall be restricted within the maximum allowable levels of current and voltage distortion as per recommendations in the latest edition of IEEE-519. The vendor shall perform design calculation for harmonic filter system considering VFD connected to the power system and including the supply of harmonic filters along with all accessories which shall be installed at owner's power system unless otherwise specified. These harmonic studies shall be conducted with maximum and minimum system fault level, cable capacitance, system equipment reactance etc.

5.1.8 The controller output overload capacity shall be 150% of rated current of motor for one minute for constant torque applications, and 110% of rated current for one minute for variable torque applications at rated voltage. If the motor load exceeds the limit, the drive shall automatically reduce the frequency and voltage to the motor to guard against overload. If load demand exceeds the current limit for more than 1 minute, the drive shall shut down to prevent over heating of the motor and damage to the drive.

5.1.9 During operation, the system shall be capable of developing sufficient torque under all load conditions to respond to a 20% alteration in speed set point within a time limit upto 60 seconds.

5.1.10 The integrator action of the speed set point alteration shall be independently adjustable for both an upward and a downward alteration. The minimum time interval between set point adjustments by the distributed control system shall be considered as 10 seconds.

5.1.11 The drive shall trip in case the speed exceeds 105%of the maximum operational speed or reduces to 95% of the minimum operational speed for more than 10 seconds.

5.1.12 Maximum noise level from the drive at 1-meter distance, under rated load with all normal cooling fans operating shall not exceed 85 dBA.

5.1.13 Variable frequency drive shall be arranged so that it can be operated in an open circuit mode, disconnected from the motor for start up adjustments and troubleshooting/ maintenance.

5.2 Control Requirement

5.2.1 The system shall operate on constant V/f supply with required voltage boost capability in low frequency mode of operation.

5.2.2 Short time voltage dips up to 20% of nominal voltage (e.g. in case of a large motor start up connected to the same bus as VFD) shall not cause the control system to stop functioning and shall not trip the drive system.

5.2.3 The system shall also be equipped with a momentary powerloss ride through feature which will restart the system in case of voltage dip over 20% or power interruptions for less than 2 seconds, with recovery of the voltage to its nominal value .. The drive shall have the facility to block this feature, if required by the operator. Upon restart, the converter shall be capable of synchronizing onto a rotating motor and develop full acceleration torque within 10 seconds.

5.2.4 The system shall be suitable for number of starts as per attached specification for Medium Voltage Motors.

5.2.5 The power controller shall be regulated to always start the motor in the forward direction. Logic shall be provided to prevent the motor from being started in the reverse direction.

5.2.6 The drive motor shall be speed controlled corresponding to 4-20mA or 0-10 V reference input signal. Upon complete loss of the user's speed reference signal, the drive shall automatically run at constant speed as at 80-100% of the last speed reference available prior to the loss of signal.

5.2.7 It shall be possible to vary the speed of the drive in either manual or auto mode. Auto/Manual selection shall be from VFD panel unless otherwise specified.

a. With the selector switch in "manual" mode, the operator shall be able to set the speed through key pad (mounted on front ofthe drive panel) or from speed increase/decrease push buttons (from the field). Motor operated potentiometer shall be provided as a speed set point device.

b. With the selector switch in "auto" mode, speed of the motor shall be controlled from a 4-20 mA signal, from owner's PLC/DCS (Process Control) system. Necessary equipment required for interfacing with PLC/DCS shall also be provided in the VFD panel.

c. Local/Remote selector switch shall be provided in local control station (in Field). With the selector switch in "Local" mode, the operator shall be able to start and set the speed through local control station (in Field). With the selector switch in "Remote" mode, speed of the motor shall be controlled either from VFD panel or from Owner's PLC/DCS as explained in a) and b) above.

5.2.8 The required provision for the interface with PLC/DCS (located at remote control room) including the details of communication module and data transfer facility, 1/0 details shall be furnished. The communication interface shall be via serial communication link with industry standard open protocol i.e. MODBUS/IEC-61850/ RS-485 etc. and same shall be coordinated with the interfacing equipment. In case the vendor is using their proprietary software, the interface software for use with owner's system (software) shall be provided.

5.2.9 Drive system shall have provision for interface with upper level automation such as Substation monitoring system or electrical control system in case specified in the data sheet/job specification.

5.2.10 The closed loop control feed back for the drive system having output transformer shall be tapped from the secondary side of the output transformer.

5.3 Panel Construction

5.3.1 The panel shall include suitable isolating device (i.e. Circuit breaker/MCCB/ Switch fuse) for main supply, contactors, semi conducting power devices (Diodes / IGBT) modules with

protective devices, reactors, filters, output isolating device, control circuit, control accessories, indication and annunciation etc.

5.3.2 Main isolating device shall function as a manual disconnect and shall be an AC thermal magnetic circuit breaker or a fused switch with dual element fuse to trip automatically on fault currents, as specified in data sheet. Devices shall be lockable in the open position and shall have a minimum interrupting capacity as specified in data sheet. Interlock shall be provided between the door, so that door cannot be opened unless the breaker/switch is open.

5.3.3 Safety Interlock shall be provided so that power cabinet can't be opened unless the upstream breaker is disconnected, safety-grounding switch is closed and DC link capacitor is discharged. Power source breaker can only be closed once the earthing switch is open and panel door is closed with lock defeat facility.

5.3.4 The drive shall be suitably housed in sheet steel panels and shall be fabricated using cold rolled sheet steel. The sheet steel used for the panel shall be of minimum 2 mm CRCA except the doors & covers that may be made of 2mm CRCA. The panel shall be suitable for indoor installation, if not otherwise specified. The panel shall be free standing with degree of enclosure protection as IP-31. Maximum and minimum operating height shall be 1900 mm and 300 mm respectively.

5.3.5 Bolted un-drilled gland plate shall be provided at bottom. Clamp type terminals shall be used for connection of all wires up to 10 mm^2 and terminal for higher sizes shall be bolted type suitable for cable lugs. Minimum space for power cable termination shall be 300mm clear.

5.3.6 Bus bars shall be of electrolytic copper/aluminium, sleeved, color coded separately for AC and DC system. All the live parts shall be sleeved / shrouded to ensure complete safety to personnel intending to carry out routine inspection by opening the panel doors. All the equipment inside the panel and on the doors shall be provided with suitable nameplate. All wires shall be ferruled and terminals shall be properly numbered, minimum 20% spare terminals shall be provided.

5.3.7 All the power and control switches shall preferably be mounted on the door and shall be operable externally. All the analogue instruments, wherever provided, shall be switch board type, back connected, 96x96mm size. Scale shall have red mark indicating maximum permissible operating rating.

5.3.8 Each panel shall be provided with illuminating lamp/ll W CFL with switch and fuse. 5/15A, 240V power socket with switch and fuse shall be provided. Each panel shall have space heater with switch fuse and variable setting thermostat.

5.3.9 Copper earth bus of min. 30X6 mm size shall be provided at the bottom of the panel extending outside the panel on both sides. All the non-metallic components/parts shall be connected to the main earth bus bar. In case a separate earth bus for electronic control system is required, the same shall be indicated in the drawings.

5.3.10 All panels shall be of same height so as to form a uniform line-up, to give good aesthetic appearance.

5.3.11 All the control wiring shall be enclosed in plastic/ metal channel. Each wire shall be identified at both ends by self-sticking wire marker tapes or PVC ferrules. Power and control wiring inside the panel shall be done with BIS approved, PVC insulated, fire retardant, low smoke, copper conductor wire 1.5mm^2 size wire shall normally be used provided the control fuse rating is 10 Amps or less and 2.5 mm^2 size for control fuse rating above 16 A for electrical circuits and 0.5mm^2 for electronic circuits. All wires shall be ferruled and terminals shall be properly numbered, minimum 20% spare terminals shall be provided.

5.3.12 All electronic modules and components shall be accessible from front of panel only. Modular assemblies for both the system control electronic equipments and power electronic equipments shall be used.

5.3.13 DC link capacitor and pre-charging & discharging circuit shall be preferably mounted in the rear of the panel.

5.3.14 Suitable eyebolts/ lifting clamps/ strap & cradle arrangement shall be provided for lifting of the panel/shipping section. The bolts, when removed shall not leave any opening in the panel.

5.3.15 Acrylic type transparent insulating material shall be used for covering live components.

5.3.16 All equipment shall be complete with cable glands, lugs etc. and cable glands shall be single or double compression type for indoor and outdoor equipment respectively. Cable glands shall also be suitable for the hazardous area application if specified in data sheet.

5.4 Cooling

5.4.1 Cooling system shall include well-dimensioned panel, adequate cooling airflow path, module cooling fan and if necessary, panel cooling fan. Vendor shall ensure that the panel dimensions and flow paths have been designed for continuous running at the specified ambient without overheating. For fan cooled drives, redundant ventilating fans (N+1) shall be provided. Necessary starters shall be provided within the VFD panels for these fans. In case redundant cooling fan is not possible to be mounted, same shall be supplied loose.

5.4.2 MCB for motor space heater, auxiliary power supply if required for local panel, drive panel space heater etc. shall be included and mounted in easy accessible location.

5.5 Equipment/ Component Specification

5.5.1 Motor

The motor shall be designed, constructed and tested in accordance with the attached standard specification for Medium Voltage Induction Motor, in addition to the following requirements:

a. The motor shall be suitable for operation with a solid-state power supply consisting of an adjustable frequency inverter for speed control.

b. The motor shall be suitable for the current waveforms produced by the power supply including the harmonics generated by the drive.

c. The motor shall be designed to operate continuously at any speed over the range (10-100%) of rated speed unless otherwise specified in data sheet.

d. Motor shall be provided with thermistor type temperature detector

e. The motors shall be provided with Class 'F' insulation with temperature rise limited to Class `B’.

f. The permitted voltage variation should take into account the steady state voltage drop across the AC drive and all other system components upstream of the motor.

g. Motors required to be transferred to DOL by-pass mode shall be rated for specified variations in system line voltage and frequency. Starting current of motor in DOL bypass mode shall be limited to value specified in motor specifications, unless otherwise specified in datasheets.

h. The motor shall be constructed to withstand torque pulsations resulting from harmonics generated by the solid-state power supply.

i. The motor insulation shall be designed to accept the applied voltage waveform, within the Vpeak and dv/dt limits as per IEC-61800-2.

j. The drive manufacturer shall be solely responsible for proper selection of the motor for the given load application and the output characteristics of the drive.

k. Motors shall be provided with Resistance Temperature Detectors (RTDs).

l. Induced voltage at the shaft end of the motor at no load shall not exceed 250 mV rms for roller and ball bearings and 400 mV for sleeve bearings. The non driving end bearing shall be insulated from the motor frame to avoid circulating current. The insulated bearing end shield or pedestal shall bear a prominent warning.

5.5.2 Converter Transformer/ Output transformer

The converter transformer shall be suitable for use with the variable frequency drive system. The impedances of transformers with two secondary windings for 12 pulse systems shall be selected to ensure equal load/current sharing between the two secondary windings, the converters and the motor windings under all operational conditions including starting and restarting. The transformer shall be provided with ± 5% off circuit taps in steps of ± 2.5%.

5.5.3 Power Converter

a. The static power converter shall consist of a line side power converter for operation as a rectifier and a load side power converter for operation as a fully controlled inverter. Power converter shall be fast switching, most efficient and low loss type.

a. Normally, for all output short circuits, the inverter shall interrupt the current before any semi-conductor fuse blows. For internal short circuits, semi-conductor fuse protection shall be provided, and for faults upstream of semi-conductor fuses, the converter shall be able to withstand a three-phase short circuit current until interrupted by normal breaker operation. In case of fuseless design, the failure shall be limited to the particular device, without causing any damage to other parts of the power module. There must be clear annunciation of the failure of the device.

b. All power converter devices shall include protective devices, snubber networks and dv/dt networks as required.

c. The current rating of the converter's semi-conductor components shall not be less than 120% of the nominal current flowing through the elements at full load of the VFD through the entire speed range.

d. All power diodes shall be of silicon type with minimum V_{BO} rating as 2.5 times the rated operating voltage.

e. The power converter circuit shall be designed so that motor can be powered at its full nameplate rating continuously without exceeding its rated temperature rise due to harmonic currents generated by the inverter operation.

f. The conversion devices and associated heat sinks shall be assembled such that individual devices can be replaced without requiring the use of any special precautions/tools.

g. The cooling system of the electronic components, if provided, shall be monitored and necessary alarms shall be provided to prevent any consequential damage to the power control devices.

h. All the power transistors, thyristors and diodes shall be protected with high-speed semiconductor grade fuse. I2t particulars of the power controller devices and the fuses shall be properly co-ordinated for the selection of fuses.

5.5.4 DC Link Reactor

a. Smoothing reactors for the DC link shall be designed to sufficiently decouple the rectifier and inverter portion of the converter and to limit fault currents in this circuit. AC line reactors, if provided as per standard vendor design, shall be suitable for harmonic suppression and fault current limitation.

b. The reactor shall be dry type, air cooled or fan cooled type located within the panel. In case of fan cooled type, operation of fans shall be monitored.

c. Reactor shall be suitable for operation with the non-sinusoidal current wave shapes and DC components under all operational conditions of the system without exceeding its temperature limits.

5.5.5 Output Filter

VFD output current waveform shall be inherently sinusoidal at all speeds, with harmonic limits as per C1.5.1.6. Output filter capacitors shall be provided with discharge circuits to ensure that all residual stored charge is reduced to less than 50 V DC within 60 seconds after a loss of AC voltage. The VFD system shall inherently protect motor from high voltage dv/dt stress, independent of cable length to motor. Output filter shall be an integral part of the VFD system and included within the VFD enclosure.

5.5.6 Bypass Feature

5.5.6.1 Output contactor/Load Break Switch shall be provided for isolation between the output of the controller and the motor for VFD systems with Bypass feature.

5.5.6.2 Bypass feature shall be provided, if specified in the data sheet. Accordingly Bypass feature with Bypass starter shall meet the following requirements, unless otherwise specified in the data sheet:-

Bypass starter shall comprise of switch-fuse, contactor, bimetal relay meeting the requirements of Type-2 coordination as per IS/IEC-60947. CBCT and ELR shall be provided for motors rated above 22kW & upto 55kW unless otherwise specified in the data sheet. Heavy duty starters shall be provided with saturable type current transformer operated overload relay only, which shall be suitable for motor starting time of 15-60 seconds. For motors rated above 55kW, ACB/MCCB and motor protection relay along with necessary metering shall be provided.

Bypass starter shall be in separate compartment and it shall be possible to isolate and maintain the VFD while drive motor runs in Bypass mode. Three contactors/ breakers shall be used for this purpose, one contactor in the bypass and two contactors across the drive, such that in case of drive mal-operation, the motor could be taken on bypass control, while the drive could be attended by opening its contactors. Suitable interlock shall be provided such that bypass mode and VFD mode shall not operate simultaneously.

5.5.7 Local Motor Control Station

a. The local motor control station, to be installed in the field near the motor shall conform to the attached specifications. Components and accessories that are required in the local motor control station may be mounted on the local field mounted panel envisaged for the driven equipment.

b. Meters in the local control station for motors rated above 5.5kW shall be suitable for 4-20mA transducer outputs and shall be calibrated for the actual motor current unless specified otherwise. Further, for drives with bypass facility, the meters shall be capable of reading bypass full load and starting currents, as well as the drive current. Local-off-Remote selector switch shall be provided in the LCS for selection of control from Local (i.e. LCS in Field) and Remote (i.e. from VFD panel / DCS / PLC).

5.6 Protection, Control, Metering, Indication and Annunciation

5.6.1 The system vendor shall provide all the necessary system control, protection, alarm and metering equipment for the entire drive system and its auxiliary equipment.

5.6.2 Automatic sequence control shall include start-up of cooling system, auxiliary system of the motor, interlock checking, automatic start and run-up of drive, planned and emergency shutdown. The same shall be processed through microprocessor-based system.

5.6.3 Operator Control Panel

a. Each drive shall be equipped with a front mounted operator control console consisting of a backlit alphanumeric display and a keypad with keys for parameterization and adjusting parameter which shall not be limited to Start/Stop, Local/Remote, Auto/Manual, Increase/Decrease, menu navigation and protection and measurement parameter selection, etc.

b. All parameter names, fault messages, warnings and other information shall be displayed in complete English words or standard English abbreviations to allow the user to understand the display without the use of a manual or cross-reference table. This shall also be used for the modification of all electrical values, configuration parameters, drive menu parameters, application and activity function access, faults, local control, adjustment storage, self test and diagnostics. Keypad shall be operable with password for changing the protection setting, safety interlock etc. However, the parameters such as measurements, setting, mode of drive etc. shall be allowed to be viewed without any password.

c. Operator console shall have facility/ port to connect external hardware such as Laptop etc. Console shall have facility to upload and download all parameter settings from one drive to another identical drive for start-up and operation.

d. Drive system control shall also have facility to receive tripping signal from upstream breaker for tripping and also provision for closing upstream breaker after all required process parameters are achieved.

5.6.4 User-friendly software for operation and fault diagnostic shall be loaded in the drive system panel before commissioning.

5.6.5 Protective Features

The system shall incorporate adequate protective features, properly coordinated for the drive control and for the motor but not limited to the following:

I. Incoming line surge protection
II. Under / Over voltage protection
III. Phase loss protection.
IV. Programmable over current protection and under load protection.
V. Inverter Fault.
VI. Over frequency/Over speed of motor
VII. Ventilation loss (In case same is not provided, drive shall generate an over temperature fault alarm and suitable sensors, as required for same, shall be provided).
VIII. Over temperature of equipment.
IX. Specific motor protection, including motor winding, bearing temperatures, over current, overload, negative phase sequence and earth fault protections etc.
X. System earth fault protection.
XI. Excitation system protection for synchronous motor
XII. Over and under frequency, rotor earth fault (if applicable), field failure protection for synchronous motor
XIII. Additional protection, if any for the drive system

5.6.6 Alarms

The system shall incorporate protection alarms, required for various fault conditions, for the Drive motor, Supply cables, Converter Transformer, DC Reactor and the Converter. Alarms shall also be included for the failure of various auxiliaries together with identification of the failing unit, loss of cooling system, various protection devices provided for converter transformer etc.

5.6.7 Control

The following controls shall be provided as a part of the Operator Control Panel or through separate switches.

I. Start/Stop
II. Speed control (Raise/Lower)
III. Forward/Reverse (if specified)
IV. Auto/Manual /Test mode
V. Local/Remote
VI. Emergency stop
VII. Start/Stop for bypass starter (where specified)
VIII. Trip-Remote Breaker
IX. Excitation control system for synchronous motors
X. Sequential switching of filters

5.6.8 Indications

Vendor shall provide indications as required for normal operation and for ease of maintenance, which shall not be limited to the following indications.Motor running

I. Motor stopped
II. VFD System Fault
III. System ready to start
IV. AC mains ON
V. Motor over speed
VI. Rectifier output 'ON'
VII. Motor zero speed

VIII. Remote breaker trip
IX. Excitation system healthy for synchronous motors

Above indications may be provided as a part of the operator control panel, i.e. door mounted keypad or through hardwired LEDs. LEDs provided for indication shall be cluster type with adequate brightness and minimum 2 Nos LEDs chips per light. LEDs shall be connected in parallel and each LED chip having diameter not less than 3mm.
Potential free contacts for items i to iv shall be wired separately for remote indications in DCS system.

5.6.9 Metering

Digital display of the following parameters shall be as a part of the Operator Control Panel, selectable by the operator.

I. Output voltage
II. Output current-VFD model Bypass mode
III. Output frequency
IV. Drive thermal state
V. Motor speed
VI. Motor energy meter
VII. Hour Run
VIII. Voltage and current meter for excitation system of synchronous motor
IX. KVAR, power factor meter for synchronous motors
X. Necessary transducer shall be provided with 4-20mA output for indicating motor
XI. speed and motor current in DCS unless otherwise specified for other parameters.

5.6.10 Annunciations

Potential free contacts shall be provided for following annunciations and shall be wired up to terminal block for owner's use for remote monitoring:

I. Rectifier fuse failure/Drive fault
II. Main AC failure
III. Inverter fuse failure/Drive fault
IV. Inverter overload
V. Inverter high temperature/Drive fault
VI. Failure of panel cooling system
VII. Motor failed to start/Drive fault

All drive internal faults will be annunciated as drive fault.

5.7 Fault Diagnostic

Fault diagnostic shall be built into the system to supervise the operation and failure of the system. The information regarding failure of any of the system including, shutdown of the system, shall be available for a period of minimum 4 days (96 hours) after a shutdown, even though no supply would be available to the system. The system may be totally de-energized for maintenance or otherwise. It shall be possible to retrieve the record of events prior to tripping of the system or de-energisation. Auxiliary supply to the system components or to the electronics (firmware) for the diagnostics / display shall be taken care by the manufacturer for this purpose.

5.8 External Power supply for auxiliary and Control Circuit

Control supply for devices external to VFD module i.e contactors control, space heater supply for Motor / VFD, indicating lamps digital meters (Ammeter, Speedometer) etc. shall operate on 240 V control supply derived from single-phase control supply transformer, with switchfuse provided in primary and MCB in secondary, located inside the drive controller.

5.9 Reliability Features

The expected life time of the VFD shall be minimum 20 years. The VFD including all individual components forming part of the system shall have an availability of minimum 0.997 and a minimum MTBF of 4 years.

The controller design shall incorporate the following reliability features:

- Pre-tested components with power components to be 100% tested under dynamic conditions.
- Printed circuit boards shall be computer tested and adjusted.
- Printed circuit boards shall be temperature cycled for a minimum of 40 hours.
- Printed circuit boards shall be treated for tropical, humid and corrosive environment.

5.10 Maintenance features

The controller design shall incorporate the following maintenance features:

Modular construction
Printed circuit boards shall be plug connected.
All components shall be easily accessible.
Standard diagnostics to aid maintenance personnel. These shall include LED or alphanumeric displays, test or measurement points.

5.11 Painting

5.11.1 After preparation of the under surface, the panel shall be spray painted with two coats of epoxy based final paint or shall be powder coated. The color shade of final paint shall be as RAL 7032, unless specified otherwise. Panel finish shall be free from imperfections like pinholes, orange peels, runoff paint, etc.

5.11.2 All metal surfaces shall be thoroughly cleaned and de-greased to remove mill scale, rust, grease and dirt. Fabricated structures shall be pickled and then rinsed to remove any trace of acid. The under-surface shall be prepared by applying a coat of phosphate paint and a coat of yellow zinc chromate primer. The under-surface shall be made free from all imperfections before undertaking the finishing coat.

5.11.3 All unpainted steel parts shall be zinc passivated, cadmium plated or suitably treated to prevent rust and corrosion. If these parts are moving elements, then these shall be greased.

6.0 INSPECTION, TESTING AND ACCEPTANCE

6.1 All tests shall be carried out at the manufacturer's works under his care and expense. The tests shall be witnessed by an inspector of PDIL/ Owner or of an agency authorized by the owner. Prior notice of minimum 4 weeks shall be given to the inspector for witnessing the tests.

6.2 During fabrication, the drive shall be subject to inspection by PDIL / Owner, or by an agency authorized by the Owner, to assess the progress of work, as well as to ascertain that only quality raw material is used.

6.3 All Routine & Type Tests shall be conducted as per the NIT for MV variable frequency drive as per IEC 61800-2. Moreover, combined test for VFD and motor at vendor's works shall be carried out.

6.4 String Test with driven equipment

If a string test with driven equipment is specified in the data sheet of the driven equipment, it shall be carried out with the job equipment.

7.0 SPARES

7.1 Commissioning Spares: Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for approval.

7.2 Spare Spares for 2 Years operation (Mandatory), as specified shall be supplied.

7.3 Recommend 2 years Operational Spares (other than mandatory spare) alongwith recommended quantity & item-wise unit price shall be furnished.

7.4 All spare parts shall be identical to the parts used in the equipment.

8.0 DRAWINGS

Vendor shall submit to Purchaser, for approval, before completion of manufacturing and assembly of equipment following drawings and literature.

(i) Installation and maintenance manual including trouble-shooting chart.
(ii) Panel drawings and cable schedule
(iii) Block diagram and control logic.

9.0 CERTIFICATION

The motors and associated Variable frequency drive system equipment shall have test certificates issued by recognized independent test house (CIMFRI BASEEFA/ LCIE/UL/FM or equivalent). All indigenous motors shall conform to Indian Standards and shall be certified by Indian testing agencies. All motors (indigenous and imported) shall also have valid statutory approvals as applicable for the specified hazardous location. All indigenous flameproof motors shall have valid BIS license and marking as required by statutory authorities.

Also the motor nameplate shall clearly indicate that the motor is suitable for operation with variable frequency drive along with VFD make and model number.

10.0 PACKING AND DESPATCH

All the equipment shall be divided in to several shipping sections for protection and ease of handling during transportation. The equipment shall be properly packed for selected mode of transportation i.e. ship/rail or trailer. The equipment shall be wrapped in polyethylene sheets before being placed in wooden crates/cases to prevent damage to the finish. Crates/cases shall have skid bottoms for handling. Special notations such as 'Fragile', 'This side up', 'Weight', 'Owner's particulars', 'PO nos. etc., shall be clearly marked on the package together with other details as per purchaser for scrutiny. The equipment may be stored outdoors for long periods before installation. The packing shall be completely suitable for outdoor storage, in areas with heavy rains/high ambient temperature.

TECHNICAL SPECIFICATION

CAPACITOR BANK & ASSOCIATED EQUIPMENT

CONTENTS

1.0 SCOPE

1.1 This standard covers the technical requirements of design, manufacture, testing at works and delivery in packed condition of " Indoor type Shunt Capacitor Bank & Associated Equipment" required for system power factor improvement.

1.2 This standard shall be read in conjunction with relevant part of Design Philosophy - Electrical.

1.3 The capacitor bank and associated equipment shall generally consist of the following.

i) Basic Star connected capacitor bank
ii) Basic capacitor unit with built in fuse
iii) Discharge resistor
iv) Series reactor
v) Residual V. T. for mounting voltage unbalance
vi) Set of Raychem make heat insulated sleeved of suitable voltage rating for bus bars.
vii) Copper bus bar interconnecting the basic units.
viii) Set of supporting insulators
ix) Hot dip galvanised Steel stand/racks / cabinets of mounting capacitor units complete with interconnection insulator etc.
x) Door limit switch
xi) Control panel for automatic operation
xii) Any other equipment not specified, but required for safe & proper operation of the system.

2.0 STANDARDS TO BE FOLLOWED

2.1 The design, manufacture & testing of the equipment covered by this specification shall comply with the latest issues of following Indian standards, unless otherwise specified.

IS: 13925-1,2,3 /IEC 60871	Shunt Capacitor for power system
IS:5553/IEC60289 / IEC60076-6/IEC 726	Series reactors
IEC60186	Voltage Transformers
IEC:593/IS 12672	Internal Fuse for shunt capacitor
IS/IEC:60947	Switch gear and control-gear for voltage up to & including 1000V & 1200V DC
IS/IEC:60947	General requirements for switchgear and control-gear for voltage not exceeding 1000V & 1200V DC
IS :9921	AC Isolator & Earthing switches for voltage above 1000V
IS 2099/ IEC 60137	Bushing for voltage above 1000V
IS 13067	Impregnant For power capacitors
IS 5	Colour of mixed paints
IS 2629	Recommended practice for Hot-Dip Galvanizing of Iron and Steel
IS 4759	Hot-dip zinc coatings on structural steels and other allied products.
IS 60270	High Voltage test technique-Partial Discharge measurements
IS 8084	Interconnecting Bus bars for AC voltage above 1 kV up to and including 36 kV.

IEEE 1036	Guide for application of shunt power capacitors
IEEE 18	Standard for shunt power capacitors
IE Act	Indian Electricity Act

2.2 The design & operation features of equipment shall also comply with provision of the latest issue of the Indian Electricity Rules & other relevant statutory acts & regulation. The supplier shall, wherever, necessary, make suitable modification in the equipment to comply with the above.

2.3 Wherever, any requirement laid down in this standard differs, from that in Indian standard specification, the requirement specified herein shall prevail. Equipment complying with equivalent IEC standards shall also be acceptable.

3.0 SERVICE CODITIONS

3.1 Ambient Conditions

These shall be as indicated in Design Philosophy - Electrical.

3.2 System Details

These shall be as indicated in Design Philosophy - Electrical.

4.0 OPERATING REQUIRMENTS

4.1 The capacitor bank and associated equipment shall be suitable for operating at the specified rating continuously with the specified voltage and frequency variation under the ambient condition without exceeding the permissible temperature rise and without any detrimental effect on any part of equipment.

4.2 The capacitor bank and associated equipment shall be suitable for parallel switching and withstand the thermal and dynamic stresses caused by transient during switching operations.

5.0 GENERAL DESIGN FEATURES

5.1 Capacitor Unit

5.1.1 The capacitor bank / sub bank shall comprise of appropriate number of basic single phase units & which shall be connected in star formation to obtain rated KVAR at rated voltage.

5.1.2 Each unit shall have required number of capacitor elements housed in hermetically sealed, leak proof, sheet steel container. The container shall be provided with suitable brackets, supporting insulators, terminal & bushing for external connections.

5.1.3 Each element of basic units has its own built in fuse which shall isolate the faulty element automatically without affecting the healthy elements.

5.1.4 The capacitor units shall have overload capacity as per IS 13925.The capacitor bank shall be suitable for continuous operation at 110% of rated RMS voltage and at 130% of rated RMS current.

5.1.5 Capacitor units shall be all high grade All Polypropylene type with non-PCB base, bio degradable, non-toxic impregnant. The capacitors offered shall be built from best material and shall develop minimum losses. Capacitor bank losses shall be given at

45ºC.Capacitor shall be compact in size, metal enclosed and hermetically sealed. Internal silver wire fuses shall be provided for protection of each capacitor element.

5.1.6 The Capacitor bank and associated equipments shall be suitable for parallel switching and withstand the thermal and dynamic stresses by transient during switching operation.

5.1.7 All the fasteners and bolts shall be hot dip galvanized or zinc passivated.

5.1.8 Capacitors shall be provided with Overpressure protection as necessary for safety. Overpressure switches shall be fitted to the capacitor units and connected to trip the capacitor bank.

5.1.9 Each unit shall have required number of capacitor elements housed in sealed, leak proof, sheet steel container. The container shall be provided with suitable mounting brackets, supporting insulators, terminal & bushing for external connections.

5.1.10 The indoor capacitor bank units shall be installed in metallic housing with minimum IP-43 protection.

5.1.11 Each capacitor unit shall be mounted so that it can be easily removed from the racks and replaced without removing other units, de-assembling any part of the rack.

5.1.12 The outside of the capacitor units and other structures should have smooth and tidy look and should be coated with weather-proof, corrosion resistant epoxy paint of light gray shade, shade no. 631 of IS 5. The structure shall be suitably GI coated. Minimum coating shall not less than 600 micron / sq meters.

5.1.13 Each element of basic units has its own built in fuse which shall isolate the faulty element automatically without affecting the healthy elements. In case of one element failure, harmful over voltage shall not be generated across remaining elements and shall not make appreciable change in the operation of capacitor bank. An operation of a single fuse element does not cause cascaded fuse blowing. Permissible over voltages and surges do not cause fuse blowing.

5.1.14 The operating & design temperature category of the capacitor unit shall be +5ºC as per IS-13925 part-1. Only 5ºC temperature rise is permissible above the design temperature of 45ºC. So maximum temperature in any case shall not exceed 50º C {i.e. 45ºC (design) +5ºC (temperature rise}.

5.1.15 The capacitor shall have low value of loss which shall not exceed 0.2 watt per KVAR. The loss value of discharge device/resistor and capacitor unit shall be indicated. The tan delta characteristics of the capacitor units shall be furnished. The losses in watts for each capacitor unit including losses in fuses and discharge resistors forming integral part of the capacitors along with losses for series reactor shall be guaranteed. If these figures of capacitor losses exceed 0.2 watt per KVAR, the capacitors will be liable for rejection. However owner reserve the right to use the faulty capacitor unit till the same are replaced/rectified. The loss temperature characteristics, capacity temperature characteristics and insulation resistance temperature characteristics shall also be furnished.

5.1.16 The bidder shall furnish calculations for rise in voltage in other units in the event of failure of element(s) of a capacitor unit. The maximum rise in voltage shall not be more than 10% of rated voltage even if the entire capacitor unit failed/short circuited and relevant calculations in support of this shall also be furnished.

5.1.17 The bidder shall furnish calculation of voltage drop at rated capacitor unit per phase & losses of the reactor.

5.1.18 For both capacitor and reactor, mounting arrangement and minimum clearance required from live parts shall be indicated clearly and shall be as per Indian Electricity Act/BS162 & IS-13925-Part2 / IEC-60871-2.

5.2 **Discharge Device**

5.2.1 A suitable discharge resistor of adequate rating shall be permanently connected across the terminals inside the container to discharge the residual voltage to 50V or less within 1 minute for capacitor rated upto 650V and within 5 minute for capacitor rated above 650V.

5.3 **PROTECTIVE FUSES**

5.3.1 An internal current limiting fuse with high rupturing capacity conforming to relevant IS/IEC and the specific requirements mentioned in IS13925-Part-3/IEC 60871- 3, shall be provided. The characteristics of the fuse shall be such that it shall isolate the faulty unit only, and protect it against mechanical destruction due to internal failure. The fuses shall not melt or deteriorate when subjected to inrush currents which occur during the life of the bank.

5.3.2 The fuses shall not make any healthy capacitor element out of circuit, either in course of isolating the faulty element or due to any external fault.

5.3.3 The selection of fuse to be done in such a manner that characteristic of fuse shall match suitably with over-current withstand characteristic of associated capacitor unit.

5.3.4 The fuses shall be of adequate thermal capacity to cater for the increased heating which may occur due to harmonics and capacitor current fluctuations.

5.3.5 The number of externally connected capacitors and the available short-circuit current of the supply system should not affect the current-limiting of internal fuses.

5.3.6 It may be noted that provided internal fuses do not lead to case rupture.

5.4 **Series Reactor**

5.4.1 A suitable series reactor conforming to IS: 5553 to limit the inrush current and suppress the harmonics shall also be provided whenever required.

5.4.2 The reactor shall be copper wound, non-magnetically shielded, oil immersed, natural cooled, sealed type and shall be provided with following fittings.

i) Oil sampling cum drain valves.
ii) Filter valves with plugs.
iii) Buchholz relay with shut off valves, air release device & alarm and trip contact.
iv) Oil temperature indicator with minimum marking.
v) Oil level indicator with minimum marking.
vi) Oil conservator complete with drain plugs and oil filling hole with cover.
vii) Silica gel breather with oil seal & connecting pipes.
viii) Explosion vent.
ix) Bi-directional rollers.
x) Thermometer pocket.
xi) Radiator with isolating valves.
xii) Marshalling box.
xiii) Rating plate, wiring diagram plate & terminal marking plate.
xiv) Lifting lugs.
xv) Earthing terminals.
xvi) Air release device.
xvii) Cable termination arrangement for incoming & outgoing device.

5.4.3 Dry type/ Oil filled reactor shall only be offered. Such reactors shall be class F/H insulated.

5.4.4 The reactor shall have linear volt ampere characteristics upto 150% of rated capacitor current.

5.5 **Residual voltage transformer**

5.5.1 3 phase dry type residual voltage transformer of adequate capacity to facilitate neutral unbalance protection and rapid discharging of capacitor shall be provided.

5.5.2 The primary winding of voltage transformer shall be star connected while the secondary winding shall be in open delta for connection to neutral phase displacement relay.

5.5.3 The accuracy class shall be 3P for protection & 1 for metering.

5.5.4 RVT shall have primary and secondary windings made of copper.

5.6 **Door limit switch**

5.6.1 A door limit switch suitable for mounting on the door frame of the capacitor room shall be provided for each bank. This door limit switch shall l be used to trip the power supply to capacitors with initiation of opening action of the door of the capacitor room.

5.6.2 A door limit switch shall be totally enclosed in the aluminium / cast iron housing, fully oil, water & dust tight and shall conform to utilization category AC11 / DC11 as per IS: 6875. This shall be fast actuation type provided with 6 sets of 1 NO & 1 NC contacts rated for 5 amps at 415V AC and 1A at 220V DC.

5.7 **Capacitor control panel**

5.7.1 Capacitor control panel for control, protection and automatic switching operation of MV capacitor bank shall be provided.

5.7.2 Capacitor control panel shall be of dust, damp & vermin proof construction having enclosure class IP-51 as per IS/IEC:60947.

5.7.3 The enclosure shall be fabricated out of the cold rolled sheet steel having minimum thickness of 2 mm. the doors shall have concealed hinges & provided with neoprene gaskets.

5.7.4 The panel shall be liberally designed. All the components shall be accessible from the front. It shall be possible to attend any component without the necessary removing adjacent ones. All the relays, meters, push buttons including lamps etc. shall be flush mounted. The mounting height of components requiring operation & observation shall not be lower than 300 mm & higher than 1800 mm.

5.7.5 The capacitor control panel shall control the capacitor bank which in turn shall have a number of sub banks for easy of control & to maintain the desired power factor under varying load conditions.

The owner shall arrange C.T supply to sense the power factor. Necessary C.T., selector switch, power factor meter and power factor correction relay shall be provided in the control panel. In addition, the control panel shall have Photo manual selector switch and P.F. raise lower push buttons for manual operation. These common features shall be located near the incoming unit.

5.7.6 Each control shall be provided with TPN switch, voltmeter with selector switch, Ammeter with selector switch and other auxiliaries, as required to receive the incoming power.

5.7.7 No. of out going feeders for the control panel shall be decided as per the no. of sub banks to be controlled by it. Each feeder shall be provided with TP switch, fuses, contacts, “ON”& “OFF” indication lamps and other auxiliaries as required.

5.7.8 Required no. and size of heavy duty double compression type Aluminium cable glands suitable for incoming and out going power and control cables shall be mounted on removal gland plate provided at a minimum height of 75 mm from the bottom of the panel. Crimping type Aluminium and copper lugs for aluminium and for copper cable respectively shall be provided for termination of cables.

5.7.9 The control panel shall be complete with its base channels, foundation bolt etc.

5.7.10 A continuous earth bus of aluminium, running along the entire length of the lower part of the control panel shall be provided with lugs at two ends for connection with external earth grid. The minimum size of earth bus shall be 150 sq. mm.

5.7.11 Components Details

5.7.11.1 The switches shall be of capacitor duty type rated for 1.5 times the rated capacitor current with a minimum rating of 25 A and shall conform to IS/IEC:60947.

5.7.11.2 The fuses shall be of non-deteriorating HRC link type and suitably rated for capacitor switching. These shall conform to IS: 13703.

5.7.11.3 All contactors shall be of capacitor duty type rated for 50% higher than rated capacitor current & shall conform to IS/IEC:60947. Control supply voltage shall be 240V single phase AC unless otherwise stated. One set of NO & NC potential free contacts shall be made available as spare.

5.7.11.4 Ammeter, Voltmeter & power factor meter shall be of accuracy class 1.5 as per IS: 1248 of minimum 96 sq.mm size & shall have $0\text{-}240^{0}$ scale.

5.7.11.5 The push buttons & selector switches shall conform to utilisation category AC11/ DC11 as per IS: 6875. Contacts shall be rated for 5A at 415V AC and 1A at 220V DC. The push button shall be of momentary contact spring loaded type with a set of 1 NO & 1 NC contacts. The selector switches shall be stay put type and provided with oval shaped handless.

5.7.11.6 The signal lamps shall be LED type. Colour of lamp shall be “Red” for “ON” & “Green” for “OFF” signals.

5.7.11.7 Terminal blocks shall be pressure clamp type up to 35 sq. mm. cable and bolted lugs type for higher sizes of cables. The minimum current rating of terminal block shall be16A. 20% extra terminals shall be provided in the terminal block.

5.8 Bus Bars

5.8.1 All bus bars interconnecting the basic units shall be of copper and shall be fully insulated by using Raychem make heat shrinkable sleeves. All bus bar joints and tap-off connections shall be provided with removable FRP shrouds. The sleeves shall be rated to withstand the system Line-to-Line voltage for 1 minute.

5.8.2 The minimum clearances shall be as per relevant standards suitable for the nominal voltage of capacitor banks.

5.9 External cable termination

5.9.1 Each capacitor bank / sub bank shall be provided with proper termination arrangement where terminal connection from all the three phases shall be brought for connection with external cable. The termination arrangement shall include cable glands, cable lugs, termination kits, supporting arrangements etc. complete in all respect.

5.9.2 A cable box for termination of control cables shall be provided on the RVT. The cable boxes shall be provided with adequately sized cable entries and suitable double compression cable glands made of stainless steel. Tinned copper lugs shall be provided for the connection of all cable cores.

5.10 **Interlocks**

All necessary interlocks to ensure correct & safe operation of capacitor banks shall also be provided.

5.11 **Earthing**

Each basic capacitor unit shall be connected to the earth strip provided on the steel racks which in turn shall be connected to the main earth grid through two nos. suitable earth terminals provided on the racks.

6.0 **PROTECTIVE SCHEME (PROVIDED BY PURCHASER)**

6.1 The vendor shall confirm the adequacy of these protective devices and also suggest the setting and any other additional protective devices required.

7.0 **Accessories**

The supply shall include the following accessories.

7.1 **Control panel space heater**

The control panel shall be provided with a thermostatically controlled space heater, rated for 240V, 50Hz & controlled through double pole miniature circuit breaker.

7.2 **Name plate**

7.2.1 All the equipment shall be provided with name plates containing all the information's as per relevant standard.

7.2.2 All control switches, push buttons, lamps etc. shall have functional identification labels.

7.2.3 Name plate of capacitor control panel shall be of black prespex with white engraving and of minimum 3 mm thickness while those on other equipment shall be of stainless steel.

7.3 **Warning Plates**

7.3.1 Warning plates shall be provided on the door and inside of the equipment**,** comprising following information:

CAUTION: HIGH VOLTAGE CAPACITORS.

AT BLOWN FUSES, CHARGES MAY REMAIN

7.3.2 The warning plates shall be UV resistant engraved plastic.

7.4 **Steel racks**

7.4.1 Sheet steel racks shall be provided to house the capacitor units, residual P. T. etc. in tier formation.

7.4.2 The racks shall be suitable for assembly at site. The racks & hardware used for assembly shall be hot dip galvanized.

7.4.3 The rack shall be complete with rack insulators, foundation bolts or any other hardware etc. for assembly into complete bank.

7.4.4 Complete assembly of capacitor bank shall be mounted on a pedestal GI frame, which shall be 300 mm high.

7.4.5 Any other accessories required but not specified, shall be supplied to make the capacitor installation complete in all respect and ensure safe & proper operation.

8.0 **PAINTING**

8.1 The sheet steel enclosure after degreasing, pickling in acid, cold rinsing, phosphatising passivating etc. shall be painted with two coat of anti-rust paints followed by two coats anti corrosive paints.

8.2 Epoxy based paint shall be used.

8.3 All paint shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off, crinkle or be removed by abrasion due to normal handing.

8.4 Unless otherwise specified, the finishing shade shall be light gray shade no. 631 as per IS: 5.

9.0 **TESTS AND INSPECTION**

9.1 All capacitor banks and control panel shall be subjected to routine tests as per IS: 2834 and its associated equipment as per relevant standards.

9.2 Additional tests, wherever specified, shall be carried out.

9.3 All the above tests shall be carried out in presence of purchaser's representative. In addition, the equipment shall be subjected to stage inspection during process of manufacture at works & site inspection.

9.4 These inspections shall, however, not absolve the vendor from his responsibility for making good any defect which may be noticed subsequently.

10.0 **DRAWINGS AND DOCUMENTS**

10.1 Drawings and documents as per Annexure-I shall be supplied, unless otherwise specified.

10.2 All drawings and documents shall have following description written boldly.

- Name of client
- Name of consultant
- Enquiry / Order Number with plant / project name
- Code No. and Description

11.0 **SPARES**

11.1 Commissioning Spares: Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for approval.

11.2 Spare Spares for 2 Years operation (Mandatory), as specified shall be supplied.

11.3 Recommend 2 years Operational Spares (other than mandatory spare) alongwith recommended quantity & item-wise unit price shall be furnished.

11.4 All spare parts shall be identical to the parts used in the equipment.

12.0 **PACKING**

12.1 All the equipment shall be properly packed before despatch to avoid damage during transport, storage & handling.

12.2 The packing box shall contain a copy of the installation, operation & maintenance manual.

12.3 A sign to indicate the upright position on the position of the package to be placed during transport and storage shall be clearly marked. Also proper arrangement shall be provided to handle the equipment.

13.0 DEVIATIONS

13.1 Deviations, if any, from this standard shall be clearly indicated in the offer with reasoning.

ANNEXURE - I

DOCUMENTATION FOR CAPACITOR BANK & ASSOCIATED EQUIPMENT

Sl. No.	Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheet	N	Y	Y
2.	Technical Particulars	N	Y	Y
3.	General Arrangement Drgs. with Overall dimensions of the following equipment. - Capacitor bank - Reactor - Control panel	N	Y	Y
4.	Foundation plan indicating certified dimensions floor opening, weight, clearance etc. - Capacitor bank - Reactor - Control panel	N	Y	Y
5.	Schematic & wiring diagram	N	N	Y
6.	Descriptive literature of Various equipment	N	N	Y
7.	Installation, operation & maintenance manual	N	N	Y
8.	Guarantee certificate	N	N	Y
9.	Test certificate	N	N	Y
10.	Spare parts list with identification marks	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N - No

TECHNICAL SPECIFICATION

AUXILIARY SERVICE TRANSFORMER

CONTENTS

1.0 SCOPE

1.1 This standard covers the technical requirements of design, manufacture, testing at works and despatch in well packed condition of auxiliary service transformers.

1.2 This standard shall be applicable for 3 phase / single phase, separate winding transformers of rating below 315 KVA used for Auxiliary services such as lighting, control, Instrument supply etc.

1.3 This standard shall be read in conjunction with the relevant specification sheet.

2.0 STANDARDS TO BE FOLLOWED

2.1 The design, manufacture and testing of the equipment covered by this standard shall comply with the latest issue of following Indian Standards. Equipment complying with equivalent IEC standards shall also be acceptable.

IS: 1180 Part - 1 & 2	--	Outdoor type 3 phase distribution transformers up to and including 100 KVA, 11 KV
IS: 2026	--	Power transformers
IS: 11171	--	Dry type power transformers

2.2 The design and operational features of the equipment offered shall comply with the provisions of the latest issue of the Indian Electricity Rules and other relevant statutory acts and regulations. The supplier shall, wherever necessary, make suitable modifications in the equipment to comply with the above.

2.3 Wherever any requirement, laid down in this standard, differs from that in Indian Standard Specifications, the requirement specified herein shall prevail.

3.0 SERVICE CONDITIONS

3.1 Ambient Conditions

These shall be as indicated in Design Philosophy – Electrical.

3.2 System Details

These shall be as indicated in Design Philosophy – Electrical.

4.0 OPERATING REQUIREMENTS

4.1 The transformer shall be suitable for operating at the rated capacity continuously at any of the taps, under the ambient conditions and with the voltage and frequency variations as indicated in specification sheet without exceeding the permissible temperature and without any detrimental effect on any part.

5.0 GENERAL DESIGN FEATURES

5.1 Rated voltage and frequency

These shall be as indicated in Design Philosophy – Electrical.

5.2 **Phase connections**

5.2.1 Three phase transformer

The primary winding shall be connected in delta and secondary winding in star with neutral point earthed (Vector group Dyn-11)

5.2.2 Single phase transformer

Primary winding shall be connected between two phases of a 3 phase system or to the three phases in open delta execution as specified in specification sheet and secondary single phase winding shall have one terminal earthed with the tank through link inside the secondary terminal box.

5.3 **Tapping**

5.3.1 The transformers shall be provided with off circuit tap changer with tapping of ± 2.5% and ± 5%.

5.3.2 For transformers having primary 3.3 KV and above, tap changing shall be effected with an externally operated handle, capable of being padlocked in any position on the primary side.

5.3.3 For transformers having primary 415V and below, tap changing shall be effected by means of links in the terminal chamber on the primary side.

5.4 **Impedance voltage**

The impedance voltage of the transformer at 75ºC shall be 4% unless indicated otherwise in specification sheet.

5.4.1 **Losses**

The losses shall be indicated by the vendor and shall be guaranteed, within tolerable limits specified in IS: 2026 at rated voltage and frequency.

5.4.2 **Terminal Arrangement**

The primary and secondary side terminals shall be brought outside the tank through porcelain bushing in dust and weather proof terminal boxes, with links for tap changing where required and suitable heavy duty double compression type aluminium cable glands and cable lugs for receiving cables as indicated in specification sheet. The neutral point of the secondary winding shall be brought out separately and earthed to the transformer body through test link. Terminal board for the primary and the secondary winding shall be amply sized and made of SRBP/ FRP materials.

5.4.3 **Resistance to short circuit**

The transformers shall be able to with stand electrodynamic stresses due to terminal short circuit of the secondary assuming primary side fed from the infinite bus.

5.4.4 **Cooling System**

Transformers rated up to 50 KVA shall be natural air cooled type and above 50 KVA shall be natural oil cooled / natural air cooled type as indicated in specification sheet.

6.0 CONSTRUCTIONAL FEATURES

6.1 **Core**

The transformer core shall be of high grade non ageing electrical silicon cold rolled magnetic sheet steel of low hysteresis loss and high permeability. The maximum flux density in any part of the core and yoke at rated voltage and frequency shall not exceed 1.7 Tesla for oil cooled transformers and 1.3 Tesla for air cooled transformers.

6.1.1 The tank for oil cooled transformer shall be made of mild steel plate of adequate thickness. Cooling tubes, where necessary, shall be provided.

6.1.2 Air cooled transformer shall be sheet steel enclosed having minimum thickness of 2.0 mm and shall be provided with suitable reinforcement as required. The minimum degree

of protection for the enclosure shall be IP: 31. Ventilating louvers, if provided, shall be covered by fine wire mesh.

6.1.3 All external hardware shall be cadmium plated.

6.2 **Windings**

6.2.1 Coil shall be made out of electrolytic grade copper conductor.

6.2.2 Class-F / class-H insulating material shall be used for air cooled transformers.

6.2.3 For oil cooled transformer class-A insulating material shall be used. Mineral oil shall comply with IS: 325. 10% extra oil shall be supplied along with transformer in non-returnable drums.

6.2.4 Winding assembly shall be dried and impregnated in vacuum with tested insulating oil / varnish.

6.3 **Bushing**

The bushing insulators shall be rated for the maximum system voltage and shall comply with the requirement laid down in IS: 2099 / IS: 7421. The minimum current rating shall be 250A.

7.0 FITTINGS

7.1 Following fittings shall be provided for air cooled transformers.

i) Rating and diagram plate

ii) Lifting lug

iii) Primary and secondary cable boxes with heavy duty double compression type aluminium cable glands and lugs.

iv) Earthing terminals

v) Rollers (for 25 KVA and above)

7.2 In addition to the above following fittings shall be provided for oil cooled transformer.

i) Oil conservator complete with drain plug, oil filling hole with cover and oil level indicator with minimum marking.

ii) Silica gel breather

iii) Dial type thermometer

iv) Oil sampling cum drain valve

v) Explosion vent

vi) Air release plug

7.3 Any other fittings which may be necessary for satisfactory operation of the transformer shall also be provided.

7.4 All fittings shall conform to relevant Indian Standards.

8.0 PAINTING

8.1 The surface shall be painted after removing all dust, scale and foreign adhering matter. All traces of oil and greases should be removed by suitable treatment.

8.2 All steel surfaces in contact with insulating oil shall be painted with heat resistant oil insoluble insulating varnish.

8.3 All steel surfaces exposed to outside shall be painted with suitable anti rust and anti corrosive paints. Epoxy paints shall be used, if indicated in specification sheet.

8.4 All paints shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off, crinkle or be removed by abrasion due to normal handling.

8.5 Unless otherwise specified, the finishing shade shall be light grey shade no. 631 as per IS: 5.

8.6 1 litre paint per air / oil cooled transformer shall be supplied for touch up at site.

9.0 TESTS AND INSPECTION

9.1 All transformers shall be routine tested as per IS: 2026.

9.2 Additional tests, wherever specified, shall be carried out on one transformer of each rating.

9.3 All the above mentioned tests shall be carried out in the presence of purchaser's representative. In addition, the transformer shall be subjected to stage inspection at works and inspection at site for final acceptance.

9.4 These inspections shall, however, not absolve the vendor from his responsibility for making good any defect which may be noticed subsequently.

10.0 DRAWINGS AND DOCUMENTS

10.1 The drawings and documents as per Annexure-I shall be supplied, unless otherwise specified.

10.2 All drawings and documents shall have the following descriptions written boldly.

- Name of client
- Name of Consultant
- Enquiry / Order No. with plant / project name
- Equipment Code no. and Description

11.0 SPARES

11.1 Commissioning Spares: Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for approval.

11.2 Spares for 2 Years operation (Mandatory), as specified shall be supplied.

11.3 Recommend 2 years Operational Spares (other than mandatory spare) alongwith recommended quantity & item-wise unit price shall be furnished.

11.4 All spare parts shall be identical to the parts used in the equipment.

12.0 PACKING

12.1 The transformers shall be suitably packed in wooden crates to avoid damage in transit. Oil cooled transformers shall be properly sealed so as to completely exclude oxygen and moisture from coming in contact with oil.

12.2 The packing box shall contain a copy of the installation, operation and maintenance manual.

13.0 DEVIATIONS

13.1 Deviations, if any, from this standard shall be clearly indicated in the offer with reasoning.

13.2 Deviations, if any, from the data furnished in specification sheet shall be indicated therein beside the data by encircling it.

ANNEXURE – I

DOCUMENTATION FOR AUXILIARY SERVICE TRANSFORMERS

Sl.No.	Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheet, duly completed	N	Y	Y
2.	Technical Particulars, duly filled-in	N	Y	Y
3.	Dimensional drawing with terminal arrangement details	N	Y	Y
4.	Illustrative and descriptive literature	N	N	Y
5.	Installation, Operation and maintenance manual	N	N	Y
6.	Test Certificates	N	N	Y
7.	Guarantee certificate	N	N	Y
8.	Spare parts list with identification marks	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N - No

ELECTRICAL SPECIFICATION

FOR

BAGGING & STITCHING MACHINE WITH

WEIGHING CUM TIPPING MACHINE.

CONTENTS

1.0 SCOPE

1.1 This standard covers design, engineering, manufacture, testing at works, dispatch in well packed condition and erection, testing, commissioning at site of all electrical items required for Semi Automatic bagging & Stitching Machine with Weighing cum Tipping Machine.

1.2 The scope include but not limited to the following electrical items :-

a) Drive motors.
b) Control panels.
c) Local control stations.
d) Limit switches.
e) Solenoid operated knives.
f) Operation Counters
g) Automatic Weigh Sensing Devices
h) Junction boxes.
i) Power and control cables.
j) All other items not specified but required for satisfactory and trouble-free operation of machines.

1.3 This standard shall be read in conjunction with specification sheet and other relevant documents as specified there-in.

2.0 STANDARD TO BE FOLLOWED

2.1 All the electrical equipments shall comply with the latest issue of relevant Indian standard.

2.2 Wherever service conditions etc. laid down in this standard differs from those in Indian Standard Specifications, the conditions specified herein prevail.

3.0 STATUTORY REGULATIONS

3.1 The design and operational features of all the electrical equipment shall also comply with the provision of latest issue of the following Acts/ Statutory Regulations.

i. Indian Electricity rule Act.
ii. The Indian Electricity rule.
iii. The Factory Act.
iv. Fire insurance regulations.

The vendor shall make suitable modification, addition alteration in equipment, wherever necessary, to comply with the above mentioned Acts/Rules/Regulations.

4.0 OPERATING REQUIREMENTS

4.1 The equipment shall be designed for the following site conditions: -

As per Design Philosophy – Electrical

4.2.1 Electrical systems details shall be as follows :

a)	Nominal Voltage	:	415V ± 10%
b)	Highest System Voltage	:	457V
c)	Number of phases	:	Three + Neutral

d)	Frequency	:	50Hz ± 5%
e)	Combined Voltage & Frequency variation	:	± 10%
f)	Insulation level	:	2.5 KV
g)	Fault Level	:	36 MVA
h)	Motor Space heaters	:	240V,1Ph AC
i)	Lighting Network	:	415V / 240V AC
j)	Power Socket (63A/ 20A)	:	415V / 240V AC
k)	Control Supply for motor	:	230V, 50 HZ, 1Ph AC *
l)	Neutral Earthing	:	Solidly grounded
m)	Portable hand lamp	:	24V, 1Ph

*Control supply

*The supplier shall arrange the supply through suitably rated control transformer.

The power required at any other voltage shall also be arranged by the vendor by providing necessary transformer of suitable rating.

4.2 **SERVICES**

All the electrical equipment shall be suitable to operate the equipment at the specified capacity continuously with voltage and frequency variations under the ambient conditions as indicated in the specification sheet.

5.0 GENERAL DESIGN FEATURES

5.1 The design and layout of all the electrical equipment shall be in accordance with the latest practices.

5.2 All equipment shall be in dust and vermin proof enclosures equivalent to IP54/IP55/IP67 as per IS-13947-1993 (Part-1). Special care shall be taken to ensure that the parts to be opened for indication and maintenance retain their dust tightness even after repeated opening and closing. CIMFR certified enclosure shall only be provided.

5.3 For dust proofing neoprene rubber gaskets without any discontinuity shall be used and held in position in groove of metal work. The thickness of enclosure used shall not be less than 2.5 mm for sheet steel and 6 mm for cast aluminium.

5.4 All external hardwires up to 8 mm diameter shall be of stainless steel and for diameter more than 8 mm shall be of M.S. cadmium plated or zinc passivated.

5.5 All the equipment shall be properly painted after suitable pretreatment with application of two coats of antirust epoxy based primer followed by two coats of corrosion resisting epoxy based paints. The final shade of paints shall be as per the specified shade. All surfaces shall be picked for complete rust removal and phosphatised as required to produce clean surface free from scale grease and dust.

5.6 Only crimping type cable lugs shall be used.

5.7 All terminal blocks shall be pressure clamp type. Minimum rating shall be 16A for control and 35A for power. The terminal block shall be provided with interlocking type plastic numbered ferrules.

5.8 All cable glands shall be double compression type and made of rolled aluminium.

5.9 All equipment shall be complete with earthing terminals, terminal blocks, cable lugs and cable gland suitable for the cables.

5.10 Make of various equipments and component shall be of approved make by owner.

6.0 MOTORS

6.1 The motors shall be squirrel cage induction type, totally enclosed and in IP 55 enclosure, All motor shall be energy efficient type (IE2) as per IS: 12615. All motors shall be class F insulated with temperature rise limited to that of class B and in conformity with IS-325.

6.2 The motors shall be rated for 20-30% higher than the power requirement of the driven equipment. The duty cycle of motors shall match with machine's number of starts & stops.

6.3 The motor shall be suitable for direct-on-line starting even at a terminal voltage of 80% of the rated voltage.

6.4 The starting current of motor shall not exceed values specified in IS:12615 for with no positive tolerance.

6.5 The motor windings shall be easily replaceable type and treated with suitable varnishes to withstand the corrosive effect of the product being handled by the machine.

6.6 The motor shall be complete with all the required accessories such as cable lugs, glands, earthing terminals, lifting eye bolts etc.

7.0 MAIN PANEL

7.1 The main panel housing the required controlling elements shall be either located near the operator in the operating floor or in a separate room away from the machine.

7.2 It would be preferred to combine the control panels for all bag Stitching Machine in a big panel to reduce mounting space. Also total height of big panel shall not exceed 2200mm.

7.3 2 Nos. of 415V. 3- Ph 4-wire supply would be provided by bidder for each set of control panel.

7.4 This supply would be received in vendor panel through 2 Nos. switch fuse unit suitable rated and interlocked through contactor is such a way that in case of failure of one supply the other supply would be restored automatically.

7.5 The main panel enclosure shall be dust, damp and vermin proof equivalent to IP 54 as per IS 2147 and suitable for floor mounting. The panel shall be front opening type with concealed door hinge and knurled knob.

7.6 Wiring

7.6.1 The panel shall be completely factory wired and ready for external connection.

7.6.2 Power wiring shall be carried out by PVC insulated copper stranded cables of adequate size. The control wiring shall be carried out by PVC insulated copper stranded flexible cable of 2.5 sq.mm (minimum).

7.6.3 All control wiring shall be numbered at both ends with the superior quality markers.

7.6.4 The cable shall be of 1100 volt grade. They shall be arranged in a neat fashion and supported on PVC channels or PVC stand of screw supports.

7.6.5 For the equipment mounted on the doors, the necessary wiring shall be carried out with neatly arranged flexible stranded copper cables in such a way that no strain is put on the wires while opening the door for inspection and maintenance.

7.7 Incoming Switch

A heavy duty air break switch shall be as per IS shall be provided to isolate the incoming power supply. This shall be mounted on the door and so interlocked that the door cannot be opened when the power is 'ON'. However, a defeat interlock mechanism shall be provided on the switch for emergency use.

7.8 Motor Starters

The component for motor control shall be in conformity with IS -1822.

The switches and fuses shall be heavy duty type and rated 2 to 2.5 times the full load current of the motor. The minimum rating of switch shall be 25 Amps. The fuse shall be HRC cartridge link type. The contactor shall be of AC 4 category and rated two times the full load current of the motor. The thermal overload relay shall be bimetal, ambient compensated, and hand reset type. They shall be mounted separately. Direct mounting on contactors is not acceptable.

7.9 CONTROL

The control panel shall have the following equipment, In addition to this, any other accessories, it required, shall be provided.

1) Incoming switch.
2) SFU.
3) Control switches
4) Contractors for sewing head motor, knife solenoid.
5) Forward –Reverse-contractor for flat belt conveyor motor.
6) Breaking contractor and any other accessories required for sewing head motor brakes.
7) Over load relays for knife solenoid, sewing head motor and flat belt conveyor.
8) Control transformer.
9) Indication lamps
   a) Machine on - Red
   b) Machine tripped on over load – Amber

The indication shall be LED type, 230V A.C.

7.10 TIMERS

Necessary timers, if required, shall be provided. These shall be pneumatic or synchronous type with manual/auto feature. The minimum accuracy shall be 0.5%.

7.11 AUXILIARY RELAYS

The relay shall be as per the requirement and in conformity with IS-3231. All spares contacts of relays shall be wired up to the externals.

7.12 CONTROL SUPPLY

The supply shall be 230V, single phase, 50 Hz, A.C. and shall be obtained from the incoming medium voltage supply by providing necessary step down transformer. The control supply transformer shall be dry type with class H/C insulation. The primary side shall be provided switch fuse unit while the secondary shall be provided with fuse on one lag with the other lag earthed.
The control supply shall be properly laid and distributed inside the panel. The individual circuit shall have separates fuses. Both solenoids shall have its own fuse.

7.13 TERMINAL BLOCKS

Numbered terminal blocks of pressure clamp type rated for 1100V shall be provided. These shall be so located that the external cables can be terminated with minimum bending. Not more than two wires shall be connected to any terminal, 20% spare terminal shall be provided for owner's future use.

7.14 CABLE GLANDS

Cable glands of suitable size shall be provided on a removable gland plate on the bottom of control panel.

8.0 LIMIT SWITCHES

8.1 The limit switches shall be of heavy duty type housed in cast aluminium dust proof enclosure (IP 54) rated for the duty involved and required number of switching operations per hours.

8.2 The mode of operation of limit switches shall be positive and direct acting type.

8.3 The shaft shall be of stainless steel s and supported on sealed pre lubricated bearing.

8.4 The contacts shall be of solid silver and at least two sets of changeover contacts shall be 2 Amps at 110V D.C. and 5 Amps at 240V A.C.

8.5 The cable entry shall be of adequate size and complete with required accessories.

9.0 FUNCTIONAL EQUIPMENT

9.1 FLAT BELT CONVEYOR CONTROL

a) Forward : Through Forward-Reverse Selector, Switch starts push button and seal in-contact arrangement

b) Reverse : Reverse selector switch and stat push button.

9.2 SEWING HEAD MOTOR CONTROL

a) Automatic : Through micro switch.

b) Breaking : Automatic D.C. injunction on stop

9.3 SOLENOID KNIFE CONTROL
Automatic solenoid operated through micro switch.

10.0 LOCAL CONTROL STATION

10.1 This shall be installed near each machine, within the reach of operator.

10.2 This shall have cast aluminium enclosure having dust, damp and vermin proof execution (IP54).

10.3 This shall house the following elements :-

i. Indication lamp for control supply 'ON' – Red
ii. ON/OFF push buttons
iii. Selector switch for selection of sewing heads.
iv. Forward/Reverse switch for control of flat conveyors.

In addition to above an emergency stop shall be provided at convenient location to stop the system when required.

10.4 The control station shall be front opening type and all equipment shall be mounted on a base plate.

10.5 The control station shall be properly wired and complete with terminal block and cable gland for connection of external cable.

10.6 Necessary cable connection between local control station and other relevant parts of machine shall be done by vendor.

11.0 OPERATION COUNTERS

Six digit counters with required accessories shall be provided to count the number of weighments made by the machines. It shall have manual resetting facility. It shall be located in control room.

12.0 JUNCTION BOXES

Separate junction boxes for power and control cables shall be provided on the machine body

12.1 The junction boxes shall be of cast aluminium and in dust proof execution (IP67) and adequately sized for termination boxes of external cables.

12.2 The junction boxes shall be complete with all accessories.

13.0 EARTHING

All electrical equipment shall be provided with two no. earthing terminals on opposite sides of the equipment and marked suitably. Suitable size of lugs shall be provided for earth connection. Suitable numbers of earth bus on bagging floor for earthing of all the machines.

14.0 NAME PLATE

14.1 Each control panel shall have a name plate on the top to indicate the code no. and description of the machine.

14.2 Each component shall be provided with label inscription indicating its purpose.

14.3 The name plate shall be of stainless steel with proper engraving on it.

15.0 TESTS

15.1 Stage inspection and routine tests with special reference to the following tests shall be carried out at works in presence of owner's representative.

a) Insulation tests.

b) Continuity tests.
c) High voltage test.
d) Simulation tests

15.2 The vendor shall give a fort-night notice to the owner to enable its representative to be present for the tests. However, it should be noted that the approval of owner's representative does not relieve the vendor from his responsibility of performance guarantee.

16.0 DRAWING AND DOCUMENTS

Drawing and documents as per list of drawings documents enclosed elsewhere in NIT.

17.0 SPARES

The Vendor shall provided spares as per spare list enclosed elsewhere in NIT. Spares for commissioning, as required, shall be supplied without any extra cost.

ELECTRICAL SPECIFICATION

FOR

SCRAPPER

FOR

UREA HANDLING & BAGGING PACKAGE

CONTENTS

1.1. The scope shall include design, engineering, manufacture, testing at works, delivery to site in well packed condition, unloading and storing at site, transportation to work place, erection, testing and commissioning of complete electrical system required for SCRAPPER.

1.2. This specification shall be read in conjunction with all drawings, documents, data sheets and other relevant reference as specified herein.

1.3. The scope shall include but not limited to the followings for safe and proper operation of Scrapper :

- Drive Motors
- Motor control Centre
- Operator's control desk
- Push button stations
- Limits switches
- Brakes
- Clutches
- Lighting distribution board
- Lighting fixture
- Cables
- Cable lugs and double compression type Al. cable glands
- Cable reeling drum with trailing flexible cable
- Termination of cable of cable reeling drum at Owner's plug socket
- 25Amps, 1 phase power plug socket
- 63Amps, 3 phase power plug socket
- Cable rack for trailing cable
- Earthing of all equipment

1.4. Any other items not specified but required for the satisfactory and trouble free operation of the system are also be included in vendor's scope of work.

1.5. Power outlets shall be provided, fed from PMCC, through suitably rated power plug sockets located along the side wall of the reclaiming conveyor of silo at 30 Metres interval. Further distribution of power from these power sockets shall be done by the bidder.

1.6. The power requirement of the Scrapper shall be furnished by the vendor along with bid for selection of cable size & plug sockets by owner.

a) Total installed -------- KW

b) Maximum running load -------- KW

2. CODES & STANDARDS

2.1. The design, manufacture, testing and installation of the equipment shall comply with the latest issue of relevant Indian Standard Specification and codes of practices. In the absence of IS for any particular equipment relevant IEC shall be complied with.

2.2. The equipment and installation shall also comply with the provisions of latest issue of Indian Electricity Rules and other Statutory Acts and Regulations.

3. SERVICE CONDITIONS

3.1. The equipment shall be designed for the following site conditions: -

As per Design Philosophy – Electrical

The atmosphere inside silo shall be laden with finely divided urea dust which is very corrosive in nature.

4. SYSTEM DETAILS

4.1. Electrical systems details shall be as follows :

a)	Nominal Voltage	:	415V ± 10%
b)	Highest System Voltage	:	457V
c)	Number of phases	:	Three + Neutral
d)	Frequency	:	50Hz ± 5%
e)	Combined Voltage & Frequency variation	:	± 10%
f)	Insulation level	:	2.5 KV
g)	Fault Level	:	36 MVA
h)	Motor Space heaters	:	240V,1Ph AC
i)	Lighting Network	:	415V / 240V AC
j)	Power Socket (63A/20Amp)	:	415V / 240V AC
k)	Control Supply for motor	:	240V,1Ph AC
l)	Neutral Earthing	:	Solidly grounded
m)	Portable hand lamp	:	24V, 1Ph

5. OPERATION:

5.1. The scrapper shall be suitable for manual / automatic operation as described below:

5.1.1. Manuals :

The discharge conveyor, elevator and scrapper shall be interlocked for sequence starting. An INTERLOCK / TEST switch shall be provided for testing the motor independently. The contactors for luff and travel motions of the scrapper and also the scrapper reverse drive shall remain energised only so long as the start button / switch for these drives are operated, except in case of automatic operation. The klaxon shall be sounded before commencement of travel motion of the scrapper.

5.1.2. Automatic :

The scrapper shall luff for its full range or adjustable range. After the scrapper boom has travelled a pre determined depth in downward direction, the creep luffing motion shall be cut off.

The manufacturer shall submit their scheme of operation in line with operational requirement explained above.

6. SAFETY DEVICES:

6.1. The following safety devices shall be provided.

6.1.1. **Luffing**

Self reset type upper and lower series limit switches shall be provided in power and control circuit for limiting the movement of the boom within the limits specified with an additional horizontal zero limit switch (rotary geared type).

Electro hydraulic thruster operated brake shall be provided.

6.1.2. **Discharge Conveyor**

Self reset type rope operated limit switch & zero speed switch shall be provide for discharge conveyor. Necessary timer shall be provided for zero limit switch to allow starting.

Hold back shall be provided for automatic braking.

6.1.3. **Cable Reeling Drum**

Self reset type limit switch for over drawl of cable from the drum.

6.1.4. **Emergency Stop**

Interlocking of contactors shall be made as follows:-

a. When travel motion is taking place all other drives shall remain at stand-still.

b. Luff motion shall take place at a time.

7. GENERAL DESIGN AND CONSTRUCTIONAL REQUIREMENTS

7.1. The electrical system and installation shall be designed as per latest practice to provide maximum reliability, flexibility, safety to personnel and equipment and ease of operation and maintenance.

7.2. All equipment shall have standard ratings.

7.3. All equipment shall be dust, weather, vermin and corrosion proof and have IP--55 protection Conforming to IS-13947-1993 (Part-1). Care shall be taken to ensure that the parts to be opened for inspection and maintenance retain their dust tightness even after repeated opening and closing. CMIFR certified enclosures shall be provided for limit switches, brakes, control station, junction boxes etc. However for enclosures of motors, MCC, and control panels, certificate of dust proofness from manufacturer shall be supplied.

7.4. All equipment shall be suitable for use as per classified area.

7.5. Enclosures for limit switches, brakes cells, junction boxes , klaxon etc. shall be either cast iron or cast Al. Enclosure for panels may be of sheet steel not less than 3mm thick and wherever necessary the panel structures shall be reinforced.

7.6. Neoprene gaskets shall be used for dust sealing and all opening shall be gasketed properly. The gasket shall be without any discontinuity or joints.

7.7. No copper or copper alloys shall be exposed or used outside enclosure.

7.8. All equipments rated above 220V shall be provided with two nos. external earthing terminals and those rated up to 220V with one no. external earthing terminal.

7.9. All external hardware of diameter less than 8mm shall be of stainless steel and those of diameter 8mm and above shall be of mild steel cadmium plated or zinc passivated.

7.10. Due to high humidity only non-hygroscopic materials shall be used for insulation. Coil windings etc. shall be specially impregnated with insulating varnishes which do not absorb moisture from the air. These shall be anti-acid / alkali resistance type.

7.11. All rotating and live parts shall be adequately protected to prevent inadvertent or accidental contact.

7.12. The main isolating switch as well as control and lighting switches shall be located in operators cabin. Free movement of the operator shall not be hindered by equipment located in operator's cabin.

7.13. All equipment shall be provided with stainless steel name plates containing the particulars along with the description and Code Nos. of equipment.

8. EQUIPMENT SPECIFICATION

8.1. Motors

8.1.1. All motors shall be totally enclosed, squirrel cage induction type and conforming to IS 325. The motor shall be energy efficient having efficiency class of IE2 as per IS 12615. In addition the motor shall be dust, vermin and corrosion proof enclosure confirming to IP 55 of IS 4691.

8.1.2. The motors shall be class F insulated with temperature rise limited to class B and the same should be suitable for both direction of rotation.

8.1.3. The motors shall be suitable for direct on line starting even at a terminal voltage of 80% of the rated voltage.

8.1.4. All motors shall be suitable for operating duty involved with auto and manual operation of the scrapper. A certificate of motor manufactures shall be furnished as and evidence that the motors are suitable for the required number of starts and stops per hour with above duty cycle.

8.1.5. The motors for intermittent duty shall be provided with thermistors for sensing the winding temperature and tripping the motor in case of unsafe temperature.

8.1.6. The rating of the motors shall be as per the sizes indicated in IS / IEC. The margin between the installed power and absorbed power shall not be less than the following:

Motor Rating	Margin above driven m/c absorbed power
Less than 22 KW	25 %
22 KW & above but below 75 KW	15 %
75 KW and above	10 %

8.1.7. The starting current of the motor shall not exceed the value indicated in IS:12615 with no further positive tolerance.

8.1.8. The motor for discharge conveyor shall be slow speed type.

8.1.9. All couplings shall be direct flexible type. Gears, if required, shall be external to the motor to the extent possible.

8.1.10. The motors shall be provided with the on line greasing facility (grease nipples & drain plugs)

8.1.11. The name plates of the motors shall be of stainless steel.

8.1.12. The motors shall be complete with double compression type aluminium cable glands to terminate 3 core XLPE insulated armoured and PVC sheathed FRLS aluminium conductor cable, lifting eye bolts, earthing terminals etc.

8.1.13. Motors shall be located in such a way that maintenance can be possible without disturbing the other connected equipments.

8.1.14. Space heaters rated for 240V A.C. shall be provided to keep the winding dry for all medium voltage motors, except for motors rated below 30 KW which shall be suitable for space heating by connecting 24 V A.C to any of the two motor winding terminals.

8.2. **Cable Reeling Drum**

8.2.1. Cable reeling drum shall be motorized type , 35 Meters long trailing ATC, insulated with HRVIR and finally sheathed with HTPCP, 650 / 1100 voltage grade, conforming to VDE-250 having suitable size.

8.2.2. The main supply shall be taken from switch socket until installed all along the length of reclaiming conveyor through flexible cable which shall be housed on the reeling drum, mounted on the scrapper's structure. The motor for motorised cable reeling drum shall be of IP55 execution and suitable for duty involved. Paying out or rewinding of cable shall be done at uniform speed. Arrangement shall be provided for locking the drum while changing the plug to avoid accident. Complete technical particulars along with the set of detail drawing pertaining to cable reeling drum shall also be furnished. Ample space shall be provided for attending the maintenance job of its internal mechanism without removing it.

8.2.3. The cable reeling drum shall be provided with gear cam limit switch, pendulum limit, switch, directional limit switches, etc.

8.2.4. Slip-rings and brush-gear assembly of cable reeling drums shall have dust and weather proof enclosure having inspection window suitably located.

8.2.5. The Cable reeling drum shall have following provisions:

Power cable 4 core of suitable rating

Control cable 4 core x 2.5 sq.mm

Screen cable 2 core for communication.

8.3. **Incoming Isolating Switch**

8.3.1. One No. Switch Fuse unit of suitable rating shall be provided in the operator's cabin at a conveniently located position. The switch shall be heavy type as per IS 4047. The isolating switch shall be mechanically interlocked with its door to avoid access to live parts. Facilities shall also be provided to padlock the switch in OFF position. All panels shall be made dead once the isolating switch is put off. ON& OFF position of the switch shall be clearly indicated outside.

8.4. **Operator's Cabin & Control Desk**

8.4.1. The operator's cabin shall be totally enclosed, dust tight having glass panels, ventilation arrangement with filtering device to allow fresh air into the cabin and to prevent penetration of dust. The cabin shall be kept at a pressure little above atmospheric pressure to prevent ingress of dust from surrounding atmosphere. The height of the cabin shall be 2.2 meters.

8.4.2. One number master control desk shall be supplied and installed at the most convenient place in side of the cabin. The control desk shall have following control devices.

- Interlock-OFF-Test switches.
- Auto manual selector switches.
- Change over switches.
- Control push buttons.
- Ammeters, voltmeters along with selector switches. For mains supply.
- Indication lamps for supply 'ON'

  ON/OFF Faulty lamps for all motors.
- Push buttons for working devices such as Klaxon etc.
- All other devices required for safe and proper operation of scrapper.

8.4.3. All controlling equipments shall be mounted on the top of the desk & within the reach of operator. The spacing between various components of the desk shall be adequate for operation and maintenance. The layout and wiring drawings of the control desk shall be subject to the purchaser's approval.

8.4.4. The panel shall be accessible from front only. The front door shall have internal hinges and shall be fixed with knurled knob screws with retaining devices.

8.4.5. The control shall be so designed that the machine shall work automatically whereby it shall be possible to reclaim the material by proper selection of luffing range. The forward and reverse contactors shall be electrically interlocked. The discharge conveyors shall be suitably interlocked for sequential operations. Suitable interlocks necessary for safety shall also be provided.

8.4.6. Control supply arrangement shall be such that it shall be possible to test the sequential operation of control circuit even when the main power incoming switch in control desk is in 'OFF' position.

8.4.7. One no. Emergency push button shall be provided to cut off the entire supply. All control equipments shall be provided with FRP nameplate indicating their functional requirement.

8.4.8. The power wiring shall be carried out by XLPE insulated copper stranded cables of adequate size. The control wiring shall be carried out by PVC insulated copper stranded flexible cable of 2.5 sq.mm (minimum)

8.4.9. All the wiring shall be arranged in a neat fashion on PVC channels or on PVC stands of screw support.

All control wiring shall be numbered at both ends with superior quality markers

8.5. **Transformers (For Control, Lighting, Plug Sockets etc.)**

8.5.1. Separate transformers shall be provided for control, lighting, & plug sockets .These shall be of dry type class H/C insulated, air cooled, double wound conforming to IS1180, mounted inside the panel.

8.5.2. The transformers shall be provided with switch fuse unit on their primary side of suitable rating. One side of necessary legs of the transformer shall be earthed and other shall be provided with fuse of suitable rating.

8.5.3. The rating of the transformers shall be at least 1.5 times the continuous load.

8.6. **Brake**

8.6.1. Automatic heavy duty brakes of electromagnetic/ electro-hydraulic thrusters type shall be provided for travel & luffing drives motors.

8.6.2. The brakes shall be energised during motor operating condition and de-energised during motor stopping condition.

8.6.3. The brakes shall be enclosed in Cast iron/Cast aluminium enclosure and shall be complete with a separate cast iron/aluminium junction box with terminals and double. compression type Al. cable gland and earthing terminals.

8.6.4. The brake drum shoe shall be covered in order to prevent falling of Urea dust on it.

8.6.5. The capacity of the brakes shall be at least 50% higher than the required torque of the driven equipment.

8.7. **Limit Switches**

8.7.1. Limit switches of shunt and series type to be used in control and power circuits .These shall be of heavy duty type and of sturdier construction in cast aluminium enclosure conforming IP55 execution as per IS-2147.

8.7.2. Limit switches shall be suitable for 240V AC, 1Ph control supply. These shall be complete with double compression type Al. Cable gland and earthing terminals.

8.7.3. The mode of operation of these limit switches shall be positive and direct acting type.

8.7.4. The contacts shall be generously rated operated positively.

8.7.5. The width of the rollers of limit switches should be sufficient to avoid slippage of contact.

8.7.6. The striker provided for operating these limit switches shall have rubber padding on surface which will make contact with the roller to actuate it. The limit switches and its roller should be designed to withstand the frequent impact pressures.

8.7.7. Switches in which the contacts are operated by a spring or gravity or both on the withdrawal of a chain or similar devices shall not be used.

8.8. **Klaxon**

8.8.1. The electric klaxon shall be heavy duty type enclosed in a dust damp and vernin proof cast aluminium, epoxy painted enclosure.

8.8.2. The klaxon shall be suitable for still air range of 250 mts. and rated for 110V, 1Ph, 50Hz AC supply.

8.9. **Junction Box**

8.9.1. Cast alumiinum junction boxes having IP55 execution of IS 13947-1993(Part-1) shall be used with a adequate size of double compression type cable gland and terminals.

9. **Lighting, Light fixtures, switch sockets for plug outlets & Air blower**

9.1. Adequate No. of lights shall be provided on the machine bed, super structure and in the operator's cabin. Two nos. of flood lights, one in the front (at the top of operator's cabin) and one at the rear shall be provided for illumination of scrapping area. The lighting fixtures including the flood lights shall be in dust and corrosion proof execution.

9.2. Light shall also be provided on Cat ladders and conveyor walkway.

9.3. Following type of light fixtures shall be used in various locations :

9.3.1. Operator's cabin and MCC Room : 2x 20 W LED

9.3.2. General illumination on platform etc. :80W HPMV or 200W Bulk head where space limitation is there/ equivalent LED

9.3.3. Flood light at the front and rear : 400W HPMV lamps/equivalent LED

9.4. Following rated plug socket shall be used in various locations :

i. 1 No. 24V, 20A, double pole switch socket in MCC Room.

ii. 1 No. 24V, 20A, double pole switch socket in Operator's cabin.

iii. 2 Nos. 24V, 20A, double pole switch socket (1 No. on either side), on scrapper body.

iv. 1No. 220V, 20A, single phase switch socket on scrapper body.

v. 1 No. 415 V, 60Amps, 3 Phase switch socket on scrapper body.

9.5. A separate lighting distribution board consisting of 1 No. incoming SPN switch fuse unit having 63 Amps rating and 8 nos. MCB of 20 Amps rating for branch circuit shall be located inside Operator's cabin.

9.6. The switch socket shall be of cast aluminum enclosure with built-in switch fuse units. Each shall be complete with its plug. The switch socket shall be interlocked with the plug so that it shall not be possible to switch on unless the plug is in position and it shall not be possible to remove the plug when the switch is on.

9.7. 1 No. pressurization air blower with filter shall be mounted on the cabin to prevent ingress of urea dust inside the cabin.

9.8. Lighting, socket outlets and blowers for pressurization remain energised even when the main isolating switch for MCC is open.

10. CABLES, CABLE TERMINATION & CONNECTIONS

10.1. All electrical cable shall be 1.1 KV grade XLPE insulated with FRLS property.

10.2. The flexible cable used for power supply to scrapper shall be ATC insulated HRVIR and finally sheathed with HTPCP conforming to VDE 250 or equivalent to voltage grade 650 /1100 V having suitable size and 35 Mtr long length shall be provided. Those for interconnection of equipment mounted on moving and fixed part of the scrapper shall be 1.1KV grade TRS heavy duty type copper cable.

10.3. The Control Cables shall be multi-core of 2.5 mm^2, stranded copper conductor, XLPE insulated, PVC inner sheathed (extruded type), GI wire armoured, FRLS PVC (ST2 type) outer sheathed, 1100V grade heavy duty type as per IS:7098 (Part-1). Number of cores for control cable shall be as per operational requirement of the equipment. All control cables shall have 10% spare cores subject to minimum of one spare core.

10.4. All cables shall be properly laid on the cable racks and supported with adequately sized aluminium clamps at 500 mm interval.

10.5. Cable entry on all electrical equipment e.g. panels, motors, limit switches, brakes, junction boxed etc. shall be through double compression type aluminium cable gland.

10.6. The internal power wiring of the panels shall be done by PVC insulated copper wiring shall be done by copper stranded flexible cable sof minimum 2.5 sqmm

10.7. The wiring shall be arrnaged in a neat fashion and supported on PVC channel or PVC stand of screw support.

10.8. External looping of wire shall be done through separate dust tight junction boxes.

10.9. All cables used shall be without any intermediate joints.

10.10. The bidder shall submit the voltage drop calculations (during starting & normal running) in support of the cable size selected.

11. EARTHING

11.1. The earthing to all electrical equipment shall be provided according to IS-3043.

11.2. Aluminum earth strip of 150 sq mm area shall be arranged in a ring main manner to which all equipment earth leads shall be connected. The 4^{th} core of incoming power cable shall be connected to this ring and shall serve as earth connection to the Owner's earth bus.

11.3. Tapping shall be take from the earth ring to scrapper wheels and rails which is further connected to Owner's earth pit.

11.4. All motors, switchgears, limit switches, brakes, control boxes etc. shall be earthed independently at two different points with earth conductor of size equal to half the power conductor size subject ort a minimum size of 6 sqmm. The earthing connection shall be external so that periodic inspection can be done. The earth conductors shall be provided with PVC sleeves to protect these against corrosion from fertilizer handled.

12. PAINTING

12.1. The equipment surfaces to be painted shall be pretreated to remove all dust, scale and foreign adhering matter by suitable treatment.

12.2. All steel surfaces shall be painted with two coats of epoxy based primer followed by two coats of anticorrosive epoxy based paint after suitable pre-treatment.

12.3. All paints shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off, crinkle or be removed by abrasion due to normal handling.

12.4. Unless otherwise specified, the finishing shade shall be light grey having No.631 as per IS-5.

13. TESTING & INSPECTION

13.1. All equipment shall be routine tested as per relevant Indian/International Standard /Specifications. These tests shall be carried out in the presence of owner's representative. However, this does not absolve the Vendor from his responsibility for making good any defect which may be noticed subsequently.

13.2. At least following tests shall be specifically conducted before commissioning in presence of owner's representative. All the test results shall be recorded and submitted to the owner.

a) Insulation Test

b) Continuity Test

c) High Voltage Test

d) Simulation Test

14. COORDINATION WITH OTHER VENDORS

14.1. The successful bidder shall coordinate with owner's other vendors and shall freely exchange all technical information required for the purpose of this package.

15. DRAWINGS & DOCUMENT

15.1. All drawings and documents shall have the following descriptions written boldly:

a) Name of Client.
b) Name of Consultant i.e. PDIL.
c) Enquiry/Order Number with Project / Plant name.
d) Equipment Code No. and Description.

15.2. At the time of handing over of the installation, the vendor shall supply as built drawings taking into consideration the actual execution carried out at site.

16. Spares

16.1. The vendor shall submit spares with unit prices recommended for 2 years trouble free operation as indicated in List of spares enclosed elsewhere in NIT.

16.2. Spares for commissioning, as required, shall be supplied without any extra cost.

ENGINEERING STANDARD

ELECTRICAL ERECTION, TESTING & COMMISSIONING

REV	REV DATE	EFF DATE	PURPOSE	PREPD	REVWD	APPD
0	20.01.07	01.02.07	ISSUED FOR IMPLEMENTATION	AV	BKC / SC	BB

CONTENTS

LIST OF ATTACHMENTS

1.0 SCOPE

1.1 This standard covers the technical requirements of erection, testing and commissioning of all Electrical equipments at site.

1.2 This standard shall be read in conjunction with the relevant technical specifications and other references specified therein.

1.3 **Scope of Work**

1.3.1 The scope of work shall generally include supply (wherever specified), handling, transportation, unpacking, checking, reporting of damages/defects, storage, assembling, erection, installation, including fabrication, alignment, levelling, grouting, welding, bolting, painting, etc., testing and commissioning of various electrical equipments and machineries, illumination system, earthing system, lightning protection and fabrication & installation of steel structural etc. required for the complete electrical system as per drawings & documents, specifications, standards & codes, prevalent rules & regulations and best engineering practices.

1.3.2 Detailed Scope of Work (Supply and Erection) shall be as indicated in project specific Technical Specifications.

1.3.3 The entire electrical installation work shall be carried out in accordance with the following:

a) Indian Electricity Rules & all applicable Statutory Acts & Regulations
b) This specification
c) The latest issue of approved drawings of vendors / consultant
d) The recommendation of the manufacturers
e) Latest issue of Relevant IS
f) The direction of the site engineers

Any additional revision made to the drawings at a later stage, which in the opinion of the consultant / owner is necessary, will be binding on the contractor and shall have to be carried out.

1.3.4 The contractor shall be responsible for:

a) Obtaining approval from the Electrical Inspector / Factory inspector or any other Statutory Authority for equipment, plant design / drawings and complete installation work.
b) Carrying out modifications in the equipment & installation as required to comply with the above.
c) Submitting installation certificates on completion of installation to Electrical Inspector & obtaining certificates of approval of the installation.

These jobs shall be carried at the contractor's own cost and the work shall be deemed to have not completed unless the approved certificates mentioned under (c) are submitted to the owner.

1.3.5 No erection material shall be supplied by the owner. All materials like clamps and tags for cable/ conduit and earthing including hardware material, all tools and tackles required for erection, testing and commissioning such as, but not limited to jacks, welding sets, oxygen/ acetylene gas, cutting set, drilling machines, grinders, pipe bending machine, dies for pipe threading, scaffolding materials, cables, switches for erection power supply and workshops, temporary lightning protection, cable jointing tools, megger, earth tester, primary and secondary injection test sets, substandard meters for calibration of ammeters & voltmeters etc. and any other tools required shall have to be arranged by the contractor.

1.3.6 Consumable materials required for the erection jobs such as, but not limited to kerosene, cotton waste, jute, duster shims for alignment & levelling, cement, concrete, bricks, welding electrodes, paints, carbon tetrachloride, unleaded petrol, solder, flux, raul-plug, phill-plug, nylon-plug, anti corrosive grease for copper, aluminium contacts etc. shall also have to be arranged by the contactor.

1.3.7 Cleaning of site after completion of erection as well as regular clearance of unwanted material from site, returning of all packing materials, & excess of other material supplied by owner back to owner's stores shall also be covered under the scope of work.

1.3.8 All equipments and instruments shall be inscribed with proper number, nomenclature, cautionary signals & other instructions as may be necessary.

1.3.9 The contractor shall supply and touch-up any surface of switchgear and other electrical equipments which are scratched and / or damaged during transportation and erection. The paint used shall match exactly the surface being touched up.

1.3.10 Major civil engineering works pertaining to electrical equipment like foundation and plate inserts etc., if excluded from the scope of work, the contractor shall check their correctness as per latest manufacturer's drawing and carry out minor civil jobs such as, but not to limited to, grouting of base plates, channels, supports and foundation bolts, cutting holes in wall and ceiling, chipping of floor and ceiling, sealing of cable entries and making good the same after installation of the equipment, levelling and any other minor similar civil works advised by site engineer has to be carried out by the contractor with out any extra charges.

1.3.11 The contractor shall furnish all supervision, labour, tools, rigging material and incidental material such as bolts, welding electrodes, anchors etc. required to install, test and adjust the equipment.

1.3.12 The contractor shall employ all skilled, semi-skilled and non-skilled labourers for erection, installation & testing as required. All Electricians, cable jointers, wiremen, welder and other employed shall be suitably qualified possessing valid certificates/ licenses recognized by the complement authorities. The owner at its own discretion, put any electrician, wireman, cable jointer to test about competency of technician concerned and the contractor shall have to replace any such staff found incompetent in the opinion of the owner, to execute the job as per the requirement.

1.3.13 The contractor shall also furnish a list of Engineers / Supervisors and staff employed by him for erection and installation jobs giving in brief qualification and experience of such staff and indicating whether they hold such competency certificates / licences to supervise the electrical installation jobs as required under Indian Electricity Rules & State Electrical Inspectorate Rules.

1.3.14 The contractor shall set up his own work-shop and other facilities at site allocated place to undertake fabrication jobs, pipe bending, threading etc.

1.3.15 The contractor shall be responsible for recording of all readings and observations during erection, testing and commissioning in registers or on prescribed Performa. These shall be carried out in the presence of owner's representative. All such test data and records shall be duly singed by the contractor's Engineer / Owner's representative and shall be submitted to owner in triplicate.

1.3.16 The contractor shall hand over completed job. Minor details not specifically mentioned in the scope or schedule of quantities but required for completeness of the job shall have to be carried out by the contractor with out any extra cost.

1.3.17 The contractor shall commission all Electrical equipments and carry out all tests inclusive of load test as per the performance guarantee and will be responsible for final adjustment of relays, instruments, meters, breakers etc.

1.3.18 The specifications given under Cl. Nos. 5 & 7 are only guidelines and doesn't give the details entirely. It shall be the responsibility of the contractor to execute the work without any extra cost to owner, in accordance with the standard code of practices, the relevant manufacturer's drawings, owner's drawings, consultant's drawings and as per Site engineer's directions. Further, the stipulations of general conditions of the contract shall prevail over all other conditions stipulated in this specification.

1.4 Exclusion of Work

1.4.1 All major civil engineering works pertaining to electrical equipment like foundation and cable trenches shall generally be excluded. However, minor civil works shall be in contractor's scope. Transportation, handling, assembling, setting, aligning, levelling, plumbing and grouting of all electrical motors and generators shall generally be excluded.

1.4.2 Detailed Exclusion of Work shall be as indicated in project specific Technical Specifications.

2.0 CODES AND STANDARDS

2.1 The erection, testing & commissioning of the equipment shall comply with the latest issues of all relevant Indian Standards and Codes of practices. Design, manufacture, testing & installation of supply items shall also comply with the relevant standards. Equipments complying with equivalent IEC standards shall also be acceptable.

2.2 Some of the relevant Indian Standards are as follows:

IS: 10028(Part-2)	Code of practice for selection, installation and maintenance of transformers
IS: 6600	Guide for loading of oil immersed transformers.
IS: 10118(Part-3)	Code of practice for selection, installation and maintenance of Switchgear and controlgear
IS: 11039	Requirements for mounting on rails in switchgear and controlgear installations.
IS: 1255	Code of practice for installation and maintenance of power cables upto and including 33 KV rating
IS: 14782	Code of practice for maintenance and testing of large lead-acid batteries for generating systems and substations
IS: 2309	Code of practice for protection of buildings and alied structures against lightning
IS: 2551	Danger notice plates
IS: 3043	Code of practice for Earthing
IS: 5216	Recommendations on safety procedures and practices in electrical work
IS: 8437	Guide on effects of current passing through human body
IS: 14786	High voltage / Low voltage prefabricated substations
IS: 900	Code of practice for installation and maintenance of induction motors
IS: 15429	Storage, installation and maintenance of DC motors – Code of practice
IS: 13408	Code of practice for the selection, installation & maintenance of electrical apparatus for use in potentially explosive atmospheres (other than mining application or explosive process manufacture)
IS: 14665(Part 2)	Electric Traction Lifts: Code of practice for installation, operation and maintenance

2.3 The contractor shall observe safety rules and take all necessary safety precautions to carry out the work in the plant.

3.0 EQUIPMENT SPECIFICATION

3.1 All equipments shall conform to the relevant specifications indicated in project specific Technical Specifications. They shall be suitable for specified site & climatic conditions.

3.2 Make of equipments shall be as per project specific requirements. Make of equipment not specified shall be as indicated and shall be subject to Owner / Consultant's approval.

3.3 Drawings and documents for various equipments shall be submitted as per Documentation Schedule indicated in relevant specifications.

3.4 Spares as specified / recommended spares for 2 years operation and commissioning shall be supplied for all equipments.

4.0 GENERAL PROCEDURE FOR ERECTION

The general procedure governing "Transfer of equipment and materials to Contractor", erection and Final acceptance of Owner/ Consultant are given below:

4.1 Drawal of Equipment from Owner's stores

All equipment and materials, excepting, equipment / erection materials included in Contractor's scope of supply, shall be issued from Owner's store. Contractor shall arrange to draw the necessary equipment / material in the sequence required for erection and transports the same to contractor's store or directly to erection point.

4.2 Contractor's inspection at Owner's stores / Site

On receipt of any material (supplied by the owner) at site, before removing any issued item, contractor shall fully unpack and inspect all equipment received for completeness, signs of damages, defect etc. in the presence of owner's representative and shall get all discrepancies (damage / short supply) duly recorded by owner's/ consultant's authorised representative on the issue note, failing which, no claim by the contractor shall be entertained at a later date and he shall be required to make good/replace/repair the defective/ damaged items at no extra cost.

4.3 Handling and cleaning

4.3.1 Contractor shall be responsible for proper handling and cleaning of all materials / equipment drawn / supplied by him until Owner / Consultant finally accepts the erected equipment.

4.3.2 Equipment shall be handled with care by experienced riggers under guidance of competent supervisors and as per rigging marks given on cases. Dragging on floor shall be avoided and crane/suitable rollers shall be used for moving the equipment at any times.

4.3.3 The contractor shall be fully responsible for the safe keeping of equipment issued to him till these are erected, tested, commissioned by him and accepted by owner/ consultant.

4.4 Transportation

This involves transportation of various electrical equipments / materials from owner's stores / store siding to erection site / Contractor's stores & Contractor's Stores to erection site. When transporting the equipment, it shall be loaded on suitable trailer / trucks as per capacity and size of equipment, and shall be properly supported on the trailers / trucks by means of ropes / stoppers to avoid damage or tilting due to heavy jerks and vibration. Precautions, if any, displayed on equipment shall be strictly observed.

4.5 Storage

Whenever materials are required to be stored by the Contractor in his own stores at site, the contractor shall strictly observe the following requirements: -

4.5.1 The contractor shall keep a proper record of the materials handed over to him by owner / consultant at the initial start of the work and the materials drawn by him and kept in his stores.

4.5.2 All equipment and materials shall be properly stored by the contractor at site in the designated storage area provided by the owner.

4.5.3 The contractor shall ensure that all the materials drawn / supplied by him are stored indoor / under shade. However, if a package is temporarily stocked outdoor due to unavoidable reasons, this shall be ensured that the storage area is dry, hard and well-drained area.

4.5.4 Goods must not be placed directly on the floor / ground but shall be kept on blocks, 60 mm to 120 mm above the floor level such that the bottom is well ventilated.

4.5.5 In case of outdoor storage, the contractor at his own cost shall provide waterproof PVC sheets / tarpaulin to cover all goods so as to protect them from rain etc. These sheets / tarpaulin shall be removed for inspection once in a week and if found moist or mouldy, shall be dried in direct sunlight.

4.5.6 In addition to the above, the equipment manufacturer's storage instructions, if any, shall be strictly followed.

4.6 Erection Requirements

4.6.1 All work shall be carried out as per drawings supplied. Placing of equipment on foundation, aligning, grouting, connecting, fixing danger notice plate / board on equipment shall be done as specified. Meggering, labelling and painting shall form part of erection requirements.

4.6.2 Fixing of supporting frames / pedestals, grouting, cutting and dressing holes in walls / ceiling and any other minor civil work necessary for installation and levelling of electrical equipment are included in electrical erection scope.

4.6.3 The scope of erection also includes cable dressing/ clamping/ minor rerouting, minor relocation of fittings, internal cleaning of equipment, overhauling and minor repairs.

4.6.4 Fabrication of clamps from the materials specified and clamping of cables on racks, trays etc. fixing of single core cables in tri-foil formation in aluminium clamps, earthing of cable armour and lead sheath, wherever necessary (and as per the details given by Consultant) fall under erection scope of work.

4.6.5 Marking of cables by fixing / grouting the cable marks / number tags for every 25 meters along entire route of cables is included in the scope of work. The tags shall be made of Aluminium Strips.

4.6.6 The contractor shall without any extra cost, touch up with paint all electrical equipment which are damaged / scratched during handling, erection or repair. The paint used shall match exactly the painted surface of the equipment on which touch-up is done, and shall be epoxy based.

4.6.7 The descriptions given above are only to give a preliminary idea about the scope of work and they do not limit the entire scope to these descriptions only. Hence all other parts of the tender document shall be read in conjunction with the referred standards, associated drawings, specification sheets and schedule of materials & services to assess actual scope of work.

4.6.8 The contractor shall undertake erection of all equipment specified herein in accordance with good engineering practices in conformity with statutory regulations and Code of Practice and to the entire satisfaction of the purchaser/ owner.

4.6.9 The contractor shall arrange all the necessary erection tools, tackles, testing and measuring instruments and shall supply all erection materials as required.

4.7 Services of Suppliers' Erectors

For guiding / supervising erection of sophisticated equipment, services of main equipment supplier's engineers / erectors may be made available free of cost to Contractor as per discretion of Owner/ Consultant. However, this will not absolve the contractor from his responsibility nor his obligation to provide his own supervisors or technical personnel.

The contractor shall comply with all the directions, drawings etc. issued to him within the scope of his contract by Supplier's Engineer / Erector.

4.8 Installation Certificate

On completion of work the contractor shall submit installation certificates in prescribed Performa as required under prevailing Electricity Act/ Rules to Electrical Inspector or other competent statutory body and obtain certificates of acceptance/ approval of Electrical Installation carried out by him.

5.0 SPECIFICATION FOR ELECTRICAL ERECTION

5.1 General

5.1.1 These specifications lay down the erection procedures to be followed for each type of equipment, over and above the general "Erection Requirements".

5.1.2 The contractor shall also follow manufacturer's instructions and any other instructions of consultant / owner / Statutory bodies during erection.

5.1.3 Suggestive Erection Drawings shall be supplied to the successful bidder for Lighting, Earthing, Cable Tray Routing, etc. These drawings may be suitably modified, if required, to suit site requirement with the approval of owner / consultant.

5.1.4 As-Built Drawings shall be prepared by the Erection Contractor and supplied to owner / consultant.

5.2 Prefabricated Sub-Stations

5.2.1 New emerging technologies for Electrical Power Distribution Systems have brought in the concept of Modular / Transportable Sub-Stations instead of conventional RCC Sub-Stations.

5.2.2 Transportable Sub-Stations shall comprise of pre-fabricated transportable modules made of galvanized steel, duly installed with electrical equipment like HV & LV switchboards, distribution boards, lighting transformers, battery, battery chargers, I/O racks, etc. and complete with air conditioning system, illumination, earthing & lightning protection, fire protection & management system, communication system, interconnecting cabling and cable tray support system, etc. within itself.

5.2.3 Most of the work shall be completed and tested at works. After testing, for safe delivery to site, the battery electrolyte shall be removed and all equipments shall be secured.

5.2.4 Due to local transport restrictions, some of the pre-fabricated buildings may be required to be split into units / modules of suitable size for delivery. Splitting shall be done by providing several units placed side by side, each unit complete in itself or a large sub-station split in modules with false walls in between modules for transportation, which shall be removed at the time of assembly at site.

5.2.5 The modules / units shall be assembled at site to complete an Electrical Sub-Station with minimum work required to be done at site. Following work shall be carried out at site:

a) Transportable building shall be put on prepared foundations and anchored.

b) Transportation fixtures and temporary walls shall be removed.

c) Different sections of the transportable buildings shall be joined together.

d) Staircases shall be assembled and placed in position.

e) Cable Trays shall be fixed.

f) Re-connection of fire protection & internal lighting system.

g) Internal wiring between sections of the transportable buildings shall be connected.

h) Connection to ground & lightning protection system.

i) Installation of panels within transportable building, if supplied by Owner.

j) Re-testing & commissioning of all the installed panels.

5.2.6 The installation works shall be carried out as per manufacturer's instructions.

5.3 Transformers

5.3.1 Contractor's inspection

Particular attention is to be paid to the following while inspecting / examining the transformers for any sign of damage:

a) Tank side and cooling tubes dented

b) Cooling Tubes damaged

c) Any sight glasses broken (including explosion vents)

d) Bushings cracked / broken

e) Bolts loose

f) Oil leakage (particularly along welds)

g) If gas filled, whether gas pressure O.K.

h) Valves leakage

i) Any other damage

5.3.2 Handling

a) Lift the transformers by lugs or shackles provided for the purpose.

b) Use lugs and shackles to avoid unbalance while lifting.

c) Lifting chains not to interfere with any part of the transformer.

d) Check cover bolts for tightness. Tighten fully (if found loose) before handling. Care shall be taken that the bolt does not rotate to avoid damage of the gasket.

e) In case use of jacks is necessary, use jacks only on jacking pads provided for the purpose. (Jacks shall never be used under valves or radiator tubes).

f) Do not keep transformer on bare ground. Where it is not possible, unload transformer directly on the foundation. This can be done with the permission of consultant/ Owner.

g) Never leave the transformer without putting stoppers of the wheels.

5.3.3 Erection

a) Foundation of the transformer shall be prepared and checked for its level as per Drg. before shifting / transferring the transformers from the stores.

b) Transformer shall be placed on the prepared foundation only.

c) For transformers of high rating (above 1000 KVA) place the transformer on foundation (channels / rails already grouted on the foundation) as per drawing. Proper time shall be given for curing the level of rails. Rails must be checked and adjusted.

d) Wheels shall be fixed before placing of the transformer in position. Wheels of the transformers shall be checked for its proper/ free movement on the rails / plates. Greasing shall also be done on the shaft of wheel before placing the wheels in position. Split pins must be used / placed in position before its rolling. It shall also be levelled & aligned with the bus ducts, if bus ducts are to be connected on the LT side of the transformer.

e) Clamp stoppers to the transformer wheels, immediately after alignment to prevent any movement.

f) Clean all the accessories like radiators, cooling fans, valves, conservator tanks, explosion vent pipe, bushing and other accessories.

g) Flush the radiators with hot oil before assembly.

h) Cloth only shall be used for cleaning purposes (CAUTION: While working on the transformers with hand-holes or bushing holes, take care that no tools or any other foreign matters are dropped into the tanks. All the loose tools shall be properly tied and secured).

i) Assemble all accessories such as radiators, conservator, valves, explosion vents, Buchholz relay, HV and LV bushings, cable-end termination boxes, marshalling kiosk/box, instruments, capillary tubes, silica gel breathers with dried silica gel, fans etc. as per vendor’s drawings and instructions.

j) Prior to topping up of oil, check for proper tightness of all gaskets joints and operation of shut-off valves. Also fix thermometers.

k) Test oil samples from each drum for dielectric strength before topping. (Do not fill oil from the drums, which cannot with stand 40 KV for 1 minute).

l) Filter oil before filling.

m) Oil shall be filled through filtering machine using metallic hose.

n) Fill oil to the transformer tank through bottom drain valve to prevent aeration in oil.

o) Ensure during oil filling operation that no air pockets are left in the tank, and that no dust or moisture enters the oil. Open all air vents. Reduce oil flow rate when oil level is almost up to the bottom of the main cover to prevent internal pressure from rupturing the diaphragm of pressure relief pipe. Allow sufficient time for all air bubbles to escape. Release any air bubble accumulated in Buchholz relay. Close vent plugs.

p) In case of gas filled transformers, the oil to be filled up under vacuum as per manufacturer's instructions.

q) Connect cables to HV terminals and cables/ bus duct to LV terminals of transformer.

r) Connect control cables / power cables to the marshalling box. Connect Stop push button mounted on the wall of transformer room to trip the transformer.

s) Transformer body, HV cable box and MV / LV cable box to be earthed at 2 separate points to the main earthing grid.

t) Transformer neutral to be earthed to separate and distinct neutral earth pits (through Neutral Earthing Resister, where applicable) as per design and drawings.

u) Provide danger notice board conforming to IS: 2551 and IE Rules 1956 on enclosure or door of the enclosure.

v) Earth Transformer Room's door / enclosures as per IE Rules, 1956.

w) Provide Safety items i.e. fire extinguishers, shock treatment chart, fire buckets with screened sand etc.

5.4 Switch Boards

5.4.1 Handling

a) As far as possible lifting of switchboards is to be done by making use of eyebolts provided. Ensure that before lifting, all eyebolts are fully tightened and that panel supports, nuts and bolts are in tact and tight.

b) If lifting arrangement is not provided / not feasible and final positioning by sliding is unavoidable, retain packing base as long as possible and rolled on suitable pipes. Avoid sliding / dragging panel directly on floor by crowbars.

c) Maximum care shall be taken to avoid any damage to insulator, bushings, meters and protective equipment.

5.4.2 Erection

a) Check the foundation according to the drawings. Ensure that all pockets have been rightly made. Fix the datum level, and level the foundation by chipping in such a way that the prescribed point of cubicle base plate is flush with finished floor.

b) Check the individual cubicle for any deformity and ensure that all faces are straight. Any dent on sheet steel frame is rectified before placing on foundation.

c) Wherever separate base frames are supplied level and the foundation in both directions (lateral and transverse) and ensure that these have been correctly levelled throughout. In case of runner rails, check the rails for level in both the directions and ensure that they are parallel to each other.

Wherever base frame is fixed to cubicle, place the cubicle on foundation ensuring that holding down bolts are directly over the foundation pockets.

d) Obtain correct level of panel with respect to floor / existing bus-bar by putting shims below base frame (as per drawing). Shims are to be supplied by the contractor. Measure the level of each frame with reference to datum and ensure that level difference between the two ends of the switchboard base frame is within ± 2 mm.

Owner shall provide a level benchmark in each sub-station. All levels shall be checked with this mark by Theodolite and the Contractor shall keep a record.

e) Cubicle shall be so adjusted that front face of all the panels are in one plane, all sides are plumb and corresponding horizontals on all panel faces (e.g. minimum lines, door edges, inter cubicle joints) line up in the same horizontal line(s). Match the cubicles and adjust properly. Provide gasket between edges, if required, so that no inter-panel gaps are seen.

f) Bolt adjacent cubicles and base frame together. (Drill new holes where corresponding holes of cubicles do not match after levelling, if found necessary).

g) Grout the foundation bolts with mortar. Also run grouting mixture under base of the cubicle frame and ram to ensure solidity. After grout has set properly, tighten the foundation bolts.

h) Fix bushing/ insulators of bus-bars as per drawing if these have been despatched loose.

In case of extension panels for existing boards, this must be done before step (d).

5.4.3 Bus Connections and Installation of Loose items

a) Fix bus bar links and inter panel bus-bar connections with coupling bolts/ supporting insulators. Clean the contact surface of bus bars and links and smear with contact grease before bolting.

b) Wherever recommended, fix shroud on the joints and fill compound, or compound may be put on joint to form smooth homogenous & spherical shaped mass and then wrapped with tape. Simple taping of joints may also be done. Recommendation of manufacturer/ consultant/ owner shall be followed in this respect.

c) In case of misalignment of bus bars, adjustments may be necessary. The connecting pieces may have to be re-drilled or re-fabricated.

d) Check tightness of bus bars bolts connections with torque wrench. Follow vendor's recommendations in this regard.

e) Install all loose relays, instruments, cable boxes, metering and protective CTs, PTs etc. Before fixing the relays, make sure that they are cleaned and all packing materials have been removed from them and proper operation. Clean the contacts.

f) Connect all inter-panel bus wiring. Connections of relays and instruments shall be done as per drawings. Check the wiring according to wiring diagram.

g) Connect all earthing bus bar between the cubicles and it shall be connected at two points by Al/ GI strip or cable to the main earthing ring. Fix all glands for incoming and outgoing and control cable connections on the holes provided for the purpose, as per drawings.

h) Drill holes for fixing cable glands/ cable boxes as per drawings, if such holes are not provided. All spare holes, gaps etc. shall be blanked as per instructions of Owner/ Consultant.

5.4.4 Cleaning

After erection is complete all cubicles, switches, starters, CTs, PT Chambers, Bus Bar Chambers etc. shall be cleaned by blowing air (preferably hot air). Surface of the insulation shall be cleaned with cloth soaked in CTC/ Benzene.

5.4.5 Circuit Breaker installation

5.4.5.1 Air Circuit Breaker

a) Clean the contacts properly with both soaked in CTC/ Benzene etc. Clean and lubricate the operating mechanism, check and rectify the main insulating contacts and bushings and also secondary contact for any damage/ misalignment. Check the locking mechanism.

b) Manually close and trip the breaker several times and check contact alignment and pressure. Adjustment, if required, shall be done according to the manufacturer's instruction. The arc chute if despatched separately shall be fixed properly, only after checking of contact alignment etc. After fixing the Arc Chute, operate manually the breaker and check the contacts make properly. Measure contact resistance with ductor. Check the operation of OFF-ON indicator.

5.4.5.2 Vacuum Circuit Breaker / SF6 Circuit Breaker

a) Check the breaker frame for any damage. In case of vertical isolation type, raise and lower the breaker several times and ensure that breaker moves freely on guide, lubricate the mechanism.

b) Check the operation of locking mechanism. Check the secondary isolating contacts for any deformity. Check HT bushings for any damage and repair if it is minor.

c) Manually close and trip the breaker several times. Adjust the mechanism as per manufacturer's instruction. Measure the contact resistance with ductor. Check the oil level in the chamber. If level is low, due to leakages, rectify and fill up as per manufacturer's instruction. Check the operation of ON-OFF Indicator.

d) Check that safety shutter open and close smoothly. Remove the lock if provided before racking in the circuit breakers. Put the circuit breaker inside the cubicles. If cubicle is aligned properly, the circuit breaker shall go smoothly inside the cubicle.

e) In case of horizontal isolation type circuit breaker, engage the racking mechanism and put the interlock mechanism operates smoothly and adjustment if required shall be done. Slowly rack in the breaker to service position. While racking in, ensure that safety shutters open smoothly. Check the mechanical interlock mechanism. Also check that the main and secondary isolating contacts mesh properly. Conduct this operation a few times to ensure proper functioning and alignment of all mechanism.

f) For vertical isolation type circuit breaker, put it first at the test position and check interlock mechanism and also the secondary isolating contacts engaged properly. Put it at service position, and slowly raise it to fully raised position. Ensure that main isolating contact bushings enter bush bars spouts smoothly and contacts mesh properly. Conduct the raising/ lowering operation several times to ensure a smooth functioning of all mechanism. Any other allied work thought necessary for completion of the erection will have to be done by the Contractor.

5.4.5.3 Oil Circuit Breaker

a) Check the breaker frame for any damage. In case of vertical isolation type, rise and lower the breaker several times and ensure that breaker moves freely on guide, lubricate the mechanism.

b) Check the operation of locking mechanism; check the secondary isolating contacts for any deformity. Check HT bushings for any damage and repair if it is minor.

c) After detaching tank, slowly close the breaker manually and check that moving and fixed contacts match properly. Adjustments, if required, shall be done according to manufacturer's instruction. Since contact movements and alignment etc. are adjusted at manufacturer's work, any further adjustment shall be done very carefully.

Do not operate the breaker when there is no oil in the tank. Measure the contact resistance with doctor. While operating the CB manually, check the operation of ON-Off indicator.

d) Oil filling-Detach the tank and thoroughly clean tank inside with cloth and then with the insulating oil. Fill the tank with insulating oil upon the level. The dielectric strength of oil shall be as per latest IS. In case of supplied in drum not withstanding the dielectric strength as per IS, filter it before filling in the tank. Secure the tank with bolt the top place to ensure good joint.

5.4.6 General Checks

a) Ensure that all gaskets are in position, replace the same if found damaged.

b) All opening covers and rear doors shall be bolted with required number of bolts. Take care that no bolt/ nut/ washer gets lost during handling and erection.

c) Check inter-changeability of breakers of same rating.

5.5 Motor Control Centre / Power & Motor Control Centre (MCC / PMCC)

Erection of MCC / PMCC, if required, is to be carried in accordance with Cl. No. 5.4 above. In addition, the following points are to be observed:

a) Cable glands shall be fixed in cable gland plates/ cable alloys (Drilling of holes in gland plates are to be done at site as required).

b) Cable entries are to be made vermin proof.

5.6 Panelled Equipment

These include AC/ DC Distribution Boards, Thyristor Control Panels, Inverters etc. In addition to the procedure laid down in Clause Nos. 4.0 & 5.3, any other instruction given by the manufacturer shall also be followed.

5.7 Storage Batteries

a) Installation work for storage battery cells on steel / wooden racks shall be done strictly as per supplier's drawings and instructions.

b) Steel / wooden racks shall be installed in the battery room on support insulators. The racks shall be plumbed and aligned properly.

c) Each cell shall be inspected for any damage of its positive, negative plates, containers etc. Cell shall be cleaned properly and all packing materials removed as per manufacturer's instructions.

d) The cells after assembling the plates, indicators etc. shall be placed on cell insulators over racks and interconnected to each other so as to avoid strain on cell-terminals.

e) The electrolyte shall be prepared in large glass/ PVC or special jars as per manufacturer's instructions. The jars shall be cleaned with distilled water. The concentrated sulphuric acid shall be added to the distilled water slowly (never add water to sulphuric acid) and electrolyte stirred constantly with PVC rod. Temperature and specific gravity of electrolyte shall be as per manufacturer's instruction.

f) All necessary safety precautions shall be taken while preparing the electrolyte i.e. goggles, rubber apron, and gloves etc. shall be used.

g) No foreign materials, dust or dirt etc. shall be allowed to fall in the electrolyte and it shall be kept duly covered.

h) Connection to the battery charger shall be made.

i) Prepared electrolyte shall be filled in cells up to mark level of at least 10 mm above upper edge of the plates in a manner approved by manufacturer. Electrolyte shall be allowed to cool down.

j) While giving initial charges to the cells, instructions of the manufacturer's regarding rate of charging shall be strictly followed and care taken that charging unit is not over loaded more than the rated capacity. During the period of charging, the cells must be topped up as often as necessary to prevent the electrolyte falling below the required level. Distilled water to be

used for topping purposes and quantity of distilled water used for topping up of the cells shall be noted.

k) After initial charging battery shall be discharged at specified rate. Thereafter battery shall be recharged.

l) Record all battery voltage of each cell, specific gravity, temperature, charging current during charging/discharging and shall be kept in Performa supplied by the supplier or in a form approved by the consultant/Owner. Discharging and recharging operations shall be done as recommended. After final charging the battery shall be put on float charge.

m) No naked flame or sunlight shall be permitted in battery room and smoking shall be strictly prohibited.

n) During initial charging and discharging battery shall not be left unattended.

o) It is to be assured that battery room is properly ventilated with an exhaust fan / blower.

5.8 Cable Installation

5.8.1 General

a) Fabrication of chequered plates for trench covers, cutting of all types of Al / GI Cable trays to desired length, laying, spacing, fixing etc. of all types of cables, trays, supports, hangars etc. shall be according to the drawings or according to the instructions given by consultant / owner.

b) Contractor shall keep accurate record of cable drums issued to him, the drum nos. and actual length of cable taken out of each drum. Each cable length shall be cut from a specific drum as per approved schedule of cable. Length of cable runs shown in the cable schedules is the calculated length only and the actual lengths shall be measured at site before laying and cutting the cable. The contractor shall take extreme care to adjust cable runs from drums so that joints in the cable are avoided and wastage reduced to minimum.

c) For purpose of measurement of cable run for payment the length of cable between and terminations only will be considered.

5.8.2 Laying

a) The cable drums shall be properly mounted on jack / on a cable wheel. Make sure that the spindle is suitable for carrying weight of the drum without bending. Check that spindle is laying horizontal on the bearing so as to prevent the drum creeping to one side or to the other while rotating.

b) Unroll the cables from the drum in correct direction. Rotate drum only as per arrow mark given in the cable drum. Ensure that the end protection box attached to the flange of the drum is removed and securing rope cut to allow cable and move freely. Rotate the cable drum and simultaneously pull cable steadily and with even pulls and not with unnecessary jerk or strain. In no case the cable shall be allowed to twist or kink since this is likely to spring the armour and fracture the insulation and outer serving of the cable.

c) Do not drag the cable on floor or hard surface. Use only wooden / steel cable rollers for this purpose.

d) Cable shall not be bent sharply to a small radius. The cable bending radius shall be as large as possible and will not be less than 12 times the outside diameter for paper insulated cables, 8 times for PVC cables and 15 times for XLPE cables. At joint termination, the individual core of cable shall not be bent with bending radius of less than 15 times the diameter over the insulation.

e) Where cables are laid on the MS racks, trays etc. ensure that trays / racks / supports are fixed properly in an approved manner or according to the drawings. Check from drawings that for horizontal runs of cable, bracket, risers, supports and angles are grouted or fixed in formation as required.

f) In sub-station where large no. of cables rise to panels / switchboards, it shall be ensured that these risers and rising cables do not interfere with cables on racks and rising cables do not cross the other cables in horizontal runs. Risers are to be properly supported so that weight of cable does not fall on terminations. All cable crossings shall be avoided. Cable cross section / power layout drawings shall be followed.

g) Cable laid in trenches shall be sealed at the entry to hazardous area/non-hazardous area as per details given by Consultant / Owner / Engineer-in-charge.

h) Openings in substation / MCC rooms and floors for entry of cables shall be sealed after the cables are laid.

i) Cables shall be clamped as shown in the drawings Care to be taken to space clamps to such intervals as to prevent buckling of cables.

j) Cables are laid in concrete trenches built by Consultant / Owner having covers of concrete of slabs or chequered plates. The laying of the cable on the racks shall be done in an approved manner and according to the drawings supplied.

k) Where cables are laid in open concrete trenches / slits, the trench / slits after laying cables shall be filled with sand & lean cement mixture and plastered so that surface flushes with top of trench / slit.

l) Care shall be taken that cables are not laid in waterlogged area as far as practicable. When laid above ground, cables shall be properly supported on rigid poles at least 2M high. At road crossing, minimum head clearance of 6M shall be provided.

5.8.3 Laying of Cables in underground pipes

a) Laying of cables in underground pipes shall include excavation of earth along the cable route, laying of pipes, back-filling, ramming and removing extra earth including supply of bricks and sand.

b) Ground trenches which shall be dug for laying of pipes such as to ensure that depth of the top of the pipe below the ground level shall be 600 mm min. Bottom of the trench shall be properly levelled up and all odd and sharp

materials removed. HDPVC / GI pipe shall be laid in the trenches. Proper bends & pull boxes wherever required shall be provided.

c) After laying of pipes, fill up earth in trench and ram properly. Remove all extra earth from the sides.

d) Lay the cables as per drawings and instructions of site engineer.

e) Fix cable markers at 100 M apart and at joints on the entire route length of the cables. The cable markers shall be made of pre-cast concrete block of 300 x 350 x 350 mm size with letter HT Cable, LT Cable, depth of the cable, arrow marks etc. inscribed. These shall have to be supplied by contractor at no extra cost and fixed as per the directions of the Consultant / Owner. The top of the above concrete slab shall have a smooth finish with cement only.

f) Laying of cables under road crossing shall be avoided to the extent possible. If required, it shall be done in pipes. When a larger number of pipes are laid across the road, manholes shall be built on either side to terminate the surface of road. Backfilled soil shall be rammed thoroughly to prevent road surface cracking due to settlement of loose soil.

g) Railway Crossing

Where the cable is laid under railway track, it shall be laid through cast iron pipe or spun concrete pipe of suitable diameter and strength. The pipe shall be laid not less than 1 M below the surface of the formation level. Pipes shall be laid with the gradient to facilitate drainage of water. Pipes shall be laid up to a minimum distance of 3 M from the centre of the end tracks on either side. The work shall have to be carried out in accordance with the rules and regulations of railways for cable crossings.

Where number of pipes is to be laid along road / rail crossing, these shall be laid in horizontal formation.

Masonry pipes to be constructed at both ends of road / railway crossing pipe and specified notice to be erected at crossing as per railway rules.

5.8.4 Directly buried Cables

a) Laying of underground cables shall include excavation of earth along the cable route, laying of cables, back-filling, ramming and removing extra earth including supply of bricks and sand.

b) Where cables are laid directly into ground trenches which shall be dug up for laying cables such as to ensure that depth of the top of the entire cable below the ground level shall be 750 mm min. for medium and low voltage, 900 mm min. for cables from 3.3 KV to 11 KV grade, 1050 mm min. for cables from 22 KV to 33 KV grade and 1000 mm min. for cables at road crossing and at railway level crossing respectively.

c) Bottom of the trench shall be properly levelled up and all odd and sharp materials removed. Trench bottom shall then be bedded with a 75 mm thick layer of sand. Before laying the cable over this bed, approval of consultant / owner for preparation of bed shall be taken. Cable shall be laid in the trenches in straight run, care shall be taken that any kinks or bend are not

formed. After laying the cables, bricks shall be placed lengthwise on both the sides of the cable along the entire length to form through.

d) Fill up space between bricks with sand to height of the bricks.

e) Place bricks closely width wise on the top of the sand filled through. Fill up earth in trench and ram properly. Remove all extra earth from side. Do not use broken bricks. Only Class-I (of relevant IS) bricks shall be used.

f) If new cables are to be laid crossing existing cables, the new cables will be laid under existing cable at depth of not less than 200 mm from the existing cable. Ensure that the approach of the new cable to the crossing is uniform and gradually sloped.

g) Lay the cables as per drawings and instructions of site engineer.

h) Fix cable markers at 100 M apart and at joints on the entire route length of the cables. The cable markers shall be made of pre-cast concrete block of 300 x 350 x 350 mm size with letter HT Cable, LT Cable, depth of the cable, arrow marks etc. inscribed. These shall have to be supplied by contractor at no extra cost and fixed as per the directions of the consultant / owner. The top of the above concrete slab shall have a smooth finish with cement only.

5.8.5 Laying in Trenches

a) RCC slabs and chequered plates lifted from trenches for laying cables shall be put back in position at close of work every day to avoid accident & damage to cables in the trench.

b) When cables pass through pipes, ends shall be sealed by pouring bitumen compound or any other approved compound as required.

c) Pipes shall be provided for protection of the cables entering from the floor, trench etc. in the switchgears, MCCs, and pipes shall be sealed against water ingress.

5.8.6 Laying of single core HT un-armoured cables shall be done in manner stated hereunder. Cables shall be arranged in trefoil formation and clamped with suitable clamps. The clamps shall be fixed on cable hanger, racks etc. The cables shall be laid with extreme care without causing any damage to the sheathing cables in trefoil formation shall be bounded at a regular interval and earthed. Where necessary the bounding on trefoil groups shall be interconnected. The cables shall in no case be drawn through metallic pipe, ducts etc.

5.9 Cable Joining & Termination

5.9.1 General

The scope of work includes:

a) Soldering / crimping of sockets / ferrules and connections at all joints / terminations as per specifications. Sockets shall be provided at all terminations except where pressure clamp type terminals are provided.

b) Glanding of cable and fixing of cable boxes.

5.9.2 Specifications

a) All PVC cables shall be terminated in conventional type cable boxes, fitted with wiping gland / compression type gland / clamps with rubber bush. For outdoor terminations double compression type gland and for indoor terminations single compression cable gland shall be used. Boxes may be filled with bituminous compound, epoxy M-seal, as and where specified.

b) For XLPE cables, special termination kits (heat shrink type) shall be used.

c) All paper-insulated cables shall be terminated in compound filled type cable boxes using conventional compound filling methods or in special cases resin oil filled or epoxy M-seal cable boxes. Wiping gland / clamp with rubber bush are fitted to the cable box.

d) All LT and control cables shall be terminated through compression type gland.

e) In explosion proof equipment sealing accessories, where provided in cable box, are to be used for sealing the cable entry to the box and termination.

f) All lighting and control cables shall be provided with crimped Al / Cu Sockets before termination in junction boxes.

g) In case of LT cables, armours shall be suitably earthed in compression type glands. For HT cables, this shall be done either in glands or by any other suitable means like bonding the armour with suitable wire and connecting same to the earth terminals inside cable box.

5.9.3 Crimping

All cable lugs for Cu conductor's sizes up to 400 sq. mm shall be of crimped type solder less Cu lugs, which shall be crimped by special hand / hydraulic crimping tools. Cable lugs for conductor sizes exceeding above shall be conventional soldering type, heavy duty. All the control cables, which shall be of copper conductor, shall be terminated without any additional lugs in screwed type terminals provided in various equipments. Before crimping the socket inhibiting grease shall be smeared over the conductor. Conductor shall be shaped properly before sliding the socket over it. Crimping shall be done in an approved manner.

5.9.4 Jointing

a) The jointing shall be done in an approved manner with proper jointing kits. Care shall be taken not to damage the insulation when opening the cable for jointing. Taped / temporary joints shall be avoided.

b) In case of LT PVCA cables, armours shall be suitably earthed in compression type glands. For HT cables, this may be done either in glands or by any other suitable means, like bounding the armour with suitable wire and connecting same to the earth terminals inside cable box.

c) Before commencing soldering of the socket, conductor shall be thoroughly cleaned and insulation protected. The ferrules shall be thoroughly cleaned. Ferrule and each strand of the cable shall be thoroughly sweated with solder to completely tin them and fill the conductor gaps and to remove all air pockets. Soldering materials of approved quality as per IES practice shall

be used. Taping of the conductors shall be done in an approved manner after crimping / soldering.

d) Filling up compounds and sealing the cable box, shall never be done in one operation. After the first pouring of compound, it shall be topped up again with compound and then sealed.

e) Straight through Joints

Jointing of XLPE & PVC / HRPVC cables shall be done with extreme care and manufacturer's instructions shall be strictly followed. Soldering of ferrules shall be done with extreme care as stated earlier.

Earth continuity wire shall be plumbed and or clamped. Compound shall be filled according to the instruction of manufacturer of terminating kit / cable. Joints made inside trench or racks shall be properly supported. Wherever, joints are made inside the ground, brick masonry work shall be done around the joint box and filled with sand and thereafter covered with earth at no extra cost.

f) A tent shall be used in all circumstances where jointing work is being done outdoor for protection against rain and to prevent dust from being blown into exposed joint and jointing materials. Extreme care shall be taken to maintain proper phase sequence while terminating at equipment ends. Record of connection details shall be maintained. Conductor shall be shaped properly while terminating and no sharp bend shall be given. Where numbers of cables are connected in parallel, proper tests shall be done before connecting so that no cross connection is made. No phase crossing shall be allowed for making the connection.

g) Cables shall be supported adequately at the entry to cable box / equipment so that load of cable does not come on cable gland.

h) All cables shall be meggered (checked for insulation resistance) before and after jointing and insulation resistance values recorded.

i) While terminating at equipment end, each core shall be properly tagged with numbering ferrules as per nomenclature given in the drawings. Wires shall be dressed and clamped neatly. Bolting shall be done properly.

5.10 **Earthing**

5.10.1 General

a) Painting of all earth strip joints with anti-corrosive paint shall be carried out as per details given in the respective drawings / specifications and instructions of owner / Engineer-in-Charge.

b) All electrical equipment rated 415V and above shall be connected to earth bus by two separate and distinct earth connections. All equipment rated 240V and below shall be earthed with single earth conductor.

5.10.2 Specifications

a) Earthing conductor above ground shall be of aluminium / copper wire bare or insulated or strip. Earthing conductor buried in ground shall be of G.I. or

PVC insulated aluminium / copper cables. Sizes of earthing conductors shall be according to specified drawings. All earthing installations shall conform to IS: 3043 and other relevant standards.

b) The earthing wires or strips shall be laid along the cable racks, cable trenches, risers and supports. Underground conductors shall run at a depth of 600 mm below ground level. Where these conductors run along with cables, they shall be laid at the same depth as cables. Where conductors run on wall, ceilings, they shall be laid on clamps or brackets made out of Al/ GI strips.

c) Wherever earthing conductor is passing through floor, walls etc., the conductor shall be taken through PVC / GI pipes.

d) All paints, enamel etc. shall be removed from point of contact before making connections.

e) Connections between Al/ GI strips shall be done by welding for connecting Al/ Cu/ GI wire. For connecting Al/ Cu/ GI wires, tinned Cu Socket shall be crimped on the wire. At the equipment end, connections shall be done by bolting. However, connections between GI strips shall be done by welding. Connection between Al/ Cu & GI shall be done by bolting. Graphite grease shall be applied on contact surfaces.

f) Epoxy resin paint or bitumen shall be applied on welded or bolted joints to prevent corrosion and taping done as indicated in the drawing. Connections between Al / Cu wires shall be done by crimping weak back Al / Cu ferrules.

g) Earth electrodes shall be provided as per drawings / specifications. Work includes excavation of earth, installation of electrodes and test links etc. supply and filling of charcoal and common salt, back filling of earth and removal of extra earth. It also includes making brick wall around the electrode and cover according to drawings / specifications. The testing links shall be grouted on brick wall and connections with earth electrode and conductors shall be made. Distance between two electrodes shall not be less than 10 meters and may be located 4 M away from building foundation.

h) Earth pits for equipment earthing, transformers neutral earthing and lightning protection shall be separate. However, these pits shall be inter-connected.

5.11 Lightning Protection

5.11.1 Air termination rod shall be installed as indicated in drawings.

5.11.2 Fixing of termination rod on roof with Al sheet shall be done with crank bolt and watertight compound provided.

5.11.3 Laying of down conductors and connection shall be done as per drawings. Lightning Protection installations shall conform to relevant IS.

5.11.4 Earthing of static equipment like vessels, chimneys etc. where no termination rod and down conductor is provided, shall be done by connecting the equipment

base to earth pit by GI / Al strip or PVC insulated Al / Cu wire. Clamps shall be bolted or welded to the base of the equipment.

5.11.5 Structures for the storage, protection or use of highly inflammable solids, vapour or gases or in which highly inflammable or explosive dusts or vapour may be present shall be protected against lightning. Such protection is to be carried out as per prevailing Indian / IEC Standards. The following shall be taken care of:

a) All major members of metallic structure shall be bonded together and connected to the lightning protective system. Such connections shall be made at least in 2 places.

b) Metallic pipe, electrical cable sheath, steel ropes, rails etc. entering the structure but not in electrical contact with earth, shall be bonded to the lightning protective system.

c) All metal forming part of the structure, its reinforcement or its equipment shall be bonded or welded together and connected in two places with the lightning protective system.

d) The bonding ring conductor shall be run externally about 0.5 M above ground level in order to provide a convenient point for the connection. The ring conductor shall be visible throughout its length. The arrangement of bonding shall be such as to avoid possible sparking.

5.12 Plant Lighting

5.12.1 The electrical installation covered by this specification shall conform to relevant Indian Standards and Codes of practices.

5.12.2 Where a number of cables are run together inside or outside the plant, the wiring shall be supported on GI / Al trays / steel structures.

5.12.3 Erection of light fittings, plug sockets etc. - Fabrication of supports for lighting fittings, sockets, junction boxes shall be done as per the relevant drawings / instructions given by the consultant / owner and same shall be grouted to walls, ceiling or welded to insert plates, steel structures etc. Insert plates on ceilings shall normally be provided. However, if required, the contractor shall, under instruction of the consultant / owner weld such supports to the reinforcement rods after exposing by chipping off concrete at no extra cost. Installation of lighting fittings includes control boxes, where supplied separately, and shall be done as per drawings. Before installation, checking of internal parts, assembly of accessories shall be done as per manufacturer's instruction / drawings.

5.12.4 The explosion-proof fittings shall be earthed through third core of the cable used for wiring. The third pin and body of 15 amps switch sockets shall be earthed similarly.

5.12.5 Installation of explosion proof equipment shall be done strictly following manufacturer's instruction or relevant Standards. Cable termination shall be done as per relevant drawings. No drilling of holes or any change in construction of equipment or part thereof shall be done.

5.12.6 Wiring for AC supply light and plugs may be fixed in the same brackets but wiring for emergency DC supply lights will be fixed separately. In a circuit controlled by one switch in Group Control Switchboard, there will be a number of points. Drawings for lighting layout give only tentative location of fittings and wiring route shall be decided in consultation with consultant / owner. Wiring of circuit shall be bunched together to the extent possible in the same route.

5.12.7 For wiring and laying of cables, Cl. 5.8 shall be referred. Cable for wiring, light points, socket outlets, shall normally be laid along wall, ceilings and structures on suitable brackets made out of M.S. / Al sheets or strips. Connections to the points in one circuit shall be taken through junction boxes. Junction boxes shall be suitably located for branching off from the circuit to the individual point. Wherever indicated, cables may be laid directly on walls, ceilings etc. by clamping on saddles.

5.12.8 Terminations shall be done in a manner as detailed in Cl. 5.9. Wherever indicated, the wire can be drawn through PVC bushings provided in the fittings. Relevant drawings may also be referred to.

5.12.9 Lamps shall be installed after installation of fittings and wirings.

5.12.10 All light fittings and corresponding control switches shall be numbered in a permanent way as instructed by consultant / owner / engineer-in-charge.

5.13 Street Lighting

In addition to the requirements stated in Clause No. 5.12, the following are also involved:

5.13.1 Excavation of earth, pouring of concrete foundations, erecting, aligning and grouting of poles.

5.13.2 Assembly of arms, fixing of lighting fittings, accessories like fuse carrier, control box etc.

5.13.3 Laying of cables directly underground as per Cl. 5.8 and connecting to Junction boxes and lighting fittings as per Cl. 5.9.

5.14 Installation of Cable Trays / Risers / Supports

5.14.1 The fabrication work shall be done as per drawings / specifications / sketches in an approved manner and to the complete satisfaction of consultant / owner / engineer-in-charge. The contractor shall take necessary care to avoid wastages. Scrap shall never exceed the permissible limit.

5.14.2 Erection of fabricated racks, risers, cable supports etc.

a) Erection of racks and risers for cable supports shall be done along the cable routes as indicated in the drawings. The contractor before erection shall check the route for any obstruction like process pipelines, structures,

equipment etc. In case obstructions are noticed, the matter shall be brought to the notice of consultant/ Owner in writing and racks shall be re-routed as per his instructions.

b) As and where indicated in the drawings, supports for racks, risers etc. shall be clamped/ welded on the steel structure, such as MS beams, pipe trestles, insert plates provided in the RCC column etc. for erection of racks.

c) Wherever indicated, supports for racks, risers, shall be grouted on walls. Racks & risers shall be installed on such supports and these shall be welded properly.

d) Opening on walls / floors shall be provided where racks / risers are crossing floors / walls.

e) Heavy channels, risers may also be grouted on the floors in addition to supports provided from walls, ceilings and steel structures.

f) As indicated in the drawings, racks and risers shall be erected either in multi-tier or single-tier formation.

5.14.3 Erection of supports in Trench

a) Supports and Hangers shall be grouted with rag bolts on the walls of prepared concrete trench. Insert plates shall be supplied by owner / consultant.

b) Pockets on walls, floors for erection of racks, etc. shall be provided where such racks, risers are crossing floors and walls. In prepared trench wall, pockets shall be provided for grouting rag bolts. But if needed the contractor shall arrange to make suitable pockets or modify pockets already provided for grouting the cable supports and/ or erection of riser, racks etc. at no extra costs.

c) Wherever insert plates are not provided, but required for support of cable rack, the contractor shall weld such plates to the reinforcement MS rods. This shall be done by chipping the concrete for exposing the reinforcement MS rods and thereafter welding the plates and making good the concrete chipping by plastering.

5.14.4 The pipes will have to be bent (wherever required) and fixed / embedded in floor, wall and ground for laying the cables. Neoprene bushes shall have to be fixed at the end of such pipes.

5.14.5 GI / Al trays of different sizes shall be cut in size and fixed on racks and risers. Supports for the main cable racks shall be provided by the owner. However, supports for small branch cable racks & risers may have to be fabricated by the contractor. Fixing of trays shall only be done after erection / welding / painting of the supports as required.

5.14.6 Erection of support frames for miscellaneous equipments, base channels for transformers and switchboards etc. shall be carried out at no extra cost.

5.14.7 Dismantling of steel fabrication and re-erecting as required by consultant/ owner/ engineer-in-charge shall have to be carried out.

5.14.8 Dismantling of cable racks and re-erecting shall have to be carried out.

6.0 GENERAL PROCEDURE FOR TESTING & COMMISSIONING

6.1 Before proceeding with the work, contractor shall fully inspect all installed Electrical Equipment for completeness, signs of damages, defects etc. and shall get all discrepancies duly recorded by Owner / Consultant, failing which no claims by the contractor shall be entertained at a later date and shall be required to make good / repair / replace the damaged components at no extra cost.

6.2 Cleaning and Regular Maintenance

Till the commissioned equipment is finally accepted by Owner / Consultant / Engineer-in-Charge, Contractor shall be responsible for regular cleaning and maintenance of all electrical equipment. The maintenance job is to be done in consultation with or on advice from the Owner / Consultant.

6.3 Testing & Commissioning Requirements

6.3.1 All works shall be carried out in accordance with the drawings, suppliers' instructions / manuals for equipment and as per relevant standards and codes of practices.

6.3.2 Before conducting test on any equipment, the contractor shall obtain permission from Owner / Consultant / engineer-in-charge and all tests shall be conducted in their presence.

6.3.3 Records / results of each test shall be recorded by the contractor immediately after the test on approved Performa and counter signed by both the contractor and the owner’s authorised representative.

6.3.4 Copies of the record shall be handed over to Owner / Consultant / engineer-in-charge.

6.3.5 The contractor shall commission all electrical equipment and carry out all pre-commissioning / commissioning tests inclusive of no-load and on-load tests on motors / generators and shall be responsible for final adjustments of relays, motors, instruments, starters, breakers etc. as per operational data supplied and as per directions of Engineer-in-Charge.

6.3.6 Painting

The contractor shall without any extra cost, touch up with paint all electrical equipment which are damaged/ scratched during testing and commissioning work. The paint used shall match exactly painted surface of the equipment on which touch up is done.

6.3.7 All terminations, cable joints, which are opened for testing purposes shall be re-terminated and re-insulated to restore their original state.

7.0 TESTING & COMMISSIONING SPECIFICATIONS

7.1 These specifications lay down the testing and commissioning procedures to be followed for each type of equipment, over and above the general requirements laid down in specifications for erection.

Manufacturer's instructions and any other instructions of consultant / owner / Statutory bodies shall also be followed by the contractor during testing and commissioning.

The contractor shall maintain and furnish the records of all equipments i.e. HT/LT panels, motors, transformers, CT, PT, relays etc. including any special test as per manufacturer's manual.

7.2 Transformers

7.2.1 The final testing shall be done in cold condition after drying out (Disconnect H.V. and L.V. side cables by removing links in disconnecting chamber, bus ducts or cables and also earth connections to neutral).

7.2.2 The insulation between windings and between winding and earth shall be measured with a motorized 2500/1100V megger. Compare the test result with the manufacturer's Test Certificates (for 11 KV windings, polarisation index to be noted). Auxiliary power cables and control wiring shall be tested with 500V megger and values shall be preferably more than 2 MΩ.

Polarization Index shall be recorded as below to determine whether drying is necessary or not:-

$$PI = \frac{IR\,10\,Min}{IR\,1\,Min}$$

Evaluation of insulation condition based	Base on PI	Drying on PI
Hazardous	< 1	Mandatory
Bad	1-1.5	Mandatory
Doubtful	1.5 - 2	Recommended
Adequate	2 - 3	No
Good	3 - 4	No
Excellent	> 4	No

7.2.3 Oil Tests

Crackle test: Cleaned Iron piece shall be heated red hot and put in the oil taken in a pot. In case of crackle sound, presence of moisture is indicated.

Dielectric strength test: It shall be carried out as prescribed in Appendix 'C' of IS: 335. The oil should withstand minimum of 40 KV for 1 minute.

Even if the oil condition after final topping up is found to be satisfactory, it is advisable that as an additional precaution, the transformers shall be dried out as per following procedures.

7.2.4 Drying out

Drying out of the transformers shall be carried out in accordance with IS: 10028 and other relevant standards / manufacturer's recommendation or as advised by consultant / owner.

a) Before drying out, check for the following:

- Any oil leakage through bushings and radiators.
- Transformer tank is connected to earth.
- Temperature indicators are suitably calibrated.
- Capillary tube connections made to respective temperature indicators.
- MOG, if provided, is working properly.

b) Precautions when drying

i) Use only Alcoholic type thermometers for temperature measurement. Mercury Thermometers shall only be used where pockets are provided for this purpose.

ii) Maximum sustained temperature shall not be more than 80^{o}C. Do not leave the transformer unattended during drying out period. Watch the transformer during drying out process and record carefully all observations viz. oil temperature winding temperature and insulation resistance of H.V. and L.V. windings.

iii) Drying out to be continued till the insulation resistance value is steady prescribed in standard code of practice and IS: 10028 Part-II and that the steady value remains constant for 12 hours. Within the above period, several samples of oil are to be tested to ascertain dielectric strength. Record all readings (hourly / half hourly as advised by consultant / owner) of insulation resistance and temperature of oil & winding. Collect samples of oil from transformers from bottom only after the oil has been allowed to settle for at least 24 hours (collection of oil will be done in accordance with code of practice).

iv) It may be desirable that transformer oil shall be filtered by using filtration machine and Breakdown Voltage shall be measured before and after the filtration. The minimum Breakdown Voltage shall be 45KV for one minute.

v) In case the insulation resistance does not improve by the above method, it may be desirable to run the transformer for few hours on short circuit applying low voltage, approximately equal to impedance voltage, to the HV side after short-circuiting the LV side. During this process take regular readings of insulation resistance of the winding to earth, winding to winding and temperature against time and record.

vi) If found necessary/ depending upon the manufacturer's recommendations, a vacuum pressure of 635 mm of mercury shall be applied for the removal of air bubbles.

vii) After drying out process, release hot air by opening vent cocks / screws. Close vent cocks and screws after release of air.

7.2.5 Ratio Test

Apply 3 phase 415 V supply on H.V. side for every tap position. Measure the voltage at L.V. side at all tap positions. Switch off supply before changing tap in case of off-load tap changer for every tap changing.

7.2.6 Polarity Test

Apply 3 phase 415 V supply to H.V. side. Join one terminal of H.V. side to corresponding terminal of L.V. side, say A-a, Measure voltage across A-a, A-b, A-c, B-a, B-b, B-c, C-a, C-b, C-c, N-a, N-b, N-c. Ascertain vector group from above test.

7.2.7 Magnetizing Current

Apply 3 phase 415 V supply to H.V. side and simultaneously measure the current readings of the three phases using low range A.C. ammeters of the same accuracy class.

7.2.8 Phasing of Transformers (for paralleling)

Connect two transformers in parallel on primary side. Connect secondary terminal ‘a’ to the bus bar which corresponds to the equivalent terminal of second transformer. Ensure that both transformers are at same tap. Then apply 415V 3-phase supply on the primary side. Close circuit breaker of second transformer. Measure voltage between corresponding secondary terminals of two transformers a1-a2, b1-b2, c1-c2. This voltage shall be zero in case both the transformers are of same polarity and phase displacement.

Use voltmeter having range double the reading of secondary voltage under test conditions.

In case of star connected secondary windings having star point earthed, secondary terminals need not be connected as stated earlier.

7.2.9 Buchholz relay testing

Insert air pressure through petcock gently till alarm contacts make. Pressurise further till trip contacts make. Check whether trip contacts make in case of low oil level.

7.2.10 Temperature indicators

Calibrate temperature indicator and test whether alarm contacts make properly.

7.2.11 Checks before commissioning

Before commissioning transformers, the following points shall be checked and ensured for safe energising of the transformer.

a) General Inspection

i) Check assembly with reference to accessories and mountings according to relevant drawing.

ii) Check tightness of all cover bolts, flange connections etc.

iii) Check oil leakage through bushings, valves etc.

iv) Check shut off/open marking of radiator valves.

b) Oil Level

i) Check for correct level in conservators.

ii) Check for oil level in disconnecting chamber & pockets for thermometers.

c) Buchholz relay

i) Check that floats are at normal position and unlocked.

ii) Check shut off valve between relay and conservator is open.

d) Breather

i) Check that protective cover on air passage removed.

ii) Check oil level in seal chamber and condition of silica gel.

e) Explosion vent

i) Check diaphragm is intact and no oil visible in gauge glass.

ii) Check equaliser pipe valve between vent and conservator open.

f) Radiator

i) Check that all valves between banks and main tank open.

g) Thermometer

i) Check CT and Heater element connection for winding temperature indicator.

h) Wiring

i) Check wiring from instruments to Marshalling Kiosk & to switchboard / control panel.

ii) Check wiring of driving mechanism and control gears for tap-changer.

iii) Check wiring of cooling fans & pump circuits.

i) HV and LV bushing & Connections

i) Clean bushing and check connections with incoming / outgoing lines etc.

ii) Check oil level in bushings (in case oil filled & HV bushings) and release air.

iii) Check & adjust gap of arcing horn (HV bushings).

j) Check & release air through screwed petcocks, cocks etc. from Main tank, Radiator banks, Buchholz relays etc.

k) Check & release air through screwed petcocks, cocks etc. from Main tank, Radiator banks, Buchholz relays etc.

l) After all checking is found O.K., the breaker for incoming of transformer shall be made ON for charging the transformer. It shall be watched for at 24 hours without load. Then it can be loaded after finding every thing O.K.

7.3 Switch Boards

7.3.1 General Checks

a) Check all auxiliary contacts of breakers for proper make-break operation.

b) If necessary, make minor adjustments to circuit breakers mechanism, auxiliary contacts etc. for proper operation of circuit breakers. Proper greasing and lubrication or mechanism must also be done before final commissioning.

c) Check for termination of control circuit wiring as per drawing and ensure that the terminals at equivalent and panel are mechanically sound.

d) Ensure proper operation of all test operation switches and push button.

e) Check wiring of all space heaters, indication lamps bells, buzzers etc.

7.3.2 Insulation resistance test

a) Measure the insulation resistance of main bus-bars (Phase to phase & Phase to earth) with 5000 V, 2500 V and 1000 V Megger (IR values shall generally be not less than 100 MΩ, 50 MΩ and 10 MΩ respectively in case of 11 KV, 6.6 / 3.3 KV & 415 V).

b) Insulation resistance of circuit breaker shall be measured with 1000 V Megger.

c) Control wiring shall be tested with 500 V Megger (IR values shall not be less than 2 MΩ).

7.3.3 High voltage Test

The test shall be conducted on switchgear rated 3.3 KV and above. Test voltage shall be as per relevant Indian Standard. However, for AC High voltage test, the value shall be twice the working voltage of the switchgear plus 1000 V. This voltage shall be maintained for one minute. Each phase shall be tested in turn, with remaining phases earthed. After high voltage test, a further Megger test shall be made to make sure that insulation resistance to earth has not altered appreciably. The reading of second megger test shall be consistent with that of the first.

AC test voltage for 1 minute duration shall be as follows:
24 KV for 11 KV panel, 15 KV for 6.6 KV panel and 8 KV for 3.3 KV panel

7.3.4 Testing of current transformer

a) Insulation resistance to earth of secondary winding shall be tested with 500V megger (remove earth connection before test).

b) Check the polarity of C.T. – Connect zero centre voltmeter in the secondary winding, connect 6 V batteries with switch in the primary. Close the switch and from the kick of the voltmeter, ascertain the polarity.

c) Ratio test shall be carried out by injecting current in the primary and subsequently secondary side current shall be checked.

7.3.5 Testing of P.T. Insulation.

Testing of HT & LT side of PT shall be done with 1000 V & 500 V megger respectively (the value shall not be less than 100 MΩ, 50 MΩ & 10 Ω, respectively for the voltage rating 11KV, 6.6KV & 400V).

7.3.6 Testing of Relays

a) Checking of wiring shall be done according to Manufacturer's drawings. Check relay continuity at all taps also ensure plug bridge contact satisfactory.

b) Secondary injection test.

Use secondary injection test set incorporating timer. Testing of all protective relays such as but not limited to over current, earth fault differential, motor protection, directional feeder protection, under voltage relays etc. shall be done as per the procedure set by the manufacturers of the relays. All time delay relays shall be tested to verify their characteristics for IDMT and instantaneous relay pick up and drop off values shall be noted at various taps. Relays shall be tested at all taps. Errors shall be calculated and compared with permissible limits specified by manufacturers. Adjustment, such as in establishing circuit, shall be done as recommended by manufacturer. After testing, relays shall be set at values given by Consultant.

c) Timer relay shall be tested and calibrated and set properly.

d) All auxiliary relays shall be tested for proper operation.

7.3.7 Testing of Instruments

All indicating and recording instruments like Ammeter, Voltage meter, KWh meter etc. shall be calibrated. Zero error of each instrument shall be corrected.

7.3.8 Operational Tests

Conduct the following operational tests after putting the circuit breaker at test and service position. Check that the fuses of proper rating are put in control circuit as per wiring diagram.

a) Close and trip the circuit breaker several times with power or manually. In case of motor operated spring charged closing mechanism, check the operation of charging motor. Ensure that it cuts in / off properly.

b) Check the indication scheme: 'ON', 'OFF', trip circuit healthy, auto-trip indication etc.

c) Trip the breaker by operating the protective relays (operate contact manually).

d) Check the trip free feature.

e) Check the anti-pumping feature.

f) Check operation of voltage selector relay scheme for supply.

g) Check annunciation scheme for AC/DC power supply failure.

7.4 Motor Control Centres / Power & Motor Control Centres

In addition to checks and tests (wherever applicable) detailed under Clause No. 7.3 above, the following shall also be carried out:

7.4.1 Insulation resistance test of the main bus bars, starter units control wiring etc. shall be done with 500 V megger.

7.4.2 Each motor starter shall be tested for correct operation. All operational tests to verify sequence of operation, inter-locking and alarm indication schemes (by simulating the connection) shall be done.

7.4.3 Bi-metallic type thermal over load relay shall be tested at different settings. Current shall be injected through the thermal elements (three elements can be connected in series) at twice and thrice the set value and tripping time shall be noted. The values shall be compared with the data supplied by manufacturer.

7.4.4 Single-phase prevention relays shall be tested for proper operation.

7.4.5 Check that fuses of specified ratings are put in various outlets.

7.5 Soft Starter Panel

In addition to the procedure laid above in Clause Nos. 7.3 & 7.4, any other instruction given by the manufacturer shall also be followed.

7.6 Panelled Equipments

These include relay and alarm panels, Rectifier panels, Battery charger panels DC / AC distribution boards, conveyors / control cum power supply panels, UPS, inverter static power supply, Variable Frequency Drive and PLC. Details shall be indicated in project specific Schedule of Rates.

7.6.1 Test insulation resistance with 500 V megger.

7.6.2 All operational tests to verify function of each component like relays, switches etc. and sequence of operation, interlock, alarm system as per circuit diagram.

7.6.3 Invertors / Thyristor controlled panels, static power supply system units, Variable Frequency Drive and PLC panels shall be tested as per the instructions of manufacturer.

7.7 Cables

7.7.1 All HT (11KV, 6.6KV & 3.3KV) cables shall be tested for insulation resistance with 5KV / 2.5KV motorized meggers and LT cables shall be tested for insulation resistance with 1000 V megger before and after termination. IR shall be measured between phases and between phase and earth. The voltage shall be applied for 1 minute.

7.7.2 All the 3.3KV, 6.6 KV and 11 KV cable joints shall be tested on high voltage as per IS: 1255 after making all termination and joints followed by IR test.

7.8 Lighting

7.8.1 Before energising any lighting circuit, the IR values (phase/ phase and phase/ earth) shall be recorded for entire wiring installation. The testing shall be done with 500 V megger. After switching on the power supply, load of each circuit shall be measured.

7.8.2 Illumination levels shall be tested and same shall not be less than the levels mentioned below for specific areas, unless otherwise specified elsewhere:

a)	Control room, Laboratory	:	500 Lux
b)	Office area / operators / UPS room	:	300 Lux
c)	Switchgear room	:	200 Lux
d)	Cable cellar	:	70 Lux
e)	General process area	:	60 Lux
f)	Cooling tower	:	60 Lux
g)	Battery room	:	150 Lux
h)	Compressor area	:	150 Lux
i)	Pump house, sheds	:	100 Lux
j)	Loading areas and staircases	:	60 Lux
k)	Roads and tank farm	:	10 Lux

7.9 Earthing

The continuity of earthing and resistance of each earth pit and grid shall be measured with earth megger. The resistance of grid connecting all earth pits shall be less than one ohm.

7.10 Miscellaneous Equipment

Under this are included, exhaust fans, blowers, limit switches, vibrators, electro-magnets, air pressurisation unit etc. The following tests shall be conducted:

7.10.1 Measurement of insulation resistance

7.10.2 Check up the direction of rotation.

7.10.3 Operational test

7.11 Motors / Generators

7.11.1 General Checks

a) Check the alignment of motor/generator with the driven equipment/prime mover.

b) Check and calibrate motors/generators, safety switches, bearings/ air temperature indicators, winding temperature indicators, water flow/ air flow pressure meters, lubricating oil pump motors.

c) Check operation of space heaters.

d) For motor/generator standing idle for a long time, carry out overhauling, re greasing and drying.

7.11.2 Check the condition of grease in bearings and if required replace completely with fresh grease after proper cleaning of bearings. This work shall preferably be taken up before final alignment of motor with driven equipment.

7.11.3 In case of oil lubricated bearings, the bearing housing shall be flushed with oil and then filled up to the specified level. Check that oil ring rotates freely along with motor. In case of pedestal type journal bearing, it may be necessary to open the top cover, and check the bearings.

7.11.4 Fix up all accessories like techno-generators, water pressure relay, temperature detectors and any other safety switches after calibration.

7.11.5 Check that the shaft rotates freely. This shall be done after decoupling the motor from driven equipment.

7.11.6 Check air gap between rotor and stator (wherever possible) at three places at 120^{o} apart on both sides of drive and verify with the figures furnished by the manufacturers. The variation shall not exceed 10% of average value.

7.11.7 Check the tightness of foundation bolts. Ensure pins are fitted before commissioning of motor.

7.11.8 Check that power and control cables are properly connected and tightened. All earth connections of the machine shall be checked.

7.11.9 In case of forced ventilated motor, clean the ventilation duct. Ensure that recommended flow and pressure of air is available to produce the required cooling effect. If the motor is provided with air to water heat exchanger, check for the adequate flow of water. If necessary, clean the exchanger to remove any obstruction to water flow. Check that there is no leakage from water cooler, pipe connections.

7.11.10 Check the space heater circuit. Space heaters shall be provided on all HT and special type LT motors. Switch on spare heater supply at least one week before the commissioning of motor. Wherever drain plugs are provided in motor body, open and check for water accumulation inside motor.

7.11.11 Testing

a) Insulation Resistance Test

The insulation resistance of LT motors shall be measured between the winding of the machine and its frame by means of 500 / 1000V megger. A minimum value of 1 MΩ for 400 V motors shall be considered a safe value.
3.3KV, 6.6KV and 11KV motors / generators shall be tested for insulation by 1000 5000 V megger and its value shall not be less than 1 MΩ for each KV. However, it is desirable that before commissioning the motors, the insulation resistance shall be improved substantially above the lower limits. The contractor shall carry out heating of winding as per the advice of the consultant/Owner. The following methods may be adopted.

b) Drying

i) Blowing hot air

ii) Placing heater or lamps around and inside, in case of small motors after making suitable guarding and covering arrangement so as to conserve that heat.

iii) Heating by injecting low voltage in the winding low voltage output of welding set shall be used. The winding shall be inter-connected so that current flows through each phase, and particular care shall be exercised to prevent local over heating. The voltage applied shall be suitably adjusted. The maximum temperature of winding, while drying, shall be 70^{o} to 80^{o}C by thermometer or 90o to 95^{o}C by resistance method. Heating shall be done slowly first till steady temperature of winding is reached (may be within 4 to 8 hours depending upon size of motor) once the steady temperature is reached, maintain it for some time.

iv) Check the insulation resistance which will drop first and then become steady. Hourly reading of IR shall be taken and temperature shall be recorded 1/2 hourly. If IR is reasonably steady, supply can be switched off. Measure IR under cold condition. Never keep the motor unattended during drying process.

v) For checking polarisation index of HT motor, use electric driven megger. Note IR value after 1 minute and 10 minutes. The ratio shall be compared with data supplied by manufacturer (but shall be not less than 2.5).

7.11.12 Operational Test

a) Check control gear and set the protective relays as per settings supplied by Consultant. It is preferable that before first no-load run, the settings may be kept lower than 100%. However, during load running, settings shall be restored to Normal. Simulation test shall be conducted on motor starter, circuit breaker (main fuses removed on CB at test position). All interlock shall be incorporated in the control system. Testing shall be done from local and remove control station and shall be ensured that the control system works satisfactorily. In case of any defect in the integrated control wiring the contractor shall locate and rectify such defects.

b) Any other tests recommended by the manufacturer for special type equipment like variable speed motors etc. shall be done.

7.11.13 No-load Test

Finally the motor shall be started on no load after decoupling. Check the direction of rotation and change if required. The motor shall be run for 8 to 10 hours. Voltage, starting current, and starting time shall be noted. Hourly reading of current, winding and bearing temperature, (for small motors body temperature to be measured by thermometer) shall be noted. Note vibration, excessive noise if any.

In case of variable speed motor, variation of speed shall be checked and regulation of speed noted.

7.11.14 After switching off the motor, the insulation resistance shall be measured under hot and cold condition.

7.11.15 If the no-load trial run is found satisfactory, the motor shall be run on load after adjusting the protective relay setting to 100% value. Note the starting time, load current, winding temperature etc. The temperature rise shall not be more than the specified value. Check for any excessive vibration or noise.

7.11.16 Generator shall be tested in the presence of manufacturer's representative only as per their instructions.

8.0 DOCUMENTATION

8.1 For the purpose of completion certificate, the following documents will be deemed to form completion document:

i) The technical documents according to which the work was carried out.

ii) Final check-list and completion report.

8.2 Three sets of construction drawings showing therein the modifications and correction made during the course of execution signed by Owner/ Consultant/ Engineer-in-charge.

8.3 Test certificates for the materials purchased by Contractor.

8.4 Material appropriation statement for the materials issued by Owner for the works and list of surplus materials returned to Owner's stores duly supported by necessary documents.

8.5 No claim certificate by the Contractor certifying that the entire work done by him under the contract has been measured and accepted for the final bill to his satisfaction and that he will have no claim(s) concerning any work(s) or part thereof performed by him under the Contract, to Owner except otherwise indicated in the final bill.

8.6 The completion certification shall be issued by Owner within 30 days of the Contractor furnishing documents listed in this clause jointly certified by Owner/ Consultant and Contractor's Site Engineer.

9.0 HANDING OVER TO OWNER

9.1 The contractor shall hand over the complete installation as a whole. Minor details not specified or mentioned in the scope or schedule of rates but required to complete the job as a whole will have to be done by the contractor without extra cost. Any equipment/ installation shall not be deemed as handed over to Owner until the same is complete in all respect and is accepted in writing by the Owner/Consultant.

9.2 The final acceptance of the work shall be after the demonstration of guarantees by the Contractor and Owner shall issue the final acceptance/ taking over certificate upon fulfilment of the guarantees.

10.0 OBLIGATIONS & RESPONSIBILITIES OF CONTRACTOR

The contractor's obligations and responsibilities shall include but not limited to the following:

10.1 To deploy skilled, semi skilled and unskilled personnel in requisite numbers and as per scheduled programme so as to complete the WORK as per overall project schedule.

10.2 To deploy suitably qualified supervisors and engineers in requisite numbers to assure execution of good quality job as per best engineering practices and to the full satisfaction of Owner / Consultants / Engineer-in-charge.

10.3 To prepare detailed planning and execution schedule considering the availability of fronts and materials. This shall be reviewed by Owner & consultant and Contractor shall be required to keep updating the same (as per the instructions of Owner / Consultant / Engineer-in-charge) to take care of any changes in the availability of fronts and materials and to complete all jobs as per the overall project schedule. Owner / Consultant / Engineer-in-charge shall in no way be held responsible for such changes because such changes are deemed quite a common feature in any project of this size.

10.4 To check for quantity compliance between bill of materials and drawings for cable, structural, earthing materials etc. and intimate Owner / Consultant / Engineer-in-charge sufficiently in advance regarding discrepancies, if any.

10.5 Construction power shall be made available at one point. Arrangement for distributing the same to various areas for construction shall be the contractor's responsibility.

10.6 To arrange and supply all tools and tackles, consumables, instruments, erection materials & machineries etc. for handling erection, testing & commissioning of

complete electrical installation. List of major tools and tackles required are as listed below:

i. Cranes, winches, chain pulley blocks etc. in required quantity and of suitable capacity.

ii. Trailers with prime mover/Tractor trailers.

iii. D-Shackles, slings, wire ropes etc.

iv. Transformer welding sets

v. Water level, spirit level etc. for levelling and alignment.

vi. Gas cutting sets

vii. Drilling/Grinding machines

viii. Jacks with spindles (for cable drums)

ix. Pipe bending machine

x. Hydraulic crimping tools set

xi. Hand crimping tools set

xii. Air blower/vacuum cleaner

xiii. Streamline transformer oil filtration machine with temperature and pressure gauges.

xiv. Transformer oil dielectric strength testing machine, portable type.

xv. High voltage testing set.

xvi. Secondary injection testing set

xvii. 5 KV motorised Megger Insulation tester

xviii. 500 V to 2.5 KV each rating hand operated ‘Megger’ Insulation tester

xix. Earth resistance tester with leads and spikes

xx. Clip on ammeters/tong testers

xxi. Tachometers/ Tacho-generators (for RPM checking)

xxii. Phase sequence meter

xxiii. Primary injection set up to 2000 amps., if required

xxiv. Grease gun for greasing of motors

xxv. Wooden sleepers of proper size and in adequate numbers.

xxvi. Scaffolding materials as required.

xxvii. Any other tools and tackles and facilities required completing all the jobs as per ITB to the best engineering practices.

xxviii. Drilling M/C for drilling hole in RCC Roof/ Column for grouting expansion bolts.

xxix. DG set for construction power

10.7 To arrange and supply all consumables (required for executing the under question) such as but not limited to the following in sufficient quantity, of required quality and in time to meet the schedules:

Electrodes, filler wires, industrial gases, such as oxygen, acetylene, diesel, petrol, kerosene, CTC, standard grease/ lubricant for motor bearings, insulating tapes, compounds, solders, fluxes, rawl plugs, phil plugs, saddles & bars, ferrules, bricks, sand, cement, stone chips, clamps, tags, shims, hard wares, paints, thinners (as required), salt and charcoal (for each electrode pits), copper lugs for GI earth wires, cotton waste, marking cloth, sand papers, emery papers, thread, nylon ropes.

10.8 To arrange and supply storage tanks for drinking water so as to avoid any inconvenience that may be caused due to interruption in water supply at times.

10.9 To provide proper storage and security arrangements for Contractor's tools, tackles, equipments, materials etc. as well as equipment and materials issued by Owner/ Consultant to Contractor. Owner/ Consultant shall not be responsible for any loss or damage to items in the custody of Contractor at site for any reason whatsoever.

10.10 Completion of all repairs arising out of defective work done by Contractor Owner/ Consultant / Engineer-in-charge may at his discretion require the Contractor to rectify certain defects in materials caused due to bad workmanship of supplier and/or during transportation. For such work of course, the payment modalities shall be settled by mutual agreement before starting such rectification jobs.

10.11 To maintain all the records for men, materials and execution of job as required by law as well as Owner / Consultant / Engineer-in-charge.

10.12 To get his work inspected by Owner / Engineer-in-charge and approved from statutory agencies such as but not limited to Electrical Inspector, Factory Inspector etc.

All co-ordination with Statutory Authorities shall be contractor’s responsibility. Only statutory fee required for approval shall be paid by the owner.

10.13 To make arrangements for services such as transport, medical, lighting, canteen etc. for working round the clock.

10.14 In addition to safety regulations indicated in this enquiry Owner / Consultant / Engineer-in-charge may issue certain safety directives, which shall have to be followed meticulously without any reservation.

10.15 To undertake and execute work and supply as per scope of work, scope of supply, to follow Technical Conditions including specification for electrical erection, specification for electrical testing and commissioning and as per schedule of rates. In honour all other obligations listed in other sections and sub-sections of this enquiry.

10.16 Reconciliation of materials issued to Contractor as directed by Owner / Consultant / Engineer-in-charge.

10.17 Handing over of the completed works to Owner / Consultant / Engineer-in-charge as per procedure laid down by Consultant.

10.18 To submit documentation forming part of request for issue of completion certificate.

10.19 Clearing the site after cleaning the areas where the Contractor executed the job, stored the materials and built his office, fabrication shop etc.

11.0 TERMS AND CONDITIONS

11.1 All the work shall be carried out in accordance with drawings supplied to the contractor and the entire installation shall conform to the Indian Electricity Rules/ Regulations/ Acts and with latest issue of relevant IS, Specifications, drawings & documents supplied by Consultant/ Supplier/ Owner and as per the directions of Owner / Consultant / Engineer-in-charge.

11.2 Contractor's Staff

The contractor shall employ all skilled, semi-skilled, non-skilled labourers necessary for erection, installation testing and commissioning. All electricians, cable jointer, wire man and others employed by the contractor shall be suitably qualified and must possess valid certificates / licences recognised by the competent authorities.

Engineer-in-charge at his own discretion may put any electrician / wireman / wire cable jointer to test for ascertaining the competence of the technician concerned and the contractor shall have to replace any staff found incompetent to execute the jobs as per requirements, in the opinion of the Owner / Consultant / Engineer-in-charge. The contractor shall also furnish a list of such staff and indicating whether he holds such competence certificate to supervise electrical installation jobs as required under Indian Electricity Rules and Regulations, and State Inspectorate Rules.

11.3 Contractor's Workshop

The Contractor shall set up his own workshop having facilities to undertake all jobs connected with, Erection, Testing and Commissioning. He shall provide all facilities at site to undertake steel fabrication work e.g. fabrication of cable racks/ trays, cable supports/brackets/ frameworks/ base frames for electrical equipment etc.

The contractor will be required to provide workshop and other facilities to undertake minor fabrication work, including conduit bending and threading, fixing rawl plugs, welding supports, making brackets, small foundation bolts, protective guards, and such other miscellaneous items as may be necessary for completing the erection, testing and commissioning jobs. The contractor shall also, on his

own, set up adequate office, stores, godowns etc. for his work in the area / space provided by the Owner / Consultant / Engineer-in-charge.

11.4 **Tools and Tackles**

The contractor shall have to arrange all tools, tackles including various erection machineries and instruments for measuring, testing, calibrating etc. required for erection as well as for Testing and commissioning on his own, such as compressors, cranes, winches, jacks, chain pulley blocks, welding sets, oxygen, acetylene gas cutting set, drilling machines, grinders, pipe bending machines, dies for pipe threading, scaffolding materials, cable jointing/ crimping tools, megger, ductor, filtering machines, earth tester, secondary injection sets, sub-standard meters for calibration of ammeters, voltmeter, oil testing-sets, Multi meters, phase sequence meters, HT test set, primary injection (if required), clip on ammeters (tong testers), techo-generators etc.

11.5 **Materials**

11.5.1 All materials shall be in contractor's scope of supply, unless indicated to be supplied by Owner. The contractor shall have to arrange at his own expenses all consumables required by him for erection as well as for testing and commissioning like Kerosene oil, petrol, CTC, grease, petroleum jelly, rawl plug, phil plug, screws/nails, wires for portable tools, lights, plugs, cotton waste, jute dusters, shims for alignment / levelling, cement, sand, stone chips, bricks, reinforcement rods, welding electrodes paint, insulating taps, compounds, solders fluxes, ferrules, nut bolts, washers, cable clamps, cable tags and such other materials contractor might need to execute the complete job. The contractor might need to execute the complete job. The contractor shall also provide foundation bolts, for all floor/ wall mounting equipment as per requirement at site. All hard wares supplied by the contractor shall be of GI. All GI materials shall have a minimum zinc coating of 800 g/m^2 at any point on the surface.

11.5.2 All equipment and materials including Instruments / meters required for measuring, checking, testing and commissioning are included in the scope of the contractor and shall be arranged and supplied by the contractor himself

11.6 **Inspection**

11.6.1 Electrical Installation work shall be subject to inspection by Owner's/ Consultant's engineers, statutory bodies like Electrical Inspector, Factory Inspector, and wherever applicable by equipment supplier's engineer. The contractor shall carry our without extra cost all damages/rectification/modification desired by the above engineers/ inspectors or to make the installation conform to relevant Electricity Rules etc.

11.6.2 Further the Owner/ Consultant may reject any portion of the work considered defective or of poor workmanship and contractor shall make good these defects without extra cost.

11.6.3 Owner/ Consultant reserves the right to get such repairs/replacements done from any other agencies in case the contractor fails to do the job within a period of 7 days after the request has been made to him in writing and the cost of such alteration/ repair/ testing shall be recovered from the contractor and will be adjusted against any bill due to the contractor.

11.7 Completion of work

Work shall be deemed to be incomplete until such certificates as required under statutory regulations are obtained and delivered to Owner / Consultant / Engineer-in-charge.

11.8 Clearing of Site

The contractor will be responsible for the final clearing of site after completion of erection works as well as after completion of jobs connected with testing and commissioning. He will return all excess materials such as cables, earthing materials etc. to the Stores under instructions from Owner / Consultant / Engineer-in-charge. All empty cable drums, packing materials, cut-pieces of cables, steel scraps, and other materials, supplied by Owner for the job shall be shifted to a suitable place by contractor as per instruction of Owner / Consultant / Engineer-in-charge. Contractor will also be responsible for demolition and clearance of temporary sheds and structures put up by him.
All clearance of unwanted materials shall regularly be done as per advice of the Owner / Consultant / Engineer-in-charge.

11.9 Materials utilisation statement and permissible wastage

After completion of the erection, the contractor shall submit to the Owner / Consultant a statement giving details of materials drawn from stores and quantity used in erection, balance quantity returned to stores and quantity of scraps for his checking & approval.

The scraps of steel shall not be more than 2% of total quantity used for erection. For cables, the quantity of scrap allowable is as follows:

a) 11 KV and 6.6 KV cables : 1% of actual quantity laid
b) 1000 volts & below grade power and control cables : 2% of actual quantity laid
c) Lighting cables only : 3% of actual quantity laid

Any cable cut piece less than 5 mtrs. and structural steel less than 1 mtr. shall be considered as scrap.

11.10 Civil Foundation

Owner / Consultant will give necessary civil foundations ready complete with location of foundation bolts, sleeves etc. before the contractor is expected to commence his work. Minor rectifications and chipping etc. may, however, have to be carried out by the contractor, if found necessary while grouting the foundation bolts. Contractor shall check the foundations cleared by other agency; Owner /

Consultant shall not be responsible for any delay. But all concrete cutting and chipping work necessary for fixing and grouting of base channels for switchgear and control panels will have to be done by the contractor.

12.0 MEASUREMENT

12.1 For all payment purposes, the measurement will be based on physical measurement. Wherever it is not possible to take physical measurement, payment shall be made on the basis of drawing. The contractor in the presence of Owner/ Consultant/ Engineer-in-charge will take physical measurement.

12.2 Measurement of weight / length / area / volume will be in metric system corrected to nearest kilogram / centimetre / square centimetre / cubic centimetre.

12.3 For structural steel works measurement and payment will be made on weight basis.

12.4 Measurement for cable laying shall be made on the basis of length actually laid between end terminations including that of loops provided and paid accordingly.

13.0 PRIOR APPROVAL OF THE MATERIAL TO BE SUPPLIED BY CONTRACTOR

All items to be supplied by the contractor shall be of superior quality and shall be of approved make. These shall be as per specifications and conforming to relevant Standards.

14.0 RECOVERY AGAINST OWNER'S UN-RECONCILED MATERIALS

The contractor shall be responsible for material utilisation statement. Any equipments or materials not reconciled shall be charged back to the contractor.

15.0 STATUTORY APPROVALS

All co-ordination at site with statutory authorities (including inspection of completed WORKS from statutory authorities) shall be in the scope of CONTRACTOR. Only statutory fees deposited by CONTRACTOR for approval of installations and works shall be reimbursed to the CONTRACTOR on production of documentary evidence.

16.0 GUIDELINES FOR SAFETY MEASURES

Requirement of electrical power for any construction activity is of prime importance. The utilization of power in any construction site shall be done with utmost care to avoid accidents due to electrical shocks, fire due to electrical short circuits. Electrical installation increase the risk of such accidents, if it is exposed to adverse environmental conditions i.e. presence of hazardous gases. Hence, it is absolutely essential to take extra precaution for such installation to ensure safety of personnel and equipments.

This standard gives details of required safety measures to be adopted for the electrical installations by all contractors during construction activities. Following are some general guidelines & check points that should be followed:

16.1 All electrical connections for electrical installations shall be carried out as per provisions of the followings latest codes and standards in addition to the requirements of statutory authorities and IE rules:

OISD – STD – 173 : Fire prevention and protection system for electrical installations

IS – 30 : National electric code

16.2 All electrical connections shall be done by a competent electrician having valid license and to the satisfaction of Engineer-in-charge and one competent licensed electrician shall be made available by contractor at site round the clock to attend the normal / emergency jobs.

16.3 All necessary personal protective equipment (PPE), Safety equipment shall be made available to use for persons employed by the contractors on the site and shall be maintained in condition suitable for immediate use. Protective equipment for head protection, body protection, eye protection, hand protection, hearing protection & respiratory protection shall be made available by the contractor. No loose clothing shall be allowed.

16.4 When workers are employed on electrical installations, adequate safety items / charts viz. fire extinguishers, insulating mats, hand gloves, multilingual (English, Hindi & local languages) caution boards, shock treatment charts and instruction plate containing location of isolation point for incoming supply, name and telephone number of contact person in emergency shall be provided in substation and near all distribution boards / local panels. The workers shall not wear any rings, watches & carry keys or other materials, which are good conductors of electricity.

16.5 When work has to be done on elevated places, towers, roofs, pipe racks & other lofty positions where plat-forms & other fall guards are not there, use of SAFETY BELT is compulsory. Safety Nets will prove very helpful in case somebody slipped from height.

16.6 All welding machines and switchboards shall be kept in well-ventilated and covered shed. The shed shall be elevated to avoid water logging. Use of flammable material shall be prohibited for construction shed; also flammable material shall not be stored in and around electrical equipments. Adequate clearance and operational space shall be provided around the equipment.

16.7 No work, however, small should be undertaken / started without obtaining valid work permit from the concerned department. Confined space entry should be done only by valid entry permit from the Engineer-in-charge. Safety permit shall be obtained before taking the temporary electrical equipment inside the hazardous area.

16.8 No work must be carried out on any live equipment. Electrical equipment should be considered live unless it is ensured that they are isolated & made dead / safe. A 'permit-to-work' shall be issued before any work is carried out. Don't tamper with any type of electric switches / equipments or any other appliances or moving machinery installed in factory area without permission.

16.9 Before the contractor connects any electrical appliance to any plug / socket belonging to the other contractor / owner, he shall:

i) Indicate to the Engineer-in-charge that the appliance is in good working condition.

ii) Inform the Engineer-in-charge of the maximum current rating, voltage and phase of appliance.

iii) Obtain the permission of the owner dealing the sockets to which the appliance may be conducted.

16.10 The Engineer-in-charge shall not grant permission to plug-in until he is satisfied that:

i) The appliance is in good working condition and is fitted with a suitable plug.

ii) The appliance is fitted with a suitable cable having earth conductors.

16.11 All temporary installation shall be tested before energizing to ensure proper earthing, bonding and suitability of protection system and adequacy of feeders / cables.

16.12 Voltage for all portable equipment viz. drilling machine, temporary lighting etc. will not exceed 240 volts.

16.13 Earth leakage device shall be checked for operation regularly by temporarily connecting the series lamps. The operating current of earth leakage device shall not exceed 30mA.

16.14 All the electrical equipments should be properly earthed as per Indian Electricity Rules.

16.15 Use of hoisting machines & tackle including their attachments, anchorage & supports shall be good of mechanical construction, sound materials & adequate strength & free from patent defect & shall be kept in good condition & in good working order.

16.16 No welding / grinding / cutting / soldering or open flare / fire etc. should be done without valid safety permit issued by the Engineer-In-charge. While welding / grinding / cutting make sure that sparks & molten slag etc. don't fly or come into contact with combustible materials surrounding equipments, valves etc. i.e. make provision for collection of sparks by using 'Fire Blankets'.

16.17 Use of SAFETY APPLIANCES like safety goggles, canvas hand gloves, welding helmet, chrome-leather hand gloves, safety shoes, etc. during welding/ chipping/ grinding should be enforced.

16.18 The following design features shall be ensured for all electrical installation during construction phase:

i) Each installation shall have a main switch with a protective device, installed in enclosure adjacent to the metering point. The operating height of the main switch shall not exceed 1.5M. The main switch shall be connected to the point of supply by means of armoured cables.

ii) The out going feeders shall be double or triple pole switch with fuses / MCB. Loads connected to three phase circuit shall be balanced as far as possible and load on neutral shall not exceed 20% of load in the phase.

iii) The installation shall be provided adequate protection against overload, short circuit and earth leakage by using suitable protective devices. Fuses wherever required, shall be of HRC type only. Use of rewireable fuses shall be strictly prohibited.

iv) Connections to the welding receptacles / hand tools shall be taken through proper switches, sockets and plugs.

v) It shall be ensured that all single phase sockets shall be 3-pin type only and all unused sockets shall be provided with socket caps.

vi) Contractor shall use 3 core (P+N+E) overall sheath flexible cables with minimum conductor size of 1.5 sq. mm. copper for all hand tools.

vii) Metallic distribution boxes with double earthing shall be used only at site. No wooden boxes shall be used.

viii) It shall be ensured that cables to be used for installation purpose shall be free from insulation damage.

ix) An independent earthing facility should preferably be provided within the temporary premises.

x) For local earthing, separate earth electrodes shall be installed near the supply point and earth continuity wire shall be connected to local earth plate for further distribution to various appliances. All insulated wires for earthing shall have insulation of green colour.

xi) It shall be ensured that structures shall not be used as a neutral. Separate core shall be provided for neutral earth.

xii) ON / OFF position of all switches shall be clearly marked / painted for easy isolation in emergency.

16.19 Don’t check gas leaks with lighter, matches or other flame. Always keep gas cylinders away from direct rays of sun, hot place, welding, grinding & cutting sparks. Valves on cylinders should not be lubricated. Gas cylinders should be kept away from work place & Acetylene cylinders should be kept vertical. Cylinder should not be rolled on roads for transportation from stores or one place to another place, use suitable handcart for the purpose. It is prohibited to carry gas cylinder up-stair in the plant or in-side the vessel or confined spaces for cutting / welding job.

16.20 Permission of a supervisor before any excavation is a must. Also the presence of underground electric cables or any pipelines must be taken care of during

excavation. Excavated earth must not be dumped within five feet. The further the better.

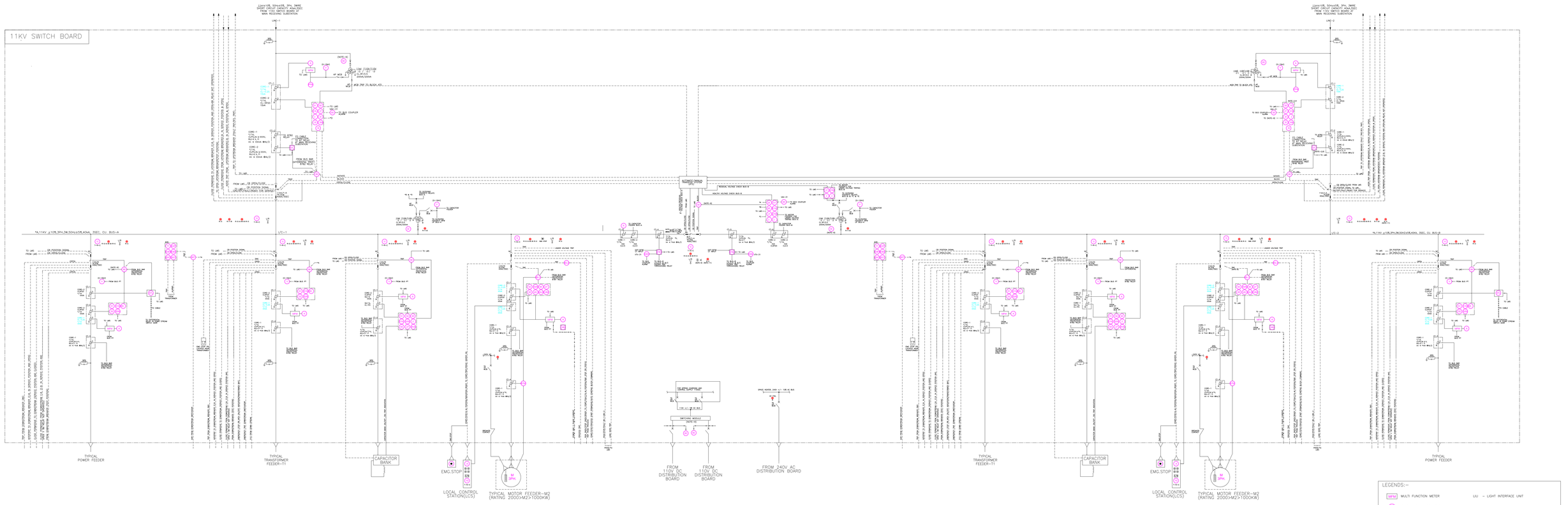
16.21 All the sewers or openings / cut-outs should be kept covered to avoid pit falls. Red illuminated signal should be displayed so that nobody goes near the pit / opening during dark hours. Proper approaches / scaffoldings / ladders etc. must be provided to avoid falls.

16.22 Be careful to keep all aisles, passageways and stairways clean & unobstructed. All discarded metal & other scrap should be collected. Storage area for keeping equipments, machines & other raw materials should be isolated & properly protected. Combustible materials like wooden pieces, cotton waste, bags etc. should be immediately removed to safe places.

16.23 Sitting or walking on rail tracks, crossing between wagons, taking rest under stabled wagons, crossing the rail through the openings underneath the stationary wagons shall be strictly prohibited. Standing under a suspended load is very dangerous. It may slip & fall on you thereby causing serious injury & even death.

16.24 Hands should be thoroughly washed before touching anything that goes in your mouth. All concerned personnel at site should maintain a high standard of 'Cleanliness'. Smoking & carrying matchbox, cigarettes, lighter, bidis etc. shall be prohibited.

16.25 Unauthorized entry into any battery limit of plant shall be strictly prohibited. Reckless driving or other non-observance of traffic safety rules shall result into withdrawal of permission to carry vehicles in side factory.



THIS IS CONCEPTUAL SLD. DETAILS SLD SHALL BE PREPARED BY BIDDER & SUBMITTED WITH BID

LEGENDS:–

MFM	MULTI FUNCTION METER	LIU	– LIGHT INTERFACE UNIT
51	IDMTL OVER CURRENT RELAY	LMS	– LOAD MANAGEMENT SYSTEM
51N	IDMT EARTH FAULT RELAY	RTCC	– REMOTE TAP CHANGE CONTROL
VS	TRIP CIRCUIT SUPERVISION RELAY	ES	– EARTH SWITCH
27	UNDER VOLTAGE RELAY	ICOG. PNL.	– INCOMING CUM OUTGOING PANEL
T	TIMER	NGR	– NEUTRAL GROUNDING RESISTER
25	SYNCHRO CHECK RELAY	VC	– VACUUM SENSOR RELAY
87L	LINE DIFFERENTIAL RELAY	VSR	– VOLTAGE SENSOR RELAY
87M	DIFFERENTIAL MOTOR PROT	ABT	– AVAILABILITY BASED TARIFF
67	DIRECTIONAL OVER CURRENT RELAY	V	VOLTMETER ALONG WITH VSS
51G	BACKUP EARTH FAULT RELAY	A	AMMETER ALONG WITH ASS
86	LOCK OUT RELAY	PFM	POWER FACTOR METER
10	TNC SWITCH		SURGE PROTECTION DEVICE
71	OIL LEVEL INDICATOR WITH CONTACTS		
63P	PRESSURE RELIEF DIAPHRAGM		
49W	TEMP. RELAY FOR WINDING		
49O	TEMP. RELAY FOR OIL		
86T	LOCK OUT RELAY(HAND RESET)–TRANSFORMER		
50	INSTANT. OVER CURRENT		
50N	INSTANT. OVER CURRENT GROUND FAULT RELAY CONNECTED IN RESIDUAL WAY		
59	OVER VOLTAGE RELAY		
80	DC SUPPLY FAILURE		
27M	UNDER VOLTAGE RELAY TO INITATE MOTOR FOR TRIP		
60	VT FAILURE		
81R	RATE OF CHANGE OF FREQUENCY		

NOTE:–

1. COMMUNICATION PROTOCOL SHALL BE AS FOLLOWS:–
   a. NUMERICAL RELAY–IEC61850
   b. MULTIFUNCTION METER (MFM)–MODBUS
2. AUTO CHANGE OVER LOGIC BETWEEN INCOMERS AND BUS COUPLER SHALL BE DEVELOPED IN NUMERICAL RELAY
3. COMMANDS/INDICATION TO/FROM LMS SHOWN IN SLD ARE INDICATIVE.
4. TNC SWITCH SHALL BE ABLE TO CLOSE ONLY IN TEST POSITION FOR ALL MOTOR FEEDERS
5. FOLLOWING MINIMUM METERING SHALL BE PROVIDED ON MULTIFUNCTION METER :–
   –3 PHASE CURRENT
   –LINE VOLTAGES
   –POWER FACTOR & FREQUENCY
   –KW,KVAR,KVA,KWH, & KVARH
   –HOUR RUN (ONLY FOR MOTOR FEEDER)
6. COMMON ALARM CIRCUIT FOR HOOTER & BUZZER SHALL BE PROVIDED IN BUS COUPLER.
7. LAMP TEST PUSH BUTTON SHALL BE PROVIDED.
8. ALL RELAYS SHALL BE NUMERICAL TYPE UNLESS SPECIFICALLY MENTIONED IN SLD AND EXCEPT THE FOLLOWING:–
   –PT FUSE FAILURE RELAY(60)
   –AC/DC SUPPLY SUPERVISION RELAY (80)
   –TRANSFORMER LOCKOUT RELAY (86T)
   –TRIP CIRCUIT SUPERVISION RELAY (95)
   –BUS BAR DIFFERENTIAL SUPERVISION RELAY (95B1 & 95B2)
   –MOTOR FEEDER
   86–1 FOR ELECTRICAL TRIP (HAND RESET)
   86–2 FOR PROCESS TRIP (SELF RESET)
   –ALL FEEDER
   86 ELECTRICAL TRIP (HAND RESET)
9. SIGNALS/INDICATIONS TO/FROM DCS SHOWN INN SLD ARE INDICATIVE. AND SHALL BE CONFIRMED DURING DETAIL ENG.
10. CIRCUIT BREAKER 'ON' , 'OFF' INDICATION SHALL BE PROVIDED AT THE BACK OF EACH PANEL. ALTERNATIVELY ALARM SHALL BE PROVIDED IN CASE PANEL BACK DOOR IS OPENED WITH BREAKER 'ON'.

REV.	DATE	DESCRIPTION	PPD.	CKD.	APPD.
0	30.07.21	ISSUED FOR TENDER	SS	RK	SKB

CLIENT:– TALCHER FERTILIZER LIMITED

REV. 0

SHEET 1 OF 1

SCALE: N.T.S.

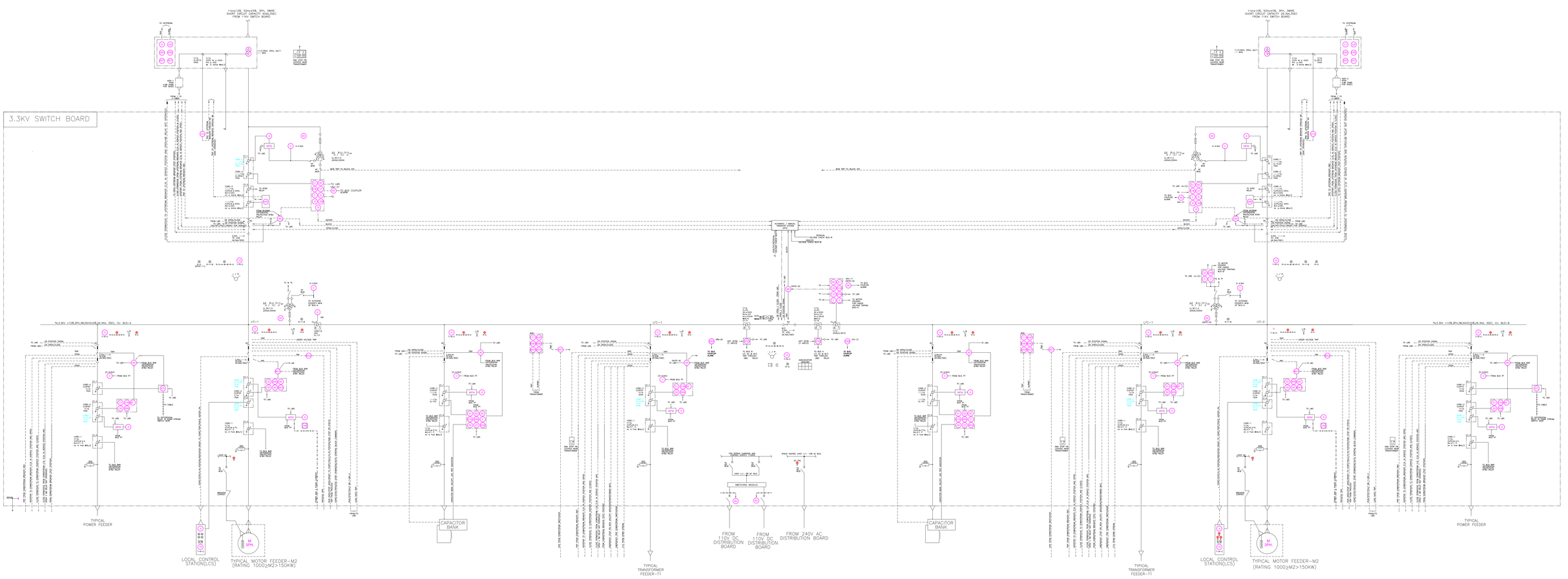
PROJECT:– UREA HANDLING & BAGGING PACKAGE

DRG. NO.– PC183–1231

TITLE:– TYPICAL 11KV SW. BD. SINGLE LINE DIAGRAM

FILE:

प्रोजेक्ट्स एंड डेवलपमेंट इंडिया लिमिटेड नोएडा
PROJECTS & DEVELOPMENT INDIA LTD.–NOIDA



LEGENDS:–

MFM	MULTI FUNCTION METER	32R	REVERSE POWER RELAY
51	IDMTL OVER CURRENT RELAY	67	DIRECTIONAL OVER CURRENT RELAY
51N	IDMT EARTH FAULT RELAY	81R	RATE OF CHANGE OF FREQUENCY RELAY
95	TRIP CIRCUIT SUPERVISION RELAY	81	UNDER/OVER FREQUENCY RELAY(WITH df/dt)
27	UNDER VOLTAGE RELAY	67N	DIRECTIONAL EARTH FAULT RELAY
T	TIMER	LMS	– LOAD MANAGEMENT SYSTEM
25	SYNCHRO CHECK RELAY	ICOG. PNL.	– INCOMING CUM OUTGOING PANEL
87G	LINE DIFFERENTIAL RELAY	NGR	– NEUTRAL GROUNDING RESISTER
67	DIRECTIONAL OVER CURRENT RELAY	VC	– VACUUM SENSOR RELAY
87B	BACKUP EARTH FAULT RELAY	VSR	– VOLTAGE SENSOR RELAY
86	LOCK OUT RELAY	V	VOLTMETER ALONG WITH VSS
10	TNC SWITCH	A	DIGITAL AMMETER ALONG WITH ASS
71	OIL LEVEL INDICATOR WITH CONTACTS	SPD	SURGE PROTECTION DEVICE
63P	PRESSURE RELIEF DIAPHRAGM		
49W	TEMP. RELAY FOR WINDING		
49OT	TEMP. RELAY FOR OIL		
86T	LOCK OUT RELAY(HAND RESET)–TRANSFORMER		
50	INSTANT. OVER CURRENT		
50N	INSTANT. OVER CURRENT GROUND FAULT RELAY CONNECTED IN RESIDUAL WAY		
59	OVER VOLTAGE RELAY		
60	DC SUPPLY FAILURE		
27M	UNDER VOLTAGE RELAY TO INTIATE MOTOR FOR TRIP		
60	VT FAILURE		

NOTE:–

1 COMMUNICATION PROTOCOL SHALL BE AS FOLLOWS:–
a. NUMERICAL RELAY–IEC61850
b. MULTIFUNCTION METER (MFM)–MODBUS RTU
2 AUTO CHANGE OVER LOGIC BETWEEN INCOMERS AND BUS COUPLER SHALL BE DEVELOPED IN NUMERICAL RELAY
3 COMMANDS/INDICATION TO/FROM LMS SHOWN IN SLD ARE INDICATIVE.
4 TNC SWITCH SHALL BE ABLE TO CLOSE ONLY IN TEST POSITION FOR ALL MOTOR FEEDERS
5 FOLLOWING MINIMUM METERING SHALL BE PROVIDED ON MULTIFUNCTION METER :–
–3 PHASE CURRENT
–LINE VOLTAGES
–POWER FACTOR & FREQUENCY
–KW,KVAR,KVA,KWH, & KVARH
–HOUR RUN (ONLY FOR MOTOR FEEDER)
6 COMMON ALARM CIRCUIT FOR HOOTER & BUZZER SHALL BE PROVIDED IN BUS COUPLER.

7 LAMP TEST PUSH BUTTON SHALL BE PROVIDED.
8 ALL RELAYS SHALL BE NUMERICAL TYPE UNLESS SPECIFICALLY MENTIONED IN SLD AND EXCEPT THE FOLLOWING:–
–PT FUSE FAILURE RELAY(60)
–AC/DC SUPPLY SUPERVISION RELAY (80)
–TRANSFORMER LOCKOUT RELAY (86T)
–TRIP CIRCUIT SUPERVISION RELAY (95)
–BUS BAR DIFFERENTIAL SUPERVISION RELAY (95B1 & 95B2)
–MOTOR FEEDER
86–1 FOR ELECTRICAL TRIP (HAND RESET)
86–2 FOR PROCESS TRIP (SELF RESET)
–ALL FEEDER
86 ELECTRICAL TRIP (HAND RESET)
9 SIGNALS/INDICATIONS TO/FROM DCS SHOWN INN SLD ARE INDICATIVE. AND SHALL BE CONFIRMED DURING DETAIL ENG.
10 CIRCUIT BREAKER 'ON' , 'OFF' INDICATION SHALL BE PROVIDED AT THE BACK OF EACH PANEL. ALTERNATIVELY ALARM SHALL BE PROVIDED IN CASE PANEL BACK DOOR IS OPENED WITH BREAKER 'ON'.

THIS IS CONCEPTUAL SLD. DETAILS SLD SHALL BE PREPARED BY BIDDER & SUBMITTED WITH BID

REV.	DATE	DESCRIPTION	PPD.	CKD.	APPD.
0	30.07.21	ISSUED FOR TENDER	SS	RK	SKB

CLIENT:– TALCHER FERTILIZER LIMITED

REV. P

SHEET 1 OF 1

SCALE: N.T.S.

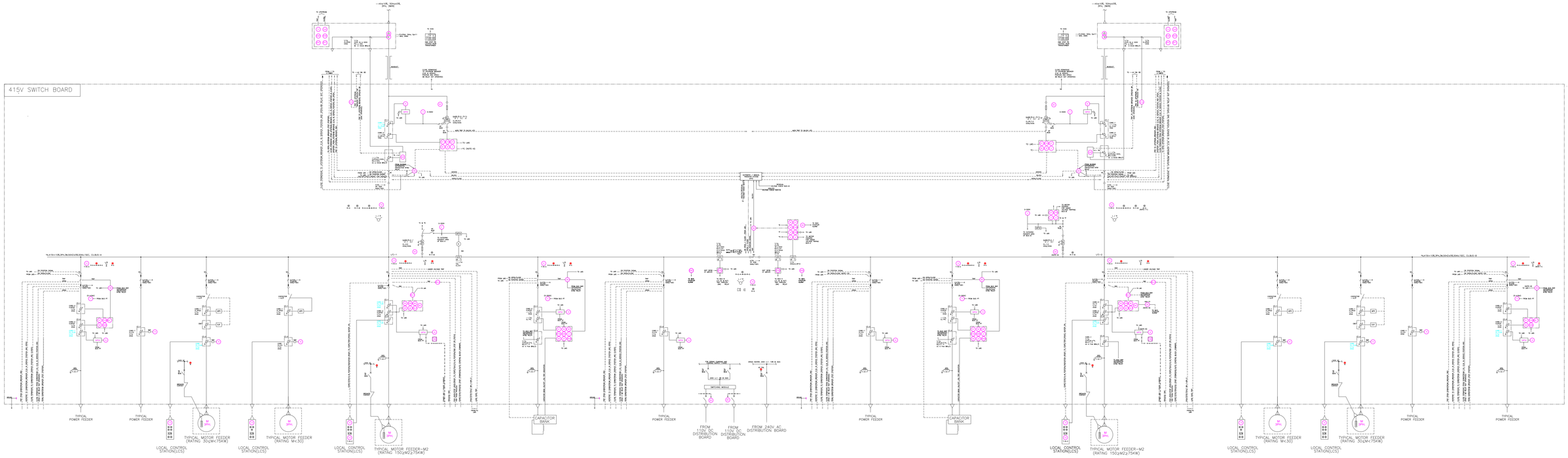
PROJECT:– UREA HANDLING & BAGGING PACKAGE

DRG. NO.– PC183–1232

TITLE:– TYPICAL 3.3kV SW. BD. SINGLE LINE DIAGRAM

FILE:

प्रोजेक्ट्स एंड डेवलपमेंट इंडिया लिमिटेड नोएडा
PROJECTS & DEVELOPMENT INDIA LTD.–NOIDA



NOTE:–

1 COMMUNICATION PROTOCOL SHALL BE AS FOLLOWS:–
  a. NUMERICAL RELAY–IEC61850
  b. MULTIFUNCTION METER (MFM)–MODBUS RTU
2 AUTO CHANGE OVER LOGIC BETWEEN INCOMERS AND BUS COUPLER SHALL BE DEVELOPED IN NUMERICAL RELAY
3 COMMANDS/INDICATION TO/FROM LMS SHOWN IN SLD ARE INDICATIVE.
4 TNC SWITCH SHALL BE ABLE TO CLOSE ONLY IN TEST POSITION FOR ALL MOTOR FEEDERS
5 FOLLOWING MINIMUM METERING SHALL BE PROVIDED ON MULTIFUNCTION METER :–
  –3 PHASE CURRENT
  –LINE VOLTAGES
  –POWER FACTOR & FREQUENCY
  –KW,KVAR,KVA,KWH, & KVARH
  –HOUR RUN (ONLY FOR MOTOR FEEDER)
6 COMMON ALARM CIRCUIT FOR HOOTER & BUZZER SHALL BE PROVIDED IN BUS COUPLER.

7 LAMP TEST PUSH BUTTON SHALL BE PROVIDED.
8 ALL RELAYS SHALL BE NUMERICAL TYPE UNLESS SPECIFICALLY MENTIONED IN SLD AND EXCEPT THE FOLLOWING:–
  –PT FUSE FAILURE RELAY(60)
  –AC/DC SUPPLY SUPERVISION RELAY (80)
  –TRANSFORMER LOCKOUT RELAY (86T)
  –TRIP CIRCUIT SUPERVISION RELAY (95)
  –BUS BAR DIFFERENTIAL SUPERVISION RELAY (95B1 & 95B2)
  –MOTOR FEEDER
   86–1 FOR ELECTRICAL TRIP (HAND RESET)
   86–2 FOR PROCESS TRIP (SELF RESET)
  –ALL FEEDER
   86 ELECTRICAL TRIP (HAND RESET)
9 SIGNALS/INDICATIONS TO/FROM DCS SHOWN INN SLD ARE INDICATIVE. AND SHALL BE CONFIRMED DURING DETAIL ENG.
10 CIRCUIT BREAKER 'ON' , 'OFF' INDICATION SHALL BE PROVIDED AT THE BACK OF EACH PANEL. ALTERNATIVELY ALARM SHALL BE PROVIDED IN CASE PANEL BACK DOOR IS OPENED WITH BREAKER 'ON'.
11 EPMCC SHALL HAVE 3 NOS OF I/C.

LEGENDS:–

- MFM – MULTI FUNCTION METER
- 51 – IDMTL OVER CURRENT RELAY
- 51N – IDMT EARTH FAULT RELAY
- 95 – TRIP CIRCUIT SUPERVISION RELAY
- 27 – UNDER VOLTAGE RELAY
- Z – TIMER
- 25 – SYNCHRO CHECK RELAY
- 87L – LINE DIFFERENTIAL RELAY
- 67 – DIRECTIONAL OVER CURRENT RELAY
- 67N – BACKUP EARTH FAULT RELAY
- 86 – LOCK OUT RELAY
- 10 – TNC SWITCH
- 71 – OIL LEVEL INDICATOR WITH CONTACTS
- 63P – PRESSURE RELIEF DIAPHRAGM
- 26W – TEMP. RELAY FOR WINDING
- 26O – TEMP. RELAY FOR OIL
- 86T – LOCK OUT RELAY(HAND RESET)–TRANSFORMER
- 50 – INSTANT. OVER CURRENT
- 50N – INSTANT. OVER CURRENT GROUND FAULT RELAY CONNECTED IN RESIDUAL WAY
- 59 – OVER VOLTAGE RELAY
- 80 – DC SUPPLY FAILURE
- 27N – UNDER VOLTAGE RELAY TO INTIATE MOTOR FOR TRIP
- 60 – VT FAILURE
- 32R – REVERSE POWER RELAY
- 67 – DIRECTIONAL OVER CURRENT RELAY
- 81R – RATE OF CHANGE OF FREQUENCY RELAY
- 81 – UNDER/OVER FREQUENCY RELAY(WITH df/dt)
- 67N – DIRECTIONAL EARTH FAULT RELAY
- LMS – LOAD MANAGEMENT SYSTEM
- ICDG. PNL. – INCOMING CUM OUTGOING PANEL
- NGR – NEUTRAL GROUNDING REGISTER
- VC – VACUUM SENSOR RELAY
- VSR – VOLTAGE SENSOR RELAY
- V – VOLTMETER ALONG WITH VSS
- A – DIGITAL AMMETER ALONG WITH ASS
- SPD – SURGE PROTECTION DEVICE

THIS IS CONCEPTUAL SLD. DETAILS SLD SHALL BE PREPARED BY BIDDER & SUBMITTED WITH BID

REV.	DATE	DESCRIPTION	PPD.	CKD.	APPD.
0	30.07.21	ISSUED FOR TENDER	SS	RK	SKB

CLIENT:– TALCHER FERTILIZER LIMITED

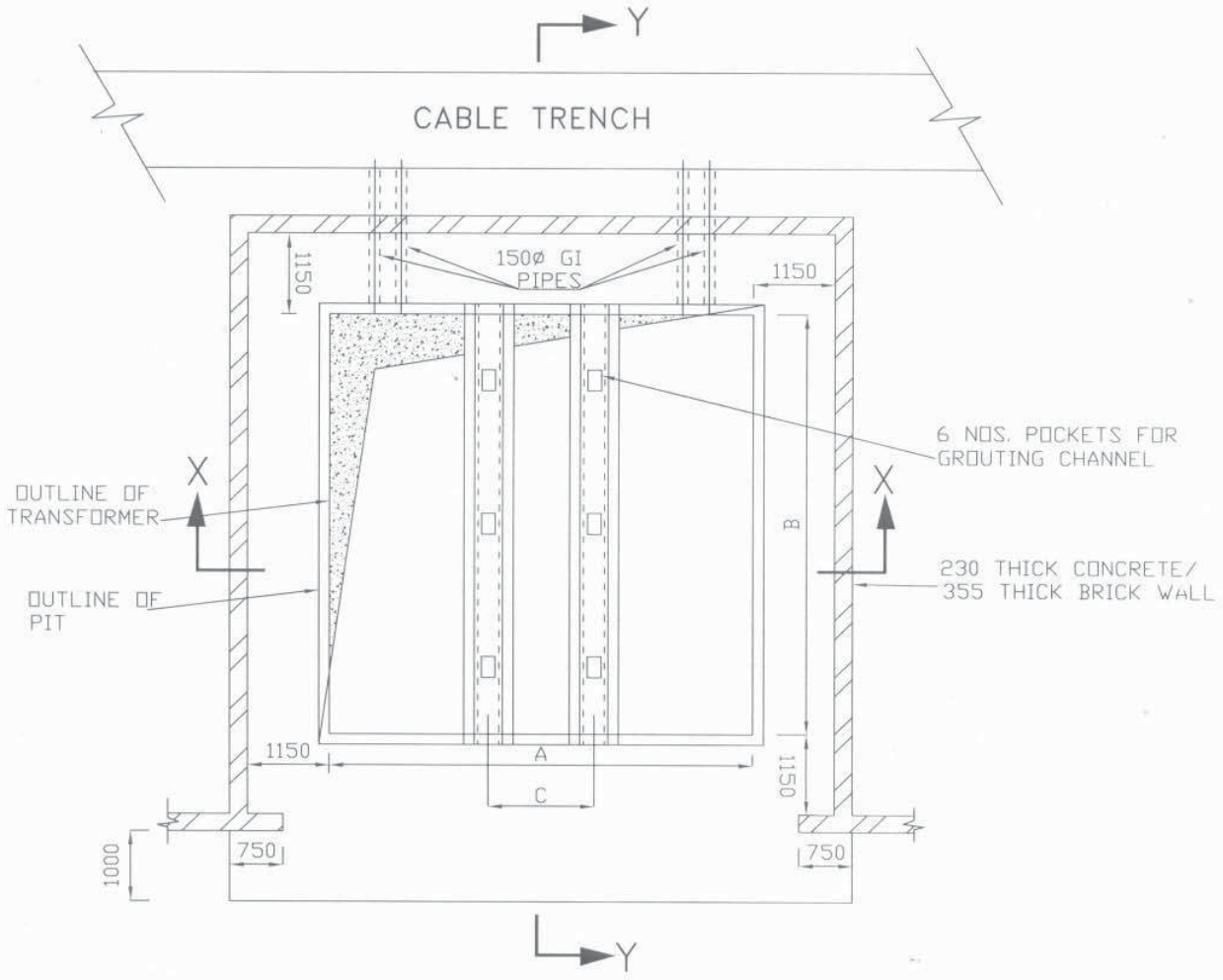
PROJECT:– UREA HANDLING & BAGGING PACKAGE

TITLE:– TYPICAL 0.415V SW. BD. SINGLE LINE DIAGRAM

REV. 0 | SHEET 1 OF 1 | SCALE: N.T.S. | DRG. NO.– PC183–1233 | FILE:

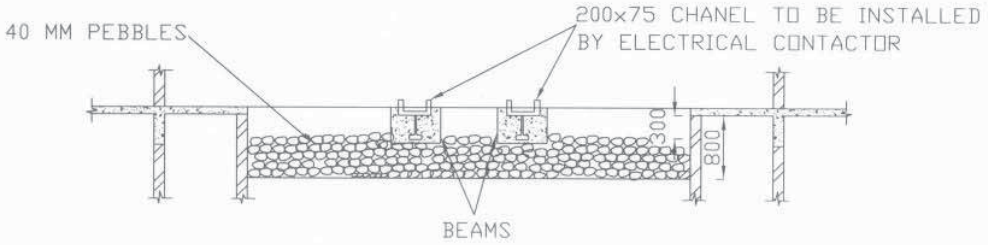
प्रोजेक्ट्स एंड डेवलपमेंट इंडिया लिमिटेड नोएडा
PROJECTS & DEVELOPMENT INDIA LTD.–NOIDA

PDIL	FOUNDATION DETAIL OF 11/.433 KV TRANSFORMER	PC183 PDS: E113 / 0
		DOCUMENT NO. / REV
		SHEET 1 OF 1

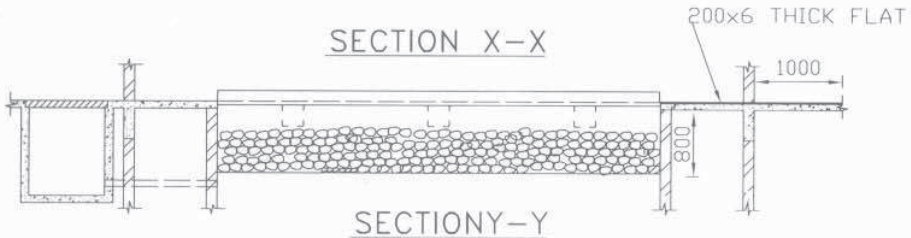


PLAN

TYPICAL DETAIL OF 11/.433KV T/F



SECTION X–X

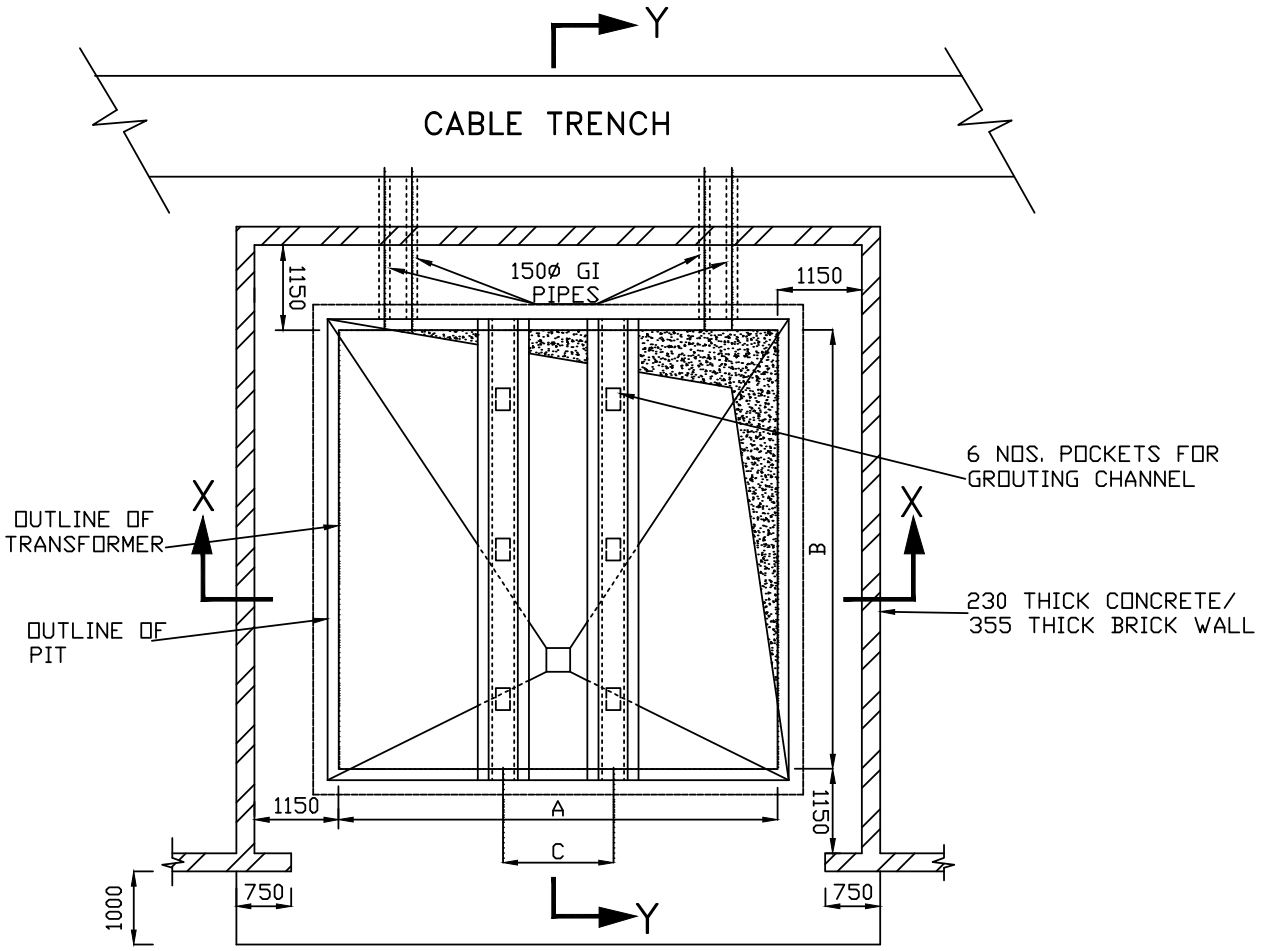


SECTIONY–Y

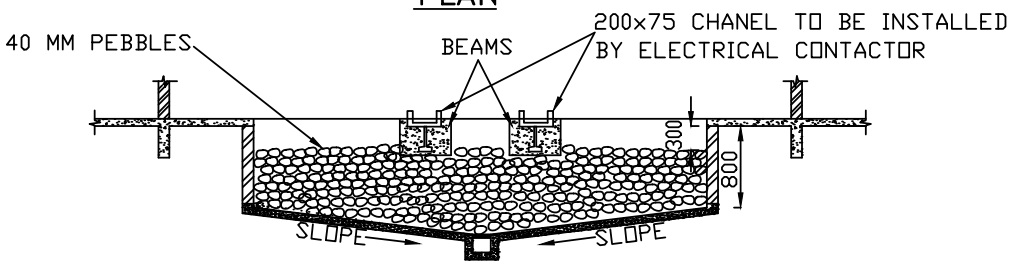
NOTE :

TRANSFORMERS RATED ABOVE 10MVA SHALL BE MOUNTED ON 200MM x 8MM THICK PLATES.

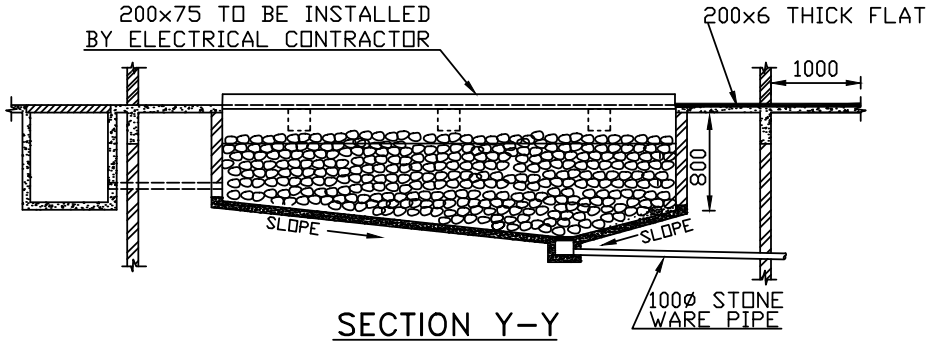
पी डी आई एल PDIL	FOUNDATION DETAIL OF 11/3.45 KV TRANSFORMER	PC183-PDS:E 114	0
		DOCUMENT NO.	REV.
		SHEET 1 OF 1	



PLAN



SECTION X-X

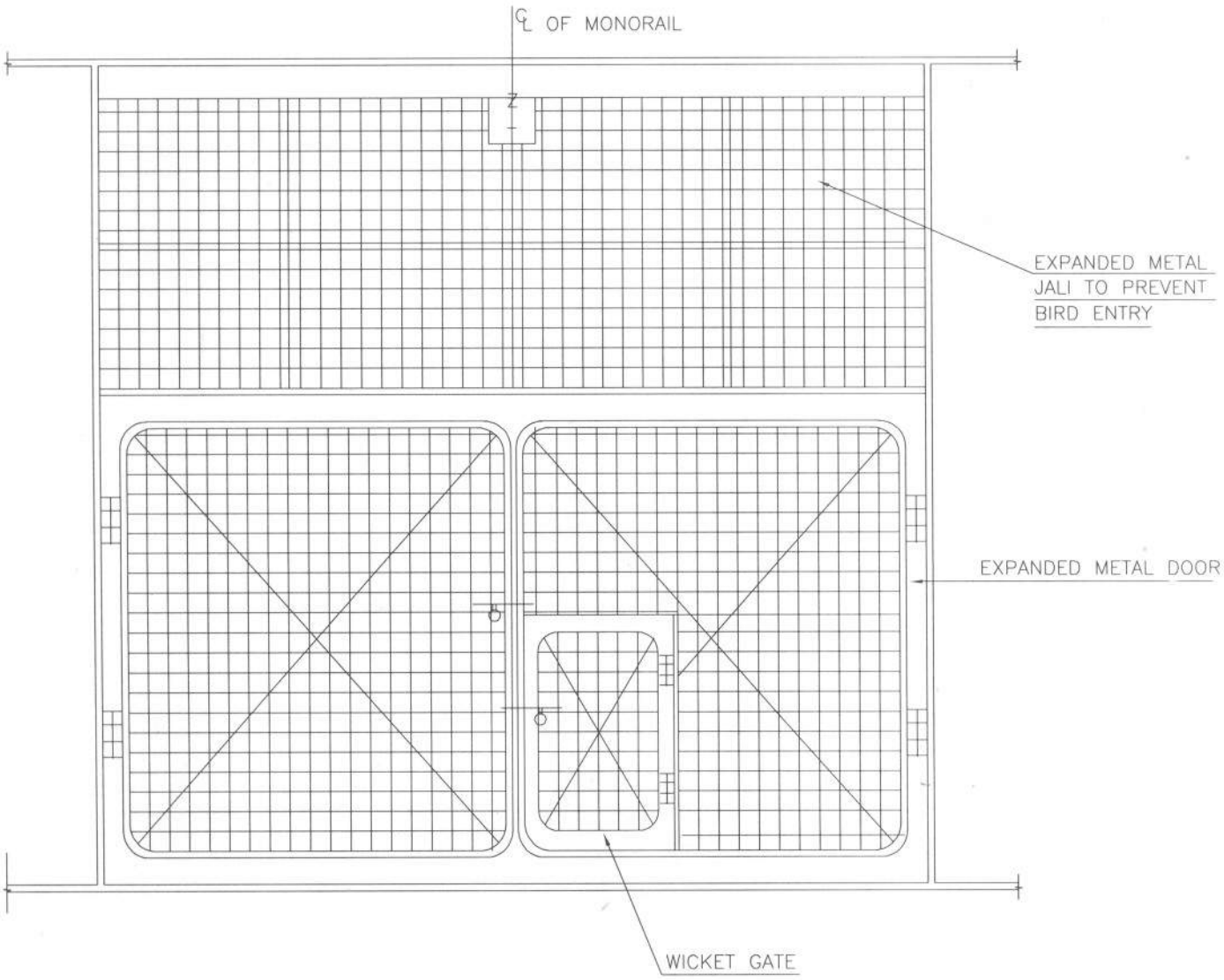


SECTION Y-Y

NOTE :

TRANSFORMERS RATED ABOVE 10MVA SHALL BE MOUNTED ON 200MM x 8MM THICK PLATES.

PDIL	TYPICAL DETAILS OF TRANSFORMER ROOM DOOR	PC183 E 115	0
		DOCUMENT NO.	REV
		SHEET 1 OF 1	



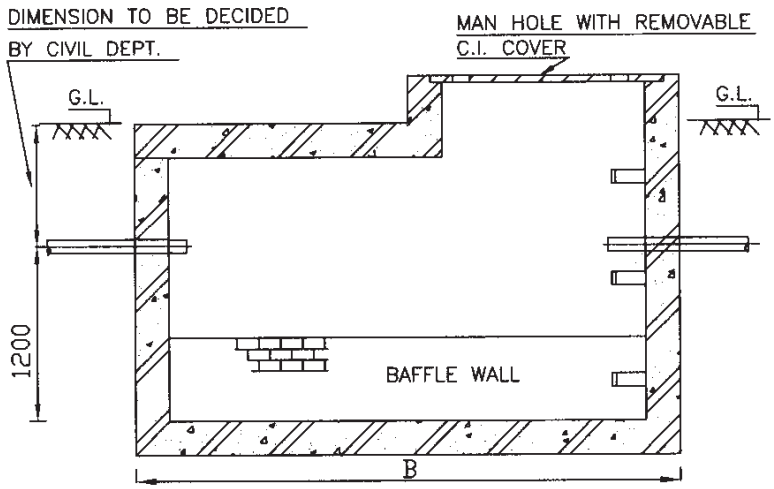
NOTE :–

1. THIS STANDARD IS INDICATIVE ONLY, THE EXACT DIMENSIONS SHALL BE DECIDED AS PER TRANSFORMER SIZE & SUB–STATION LAYOUT.

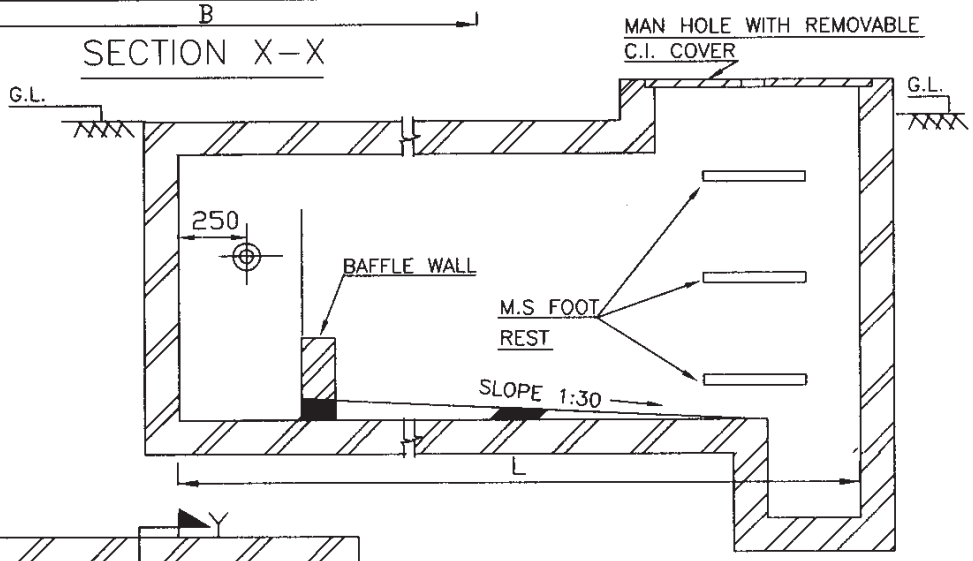
2. TRANSFORMER GATE HEIGHT SHALL BE 250MM MORE THAN THE TRANSFORMER HEIGHT AND SHALL BE OPENABLE OUTSIDE.

REV	REV.DATE	EFF.DATE	PURPOSE	PREPD	REVWD	APPD
0	20.01.07	01.02.07	ISSUED FOR IMPLEMENTATION	RUNDA/AV	SC	BB

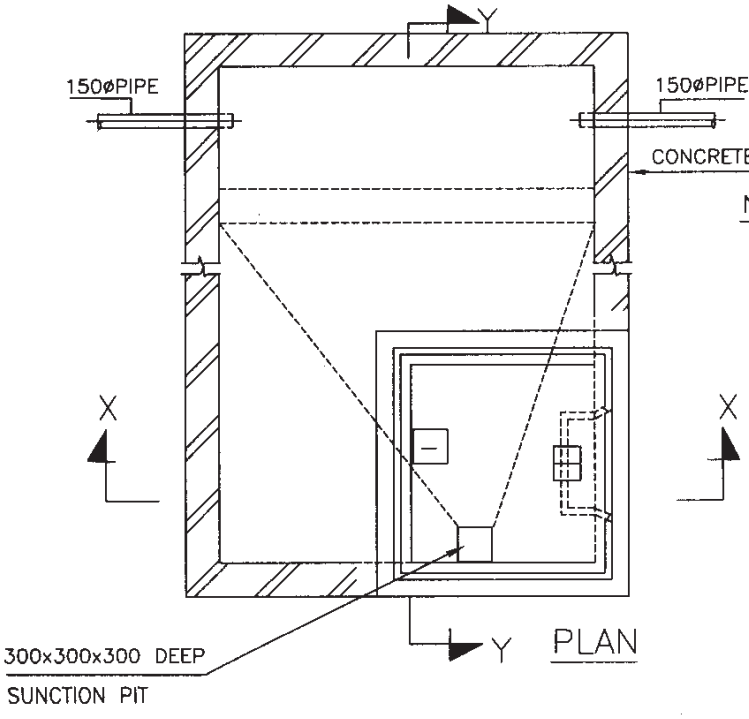
PDIL	SUMP PIT FOR TRANSFORMER OIL	PC183 PDS: E116	1
		DOCUMENT NO.	REV
		SHEET 1 OF 1	



SECTION X–X



SECTION Y–Y

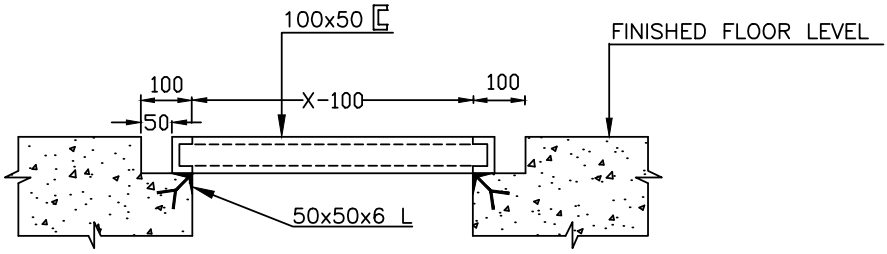


NOTES:–

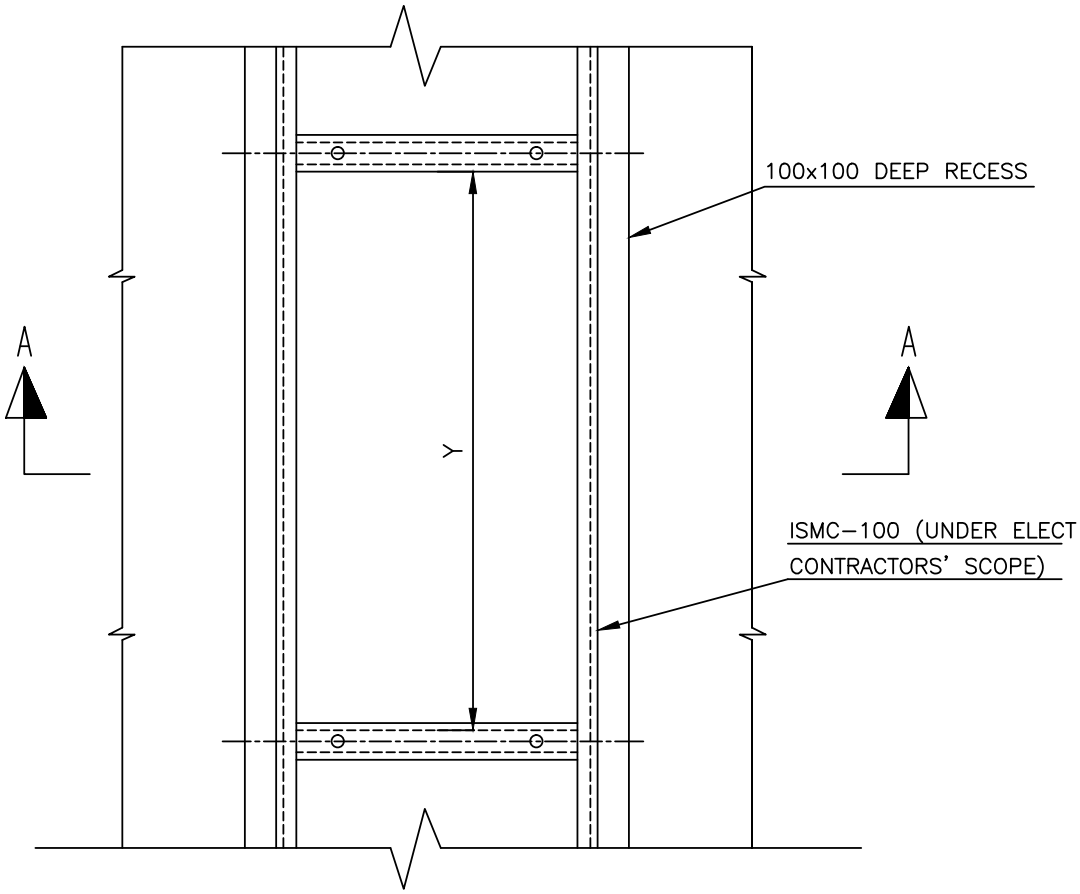
1. DIMENSION 'L' AND 'B' SHALL BE DECIDED BASED ON OIL VOLUME OF HIGHEST RATED TRANSFORMER.
2. ALL DIMENSIONS ARE IN mm

SL. No.	OIL CAPACITY	L	B
6	2000	1.5	1.5
5	3000	1.5	2
4	5000	2.5	2
3	7000	3.0	2.5
2	8000	3.5	2.5
1	10000	4.0	2.5

पी डी आई एल PDIL	TYPICAL FOUNDATION ARRANGEMENT FOR PANELS IN SUB-STATION	PC183-PDS:E 119	0
		DOCUMENT NO.	REV.
		SHEET 1 OF 1	



SECTION–A A



PLAN

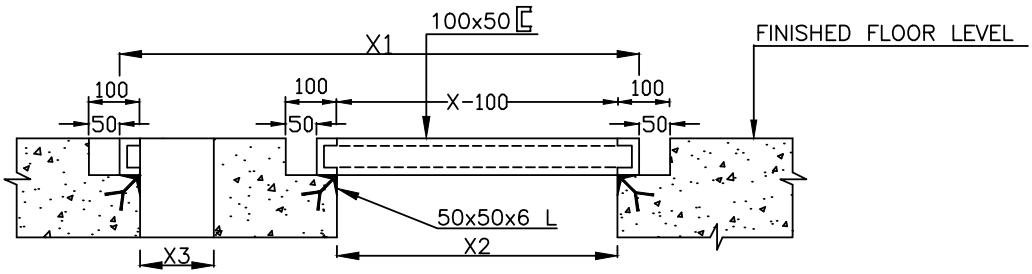
X– DEPTH OF PANEL

Y– LENGTH OF TWO PANELS

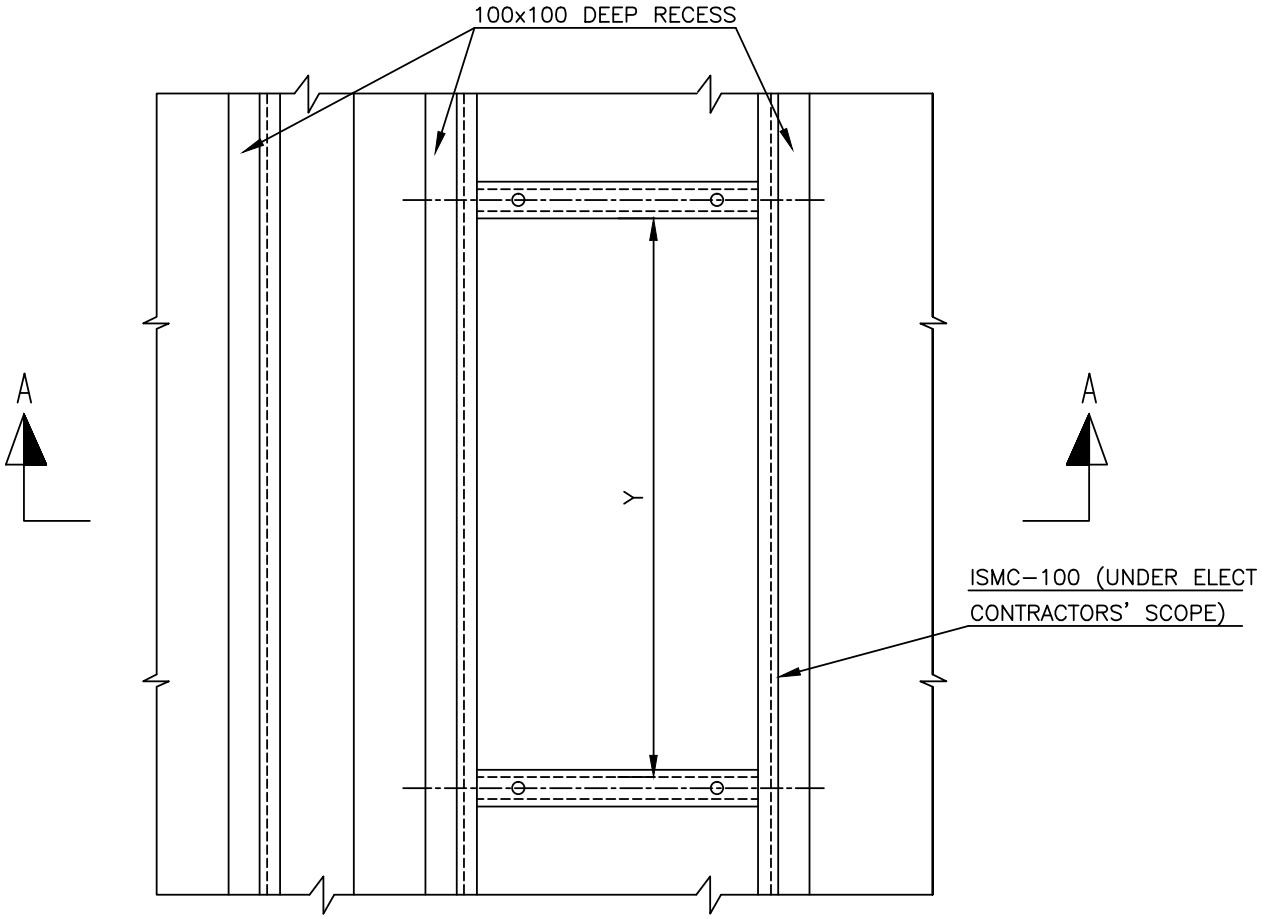
NOTES:–

1. THIS ARRANGEMENT SHALL BE APPLICABLE FOR M.C.C., DISTRIBUTION BOARDS, CONTROL PANELS ETC.
2. PANELS AFTER ERECTION SHALL BE TAG WELDED TO FOUNDATION CHANNELS

पी डी आई एल PDIL	TYPICAL FOUNDATION DETAILS FOR HT/LT CIRCUIT BREAKER PANELS	PC183-PDS:E 120	0
		DOCUMENT NO.	REV.
		SHEET 1 OF 1	



SECTION–A A



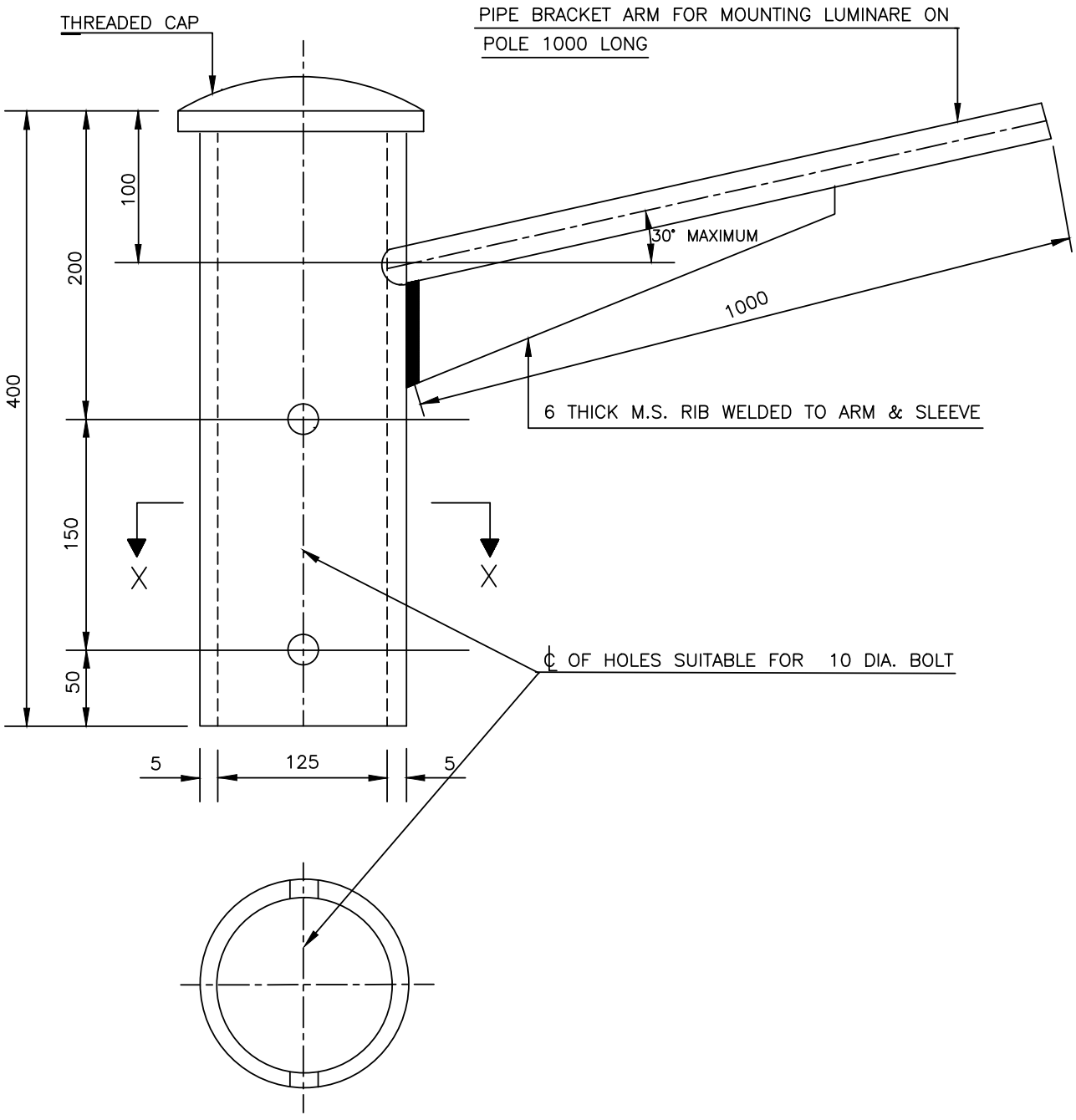
PLAN

X1 = DEPTH OF PANEL
X2 = FOOR OPENING
X3 = FOOR OPENING
Y = LENGTH OF PANEL

NOTES:–

1. PANELS AFTER ERECTION SHALL BE BOLTED TO FOUNDATION CHANNELS
2. POWER & CONTROL CABLES SHALL ENTER THROUGH OPENING X2
3. DEPENDING UPON THE FINAL DATA FROM THE VENDOR, ONLY TWO CHANNELS MAY BE NECESSARY IN WHICH CASE THE 3RD. RECESS SHALL BE FILLED AT SITE.

पी डी आई एल PDIL	DETAILS OF BRACKET ARM FOR STREET LIGHTING POLE	PC183–PDS:E 207	0
		DOCUMENT NO.	REV.
		SHEET 1 OF 1	

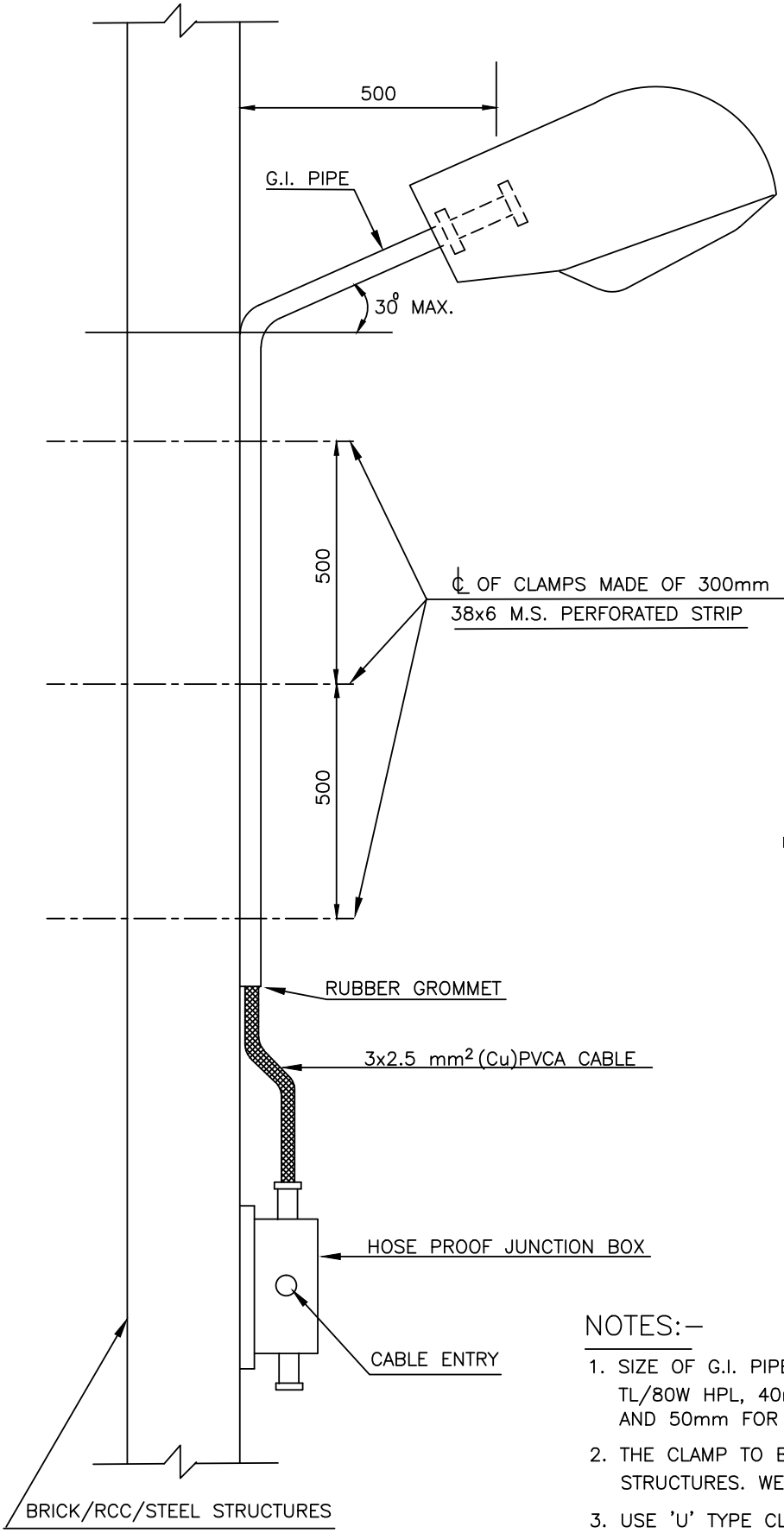


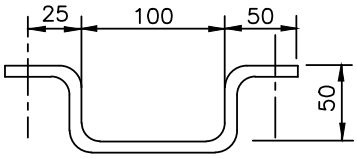
SECTION – XX

NOTES:–

1. SIZE OF PIPE SHALL BE 30mm FOR TL/80W HPL FIXTURES, 40mm FOR 70W SON/125W HPL FIXTURES AND 50mm FOR 150W SON/250W HPL FIXTURES.
2. ALL DIMENSIONS ARE IN mm.

पी डी आई एल PDIL	INSTALLATION ARRANGEMENT AREA LIGHTING FIXTURES	PC183-PDS:E 208	0
		DOCUMENT NO.	REV.
		SHEET 1 OF 1	



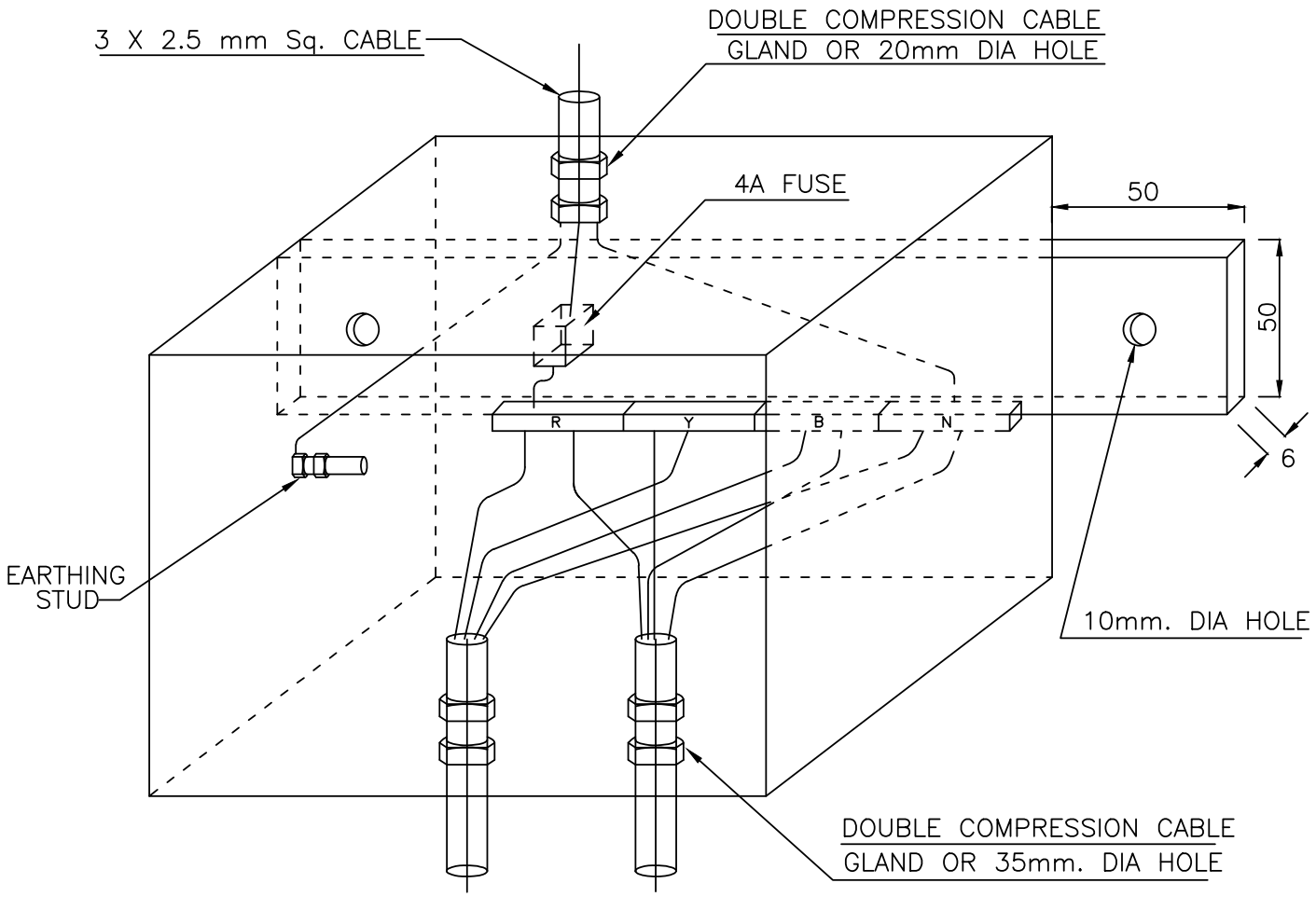


DETAILS OF CLAMP

NOTES:–

1. SIZE OF G.I. PIPE SHALL BE 30mm FOR TL/80W HPL, 40mm FOR 70W SON/125W HPL AND 50mm FOR 150W SON//250W HPL FIXTURES.
2. THE CLAMP TO BE GROUTED IN BRICK WALL/RCC STRUCTURES. WELDED TO STEEL STRUCTURES.
3. USE 'U' TYPE CLAMPS FOR RAILING.
4. ALL DIMENSIONS ARE IN mm.

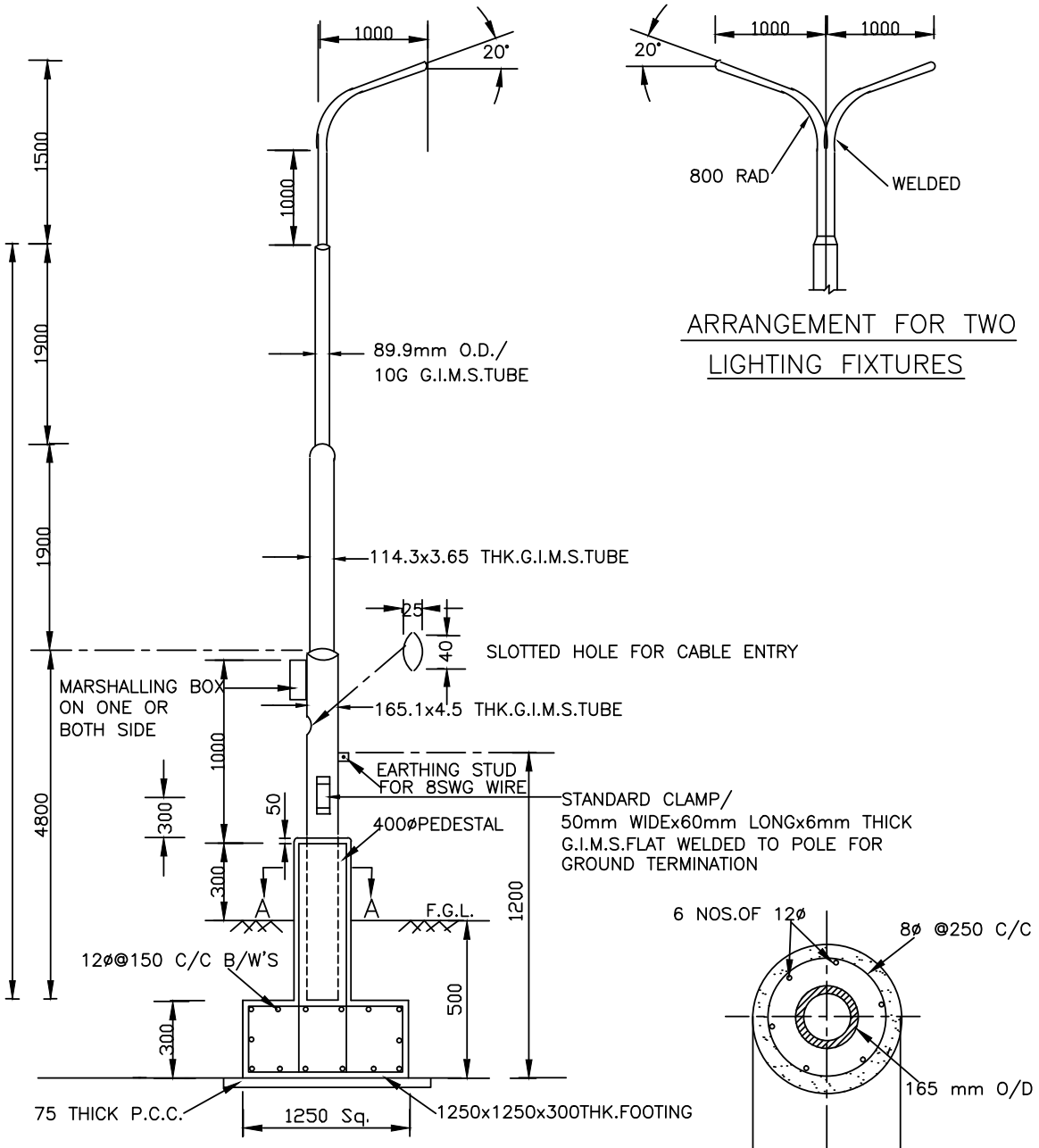
पी डी आई एल PDIL	JUNCTION BOX FOR STREET LIGHTING POLE	PC183–PDS:E 210	0
		DOCUMENT NO.	REV.
		SHEET 1 OF 1	



NOTE:–

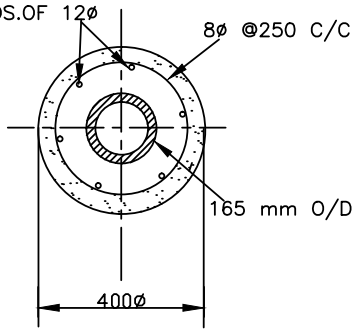
1. THE MINIMUM INTERNAL DIMENSION OF THE J.B. SHALL BE 152 X 152 X 152.
2. THE FRONT DOOR SHALL BE HINGED & LOCKABLE TYPE.
3. THE CONNECTION OF FUSE TO THE PHASE 'R' IS TYPICAL ONE THE EXACT PHASE TO WHICH CONNECTION SHALL BE MADE SHALL BE DECIDED AT SITE.
4. FOR HAZARDOUS AREA'S THESE JUNCTION BOXES SHALL BE INCREASED SAFETY TYPE AND THE FUSE NEED NOT BE PROVIDED.
5. FOR POLE MOUNTED JUNCTION BOXED THE CABLE GLAND SHALL BE SIDE MOUNTED.
6. ALL DIMENSIONS ARE IN mm.

पी डी आई एल PDIL	TYPICAL STREET LIGHTING POLE	PC183-PDS:E 213	0
		DOCUMENT NO.	REV.
		SHEET 1 OF 1	



ARRANGEMENT FOR ONE LIGHTING FIXTURE

ARRANGEMENT FOR TWO LIGHTING FIXTURES



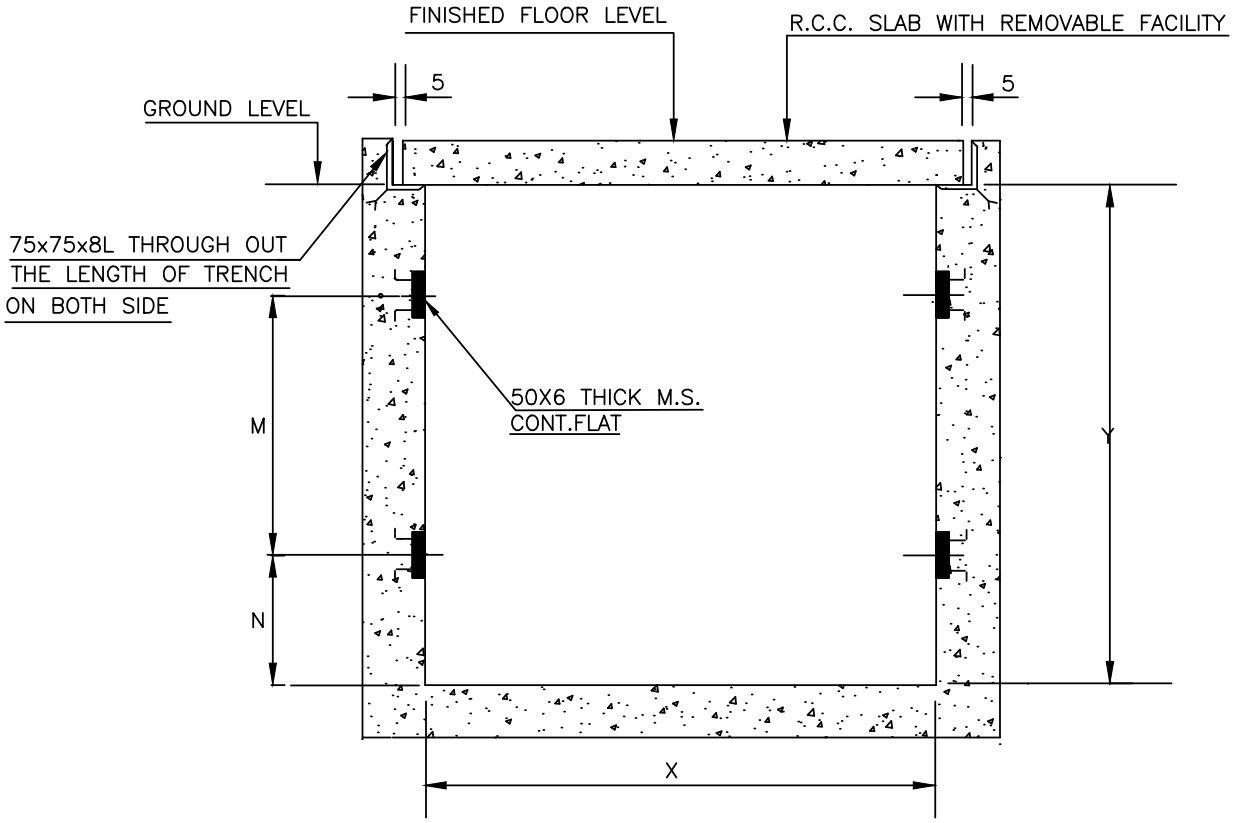
SECTION A–A

NOTE :–

1. CONCRETING AND APPROVED MOUNTING HARDWARE FOR LIGHTING FIXTURES ARE INCLUDING IN SCOPE OF SUPPLY.
2. CONCRETE FOUNDATION OF GRADE M15 SHALL BE PROVIDED.

ALL DIMENSIONS ARE IN mm.

पी डी आई एल PDIL	DETAILS OF CONCRETE CABLE TRENCH	PC183-PDS:E 510	0
		DOCUMENT NO.	REV.
		SHEET 1 OF 1	



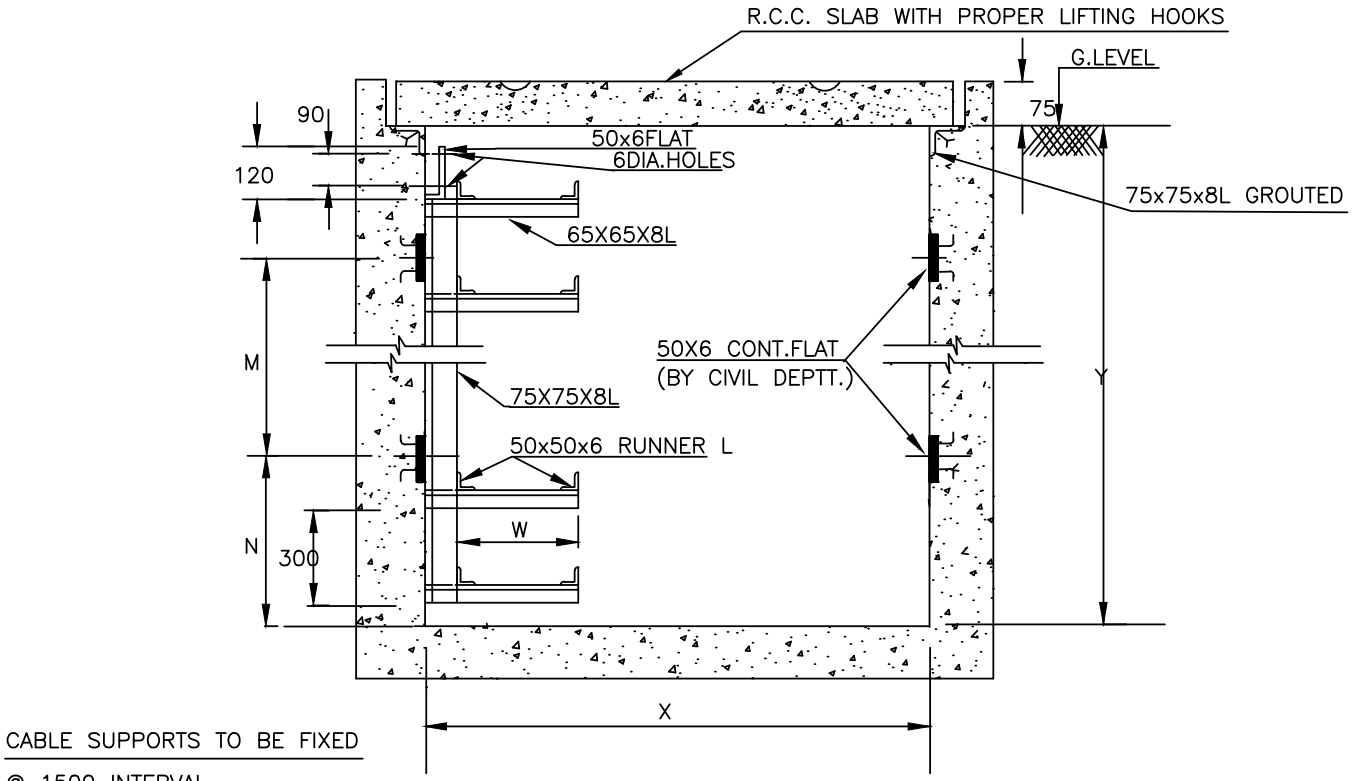
SECTION OF TRENCH

DESIGN TYPE	X	Y	N	M
5T 350DS.	1400	1500	400	650
4T 350DS.	1400	1200	250	650
3T 350DS.	1400	900	250	300
5T 350SS.	1000	1500	400	650
4T 350SS.	1000	1200	250	650
3T 350SS.	1000	900	250	300
5T 250DS.	1200	1500	400	650
4T 250DS.	1200	1200	250	650
3T 250DS.	1200	900	250	300
5T 250SS.	900	1500	400	650
4T 250SS.	900	1200	250	650
3T 250SS.	900	900	250	300

NOTES:–

1. THE TOP OF TRENCH SHALL MATCH THE FLOOR LEVEL IN PLANT AREA.
2. IN INDOORS INSTEAD OF RCC SLAB,20mm.THICK Al. EXTRUDED PLANK OR 10mm.THICK M.S.CHEQUERED PLATE SHALL BE USED AS PER PDS:E 507.
3. PROPER SLOPE TO BE GIVEN IN THE TRENCH FOR NATURAL DRAINAGE.
4. SS–SINGLE SIDE CABLE SUPPORTS.
5. DS–DOUBLE SIDE CABLE SUPPORTS.
6. ALL DIMENSIONS ARE IN mm.

पी डी आई एल PDIL	CABLE RACK ARRANGEMENT IN TRENCHES	PC183-PDS:E 511	0
		DOCUMENT NO.	REV.
		SHEET 1 OF 1	



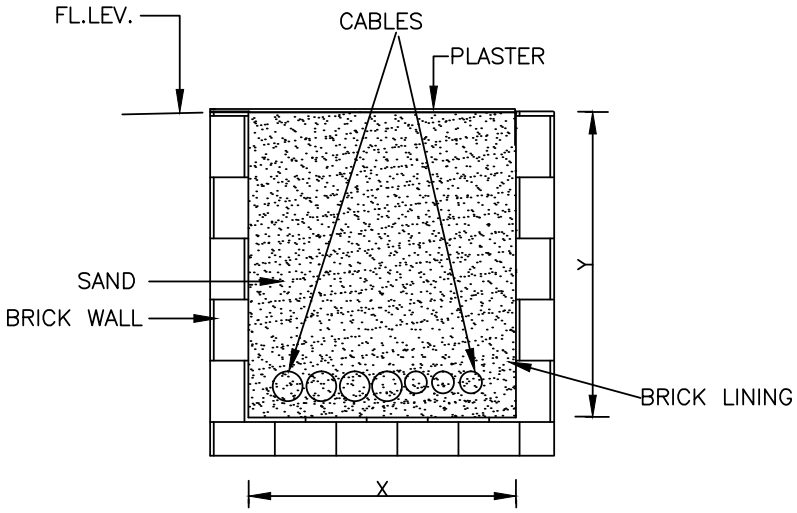
SECTION OF TRENCH

TYPICAL PLAN OF TRENCH

DESIGN TYPE	X	Y	N	M	W
5T-350-DS.	1400	1500	400	650	350
4T-350-DS.	1400	1200	250	650	350
3T-350-DS.	1400	900	250	300	350
5T-350-SS.	1000	1500	400	650	350
4T-350-SS.	1000	1200	250	650	350
3T-350-SS.	1000	900	250	300	350
5T-250-DS.	1200	1500	400	650	250
4T-250-DS.	1200	1200	250	650	250
3T-250-DS.	1200	900	250	300	250
5T-250-SS.	900	1500	400	650	250
4T-250-SS.	900	1200	250	650	250
3T-250-SS.	900	900	250	300	250

NOTES:-
1. SS-SINGLE SIDE CABLE SUPPORT.
2. DS-DOUBLE SIDE CABLE SUPPORT.
3. ALL DIMENSIONS ARE IN mm.

पी डी आई एल PDIL	TYPICAL ARRANGEMENT OF CABLES BURRIED IN SLITS	PC183–PDS:E 516	0
		DOCUMENT NO.	REV.
		SHEET 1 OF 1	



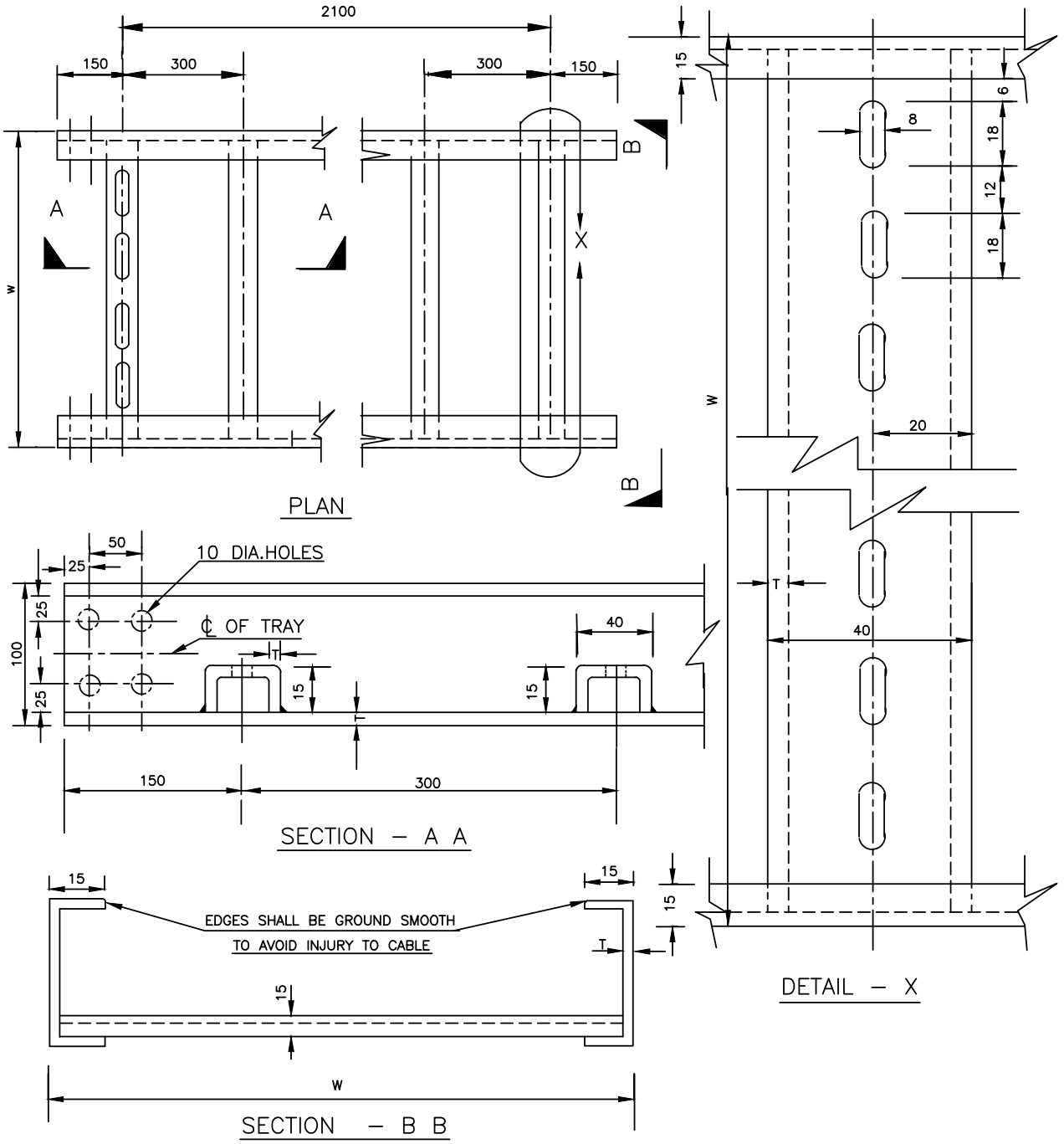
SECTION OF SLIT

DESIGN TYPE	X	Y
S 300	300	300
S 200	200	200

NOTE:–

1. CABLE SLITS SHALL BE FILLED WITH SAND AND PROPERELY PLASTERED WITH LEAN CONCRETE AFTER LAYING OF CABLES.
2. WHEREVER CABLES ARE COMING OUT OF THE SLIT, SUITABLE MECH.PROTECTION TO BE PROVIDED.

पी डी आई एल PDIL	PRE–FABRICATED CABLE TRAY STRAIGHT RUN	PC183–PDS:E 530	0
		DOCUMENT NO.	REV.
		SHEET 1 OF 1	

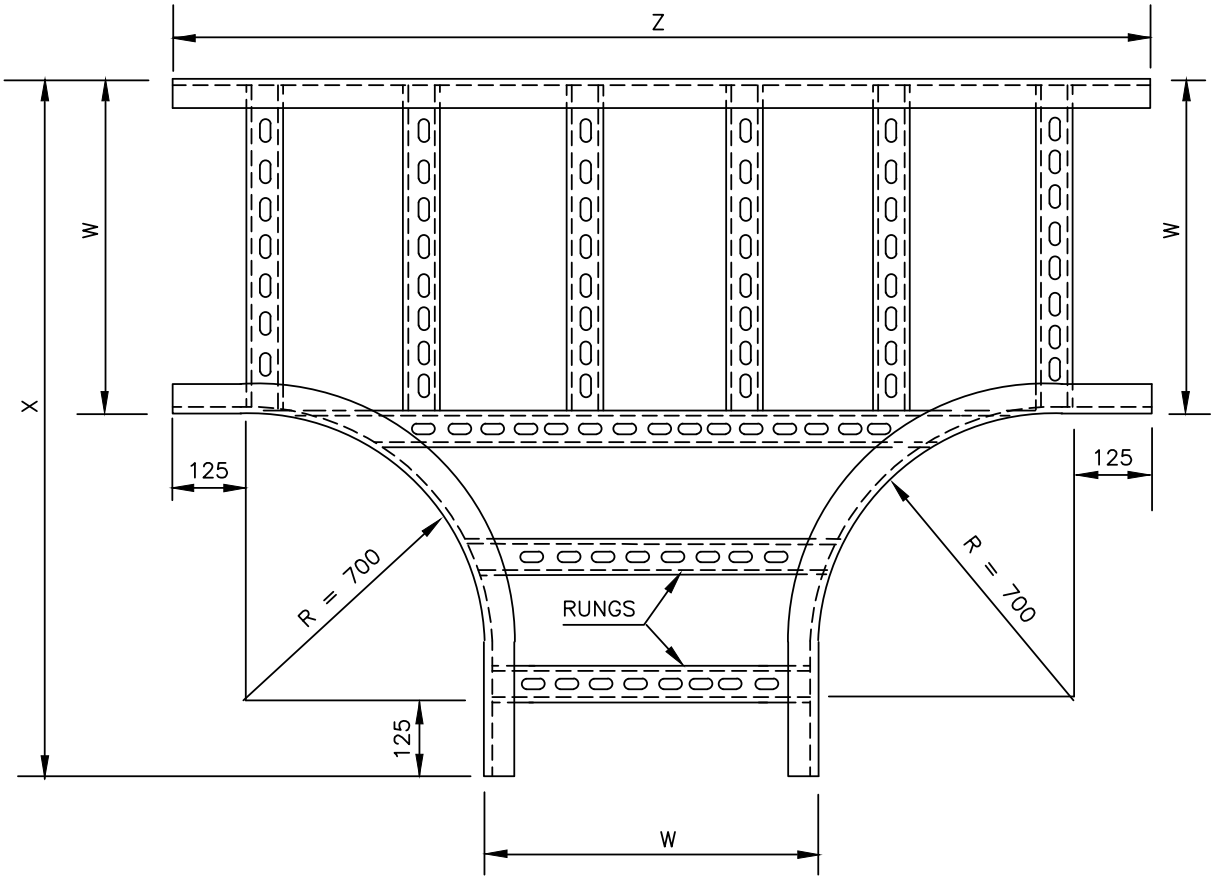


DESIGN TYPE (WIDTH)	MAX.SUPPORTING SPAN		WEIGHT/METER APPROX. IN Kg.	
	G. I.	A. L	G. I.	A. L
SR 900	2000	2000	10.5	3.6
SR 600	2000	2000	8.9	3.05
SR 450	2000	2000	8.0	2.75
SR 300	2000	2000	7.6	2.6
SR 150	2000	2000	6.8	2.33

NOTE:–

THICKNESS " T " SHALL BE 3mm FOR G.I AND 4mm.FOR AL.

पी डी आई एल PDIL	PRE–FABRICATED CABLE TRAY HORIZONTAL TEE	PC183–PDS:E 531	0
		DOCUMENT NO.	REV.
		SHEET 1 OF 1	



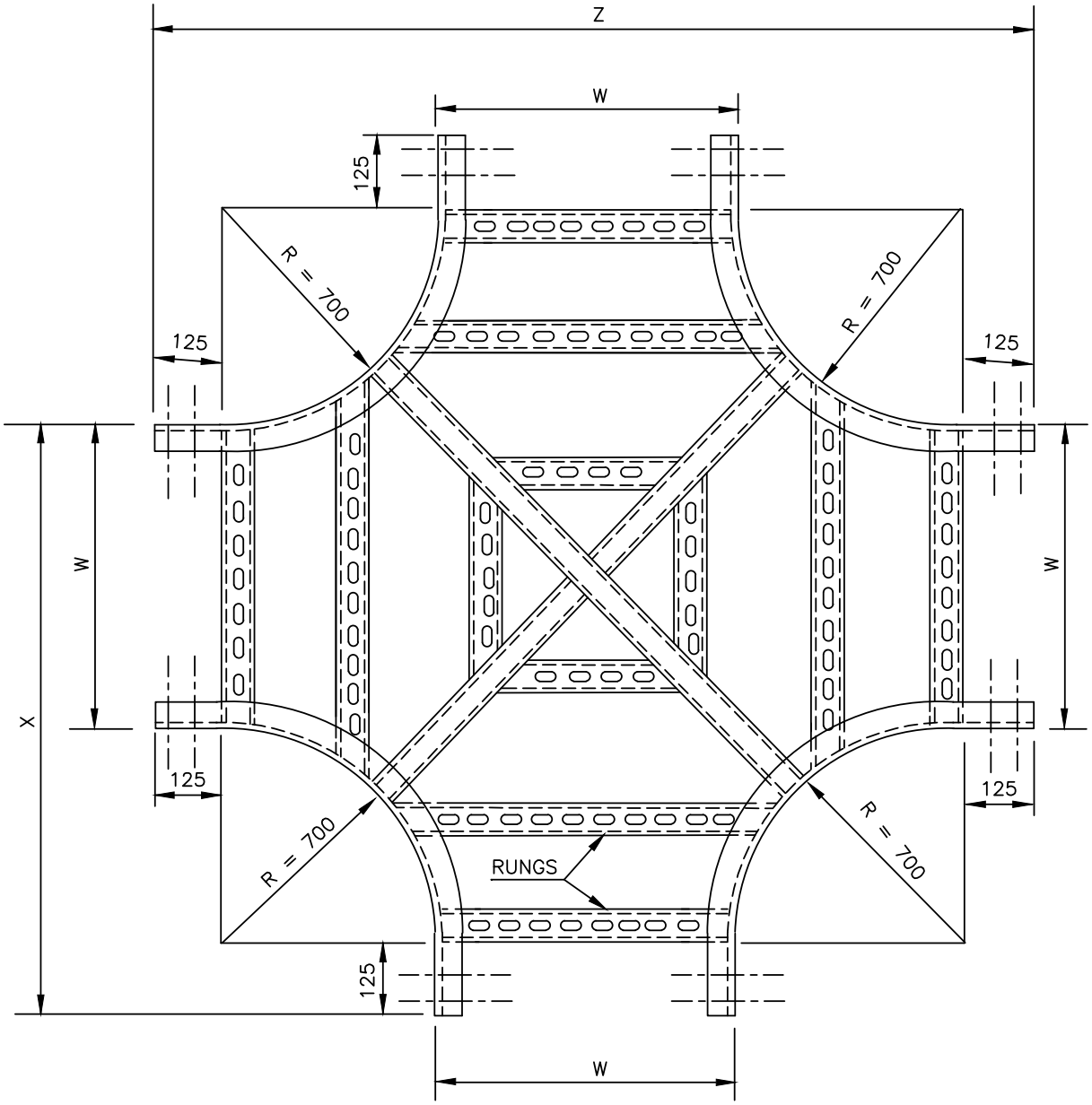
PLAN

DESIGN TYPE	W	X=R+W+125	Z=2R+W+250
HT 900	900	1725	2550
HT 600	600	1425	2250
HT 450	450	1275	2100
HT 300	300	1125	1950

NOTES :–

1. DISTANCE BETWEEN TWO RUNGS SHOULD BE APPROX. 300mm.
2. ALL DIMENSIONS ARE IN mm.

पी डी आई एल PDIL	PRE–FABRICATED CABLE TRAY HORIZONTAL CROSS	PC183–PDS:E 532	0
		DOCUMENT NO.	REV.
		SHEET 1 OF 1	



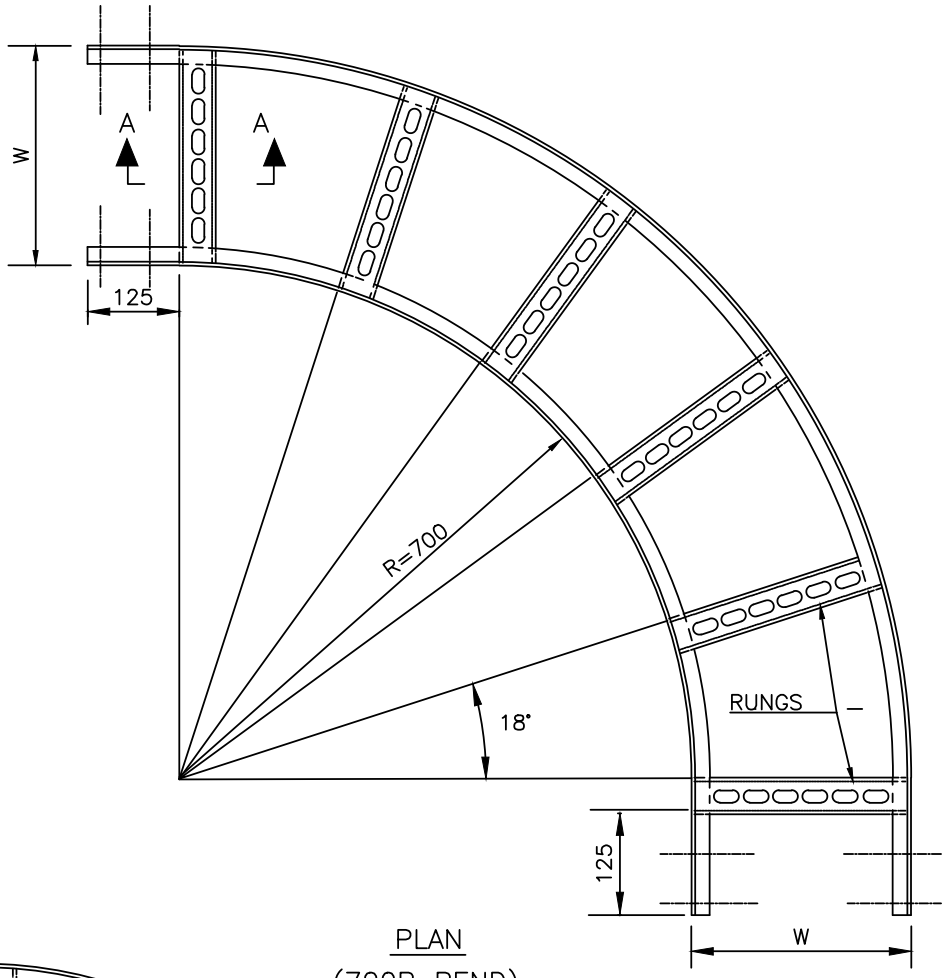
PLAN

DESIGN TYPE	W	X=R+W+125	Z=2R+W+250
HC 900	900	1725	2550
HC 600	600	1425	2250
HC 450	450	1275	2100
HC 300	300	1125	1950

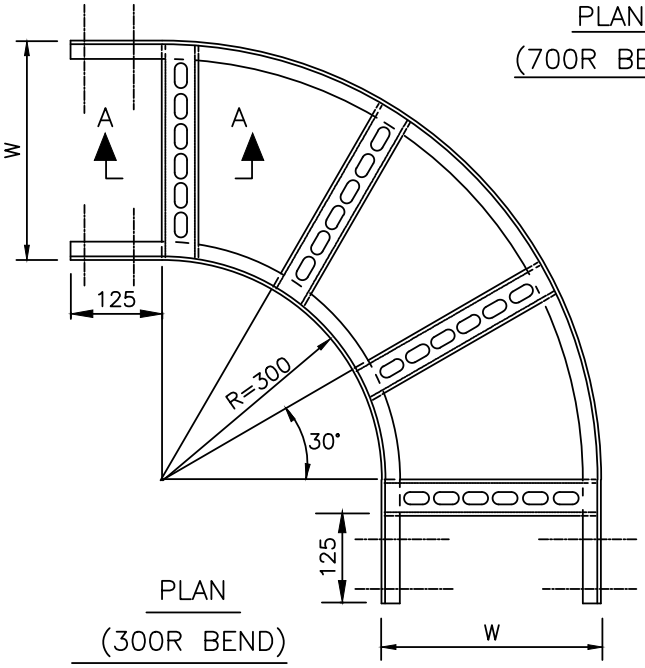
NOTES :–

1. DISTANCE BETWEEN TWO RUNGS SHOULD BE APPROX. 300mm.
2. ALL DIMENSIONS ARE IN mm.

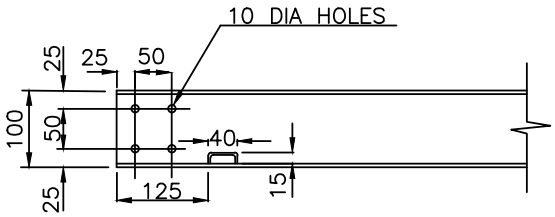
पी डी आई एल PDIL	PRE–FABRICATED CABLE TRAY 90° HORIZONTAL BENDS	PC183 –PDS:E 533	0
		DOCUMENT NO.	REV.
		SHEET 1 OF 1	



PLAN
(700R BEND)



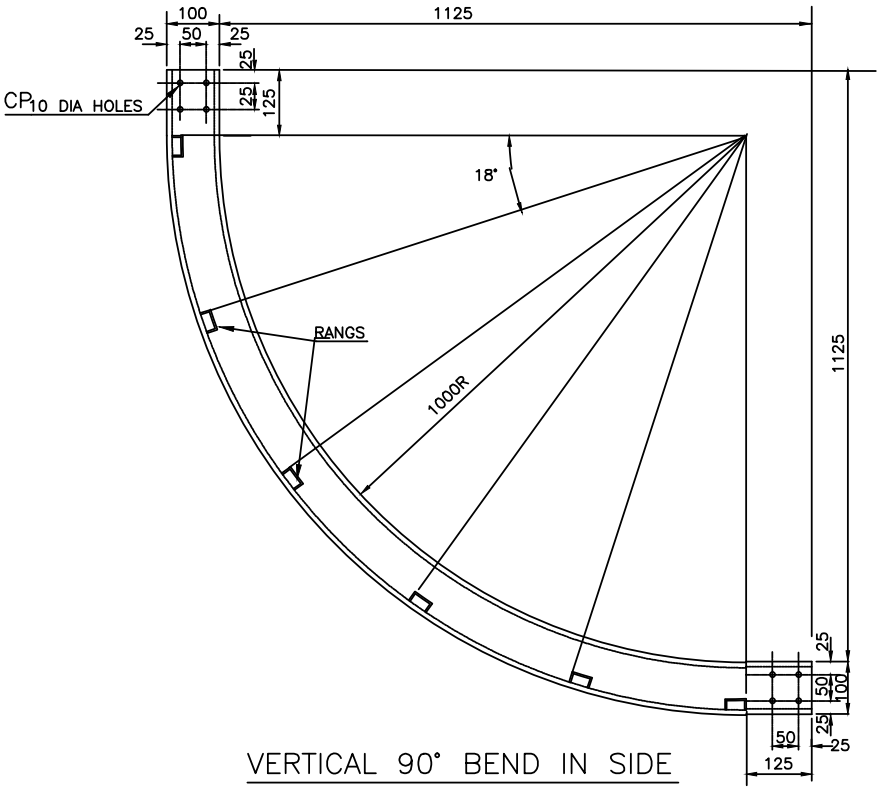
PLAN
(300R BEND)



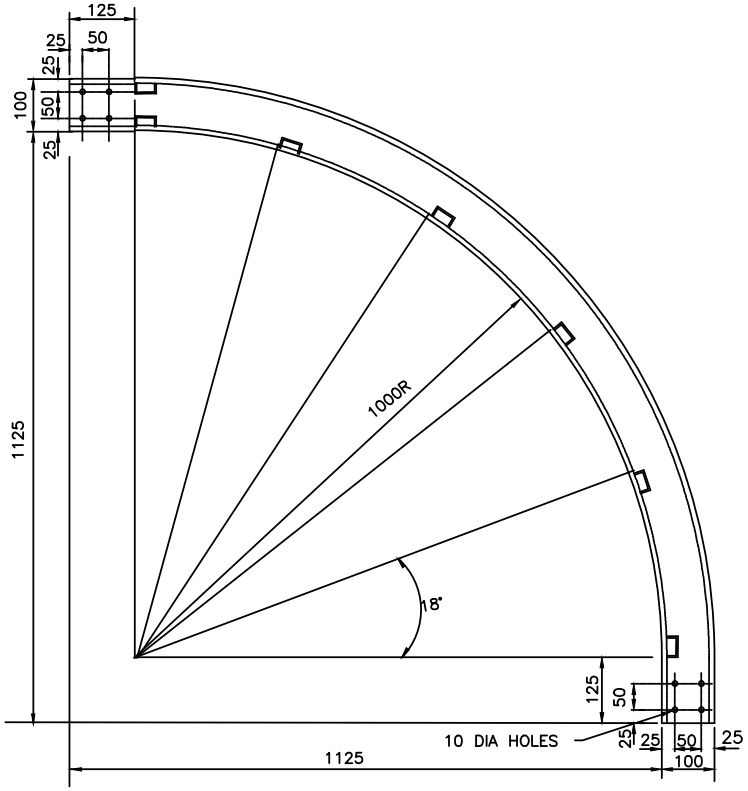
SECTION A–A

ALL DIMENSIONS ARE IN mm.

पी डी आई एल PDIL	PRE–FABRICATED CABLE TRAY 90° VERTICAL BEND BENDING RADIUS 1000 mm	PC183–PDS:E 534	0
		DOCUMENT NO.	REV.
		SHEET 1 OF 1	



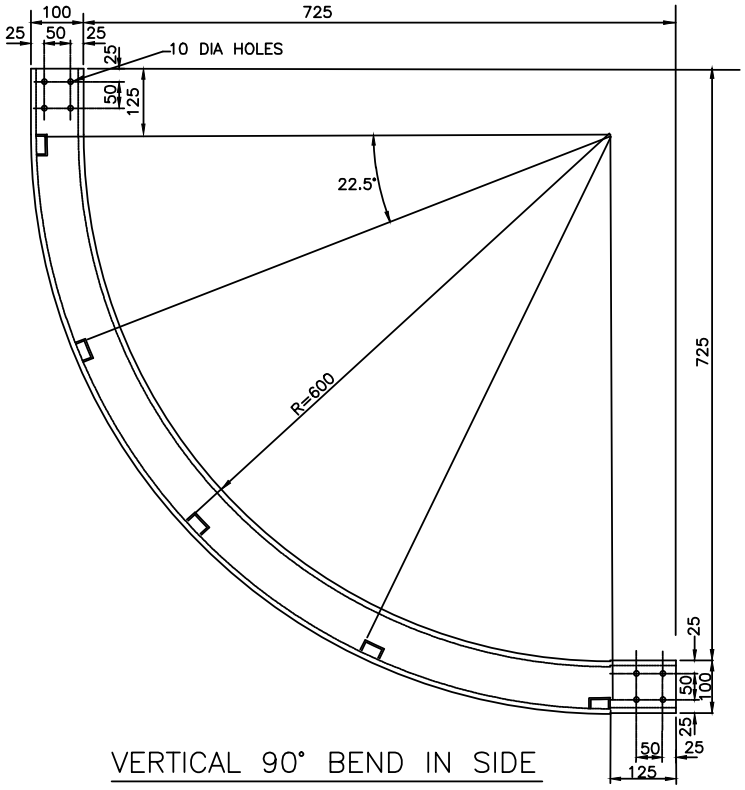
VERTICAL 90° BEND IN SIDE



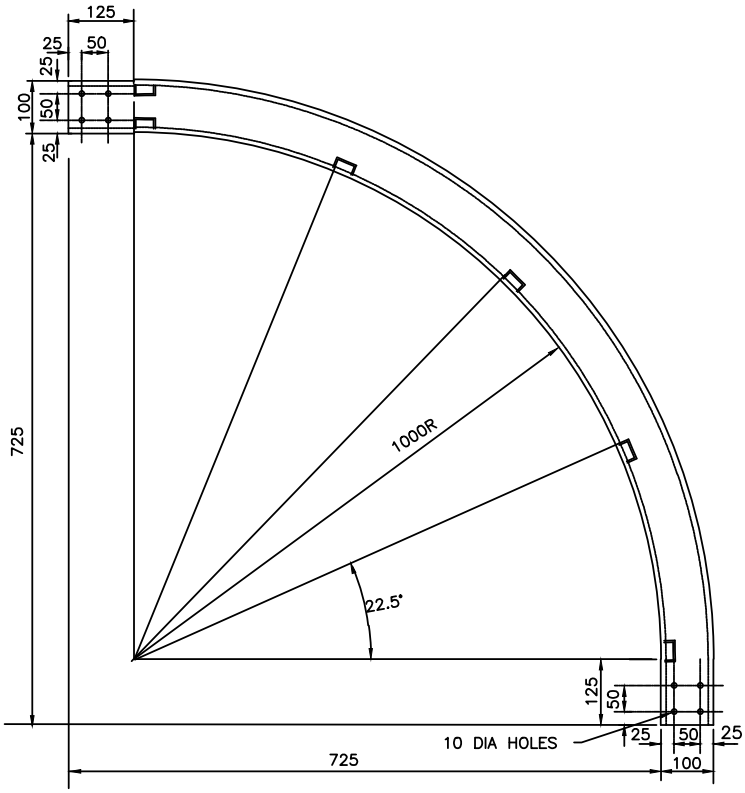
VERTICAL 90° BEND OUT SIDE

DIMENSIONS ARE IN mm.

पी डी आई एल PDIL	PRE–FABRICATED CABLE TRAY 90° VERTICAL BENDS BENDING RADIUS 600 mm	PC183–PDS:E 535	0
		DOCUMENT NO.	REV.
		SHEET 1 OF 1	



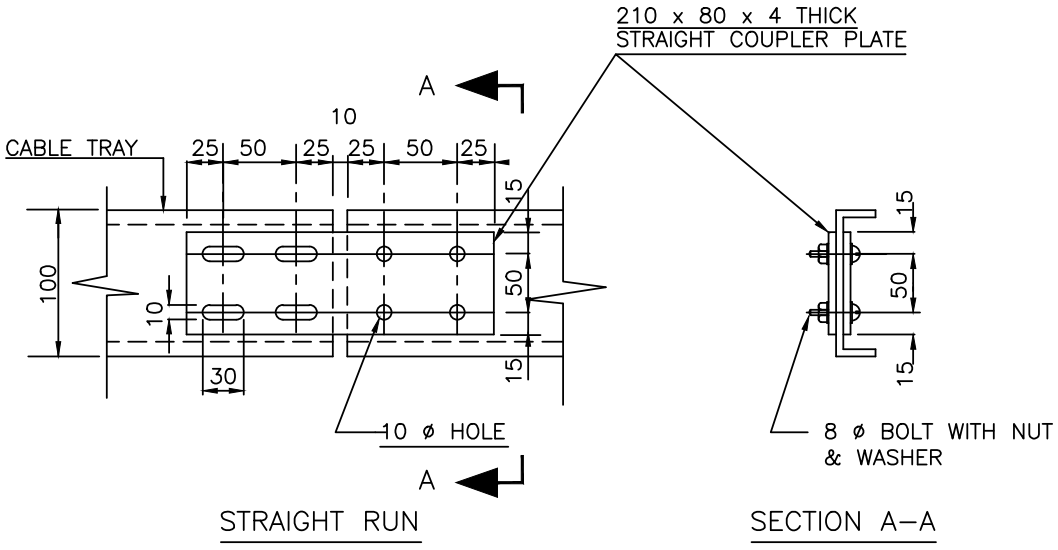
VERTICAL 90° BEND IN SIDE



VERTICAL 90° BEND OUT SIDE

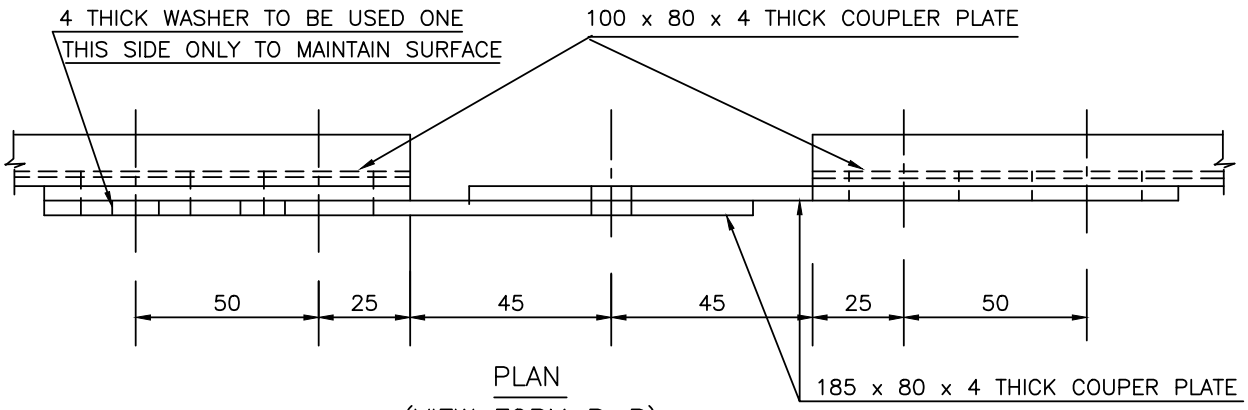
ALL DIMENSIONS ARE IN mm.

पी डी आई एल PDIL	PRE–FABRICATED CABLE TRAY COUPLING ARRANGEMENT	PC183-PDS:E 536	0
		DOCUMENT NO.	REV.
		SHEET 1 OF 1	

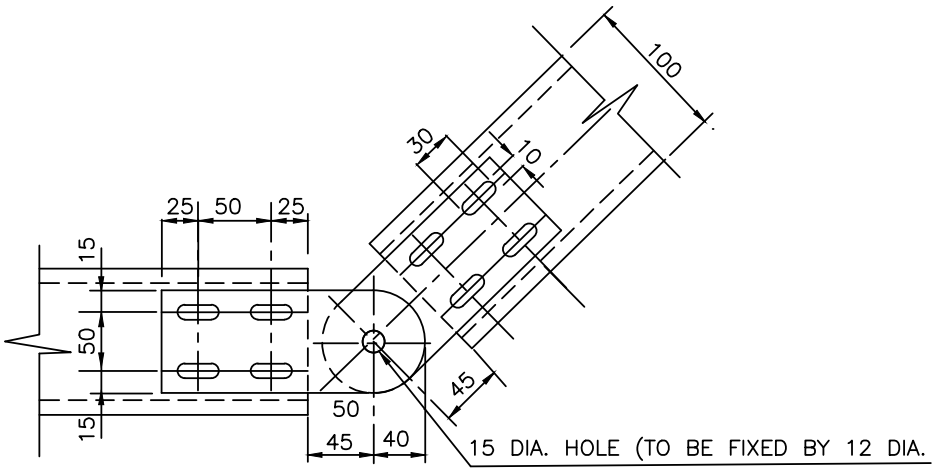


STRAIGHT RUN

SECTION A–A



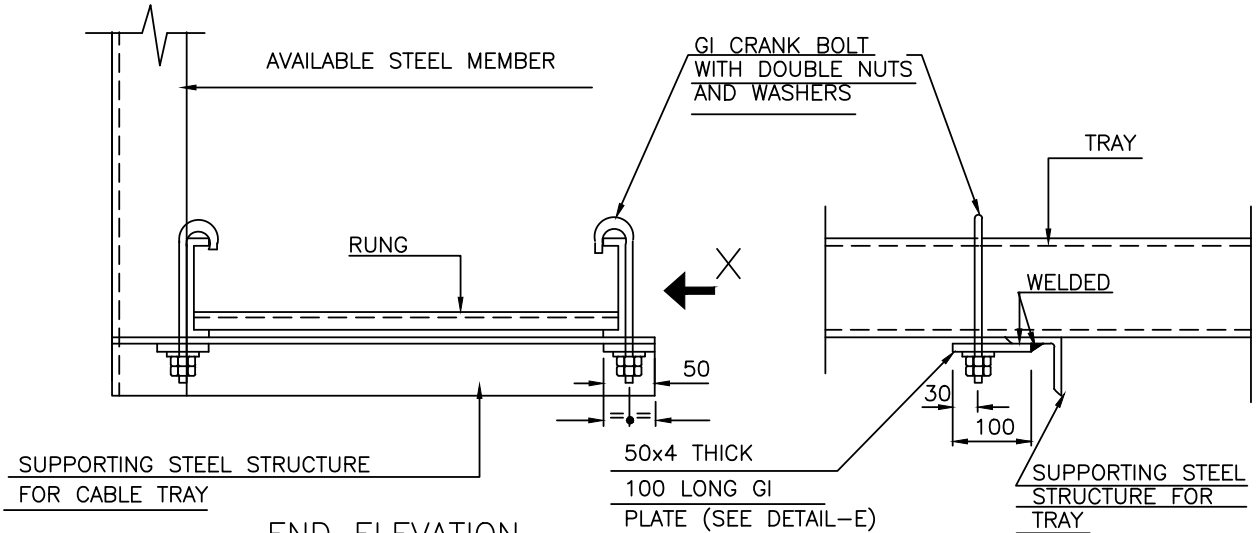
PLAN
(VIEW FORM B–B)



ELEVATION
(ADJUSTABLE BEND)

ALL DIMENSIONS ARE IN mm.

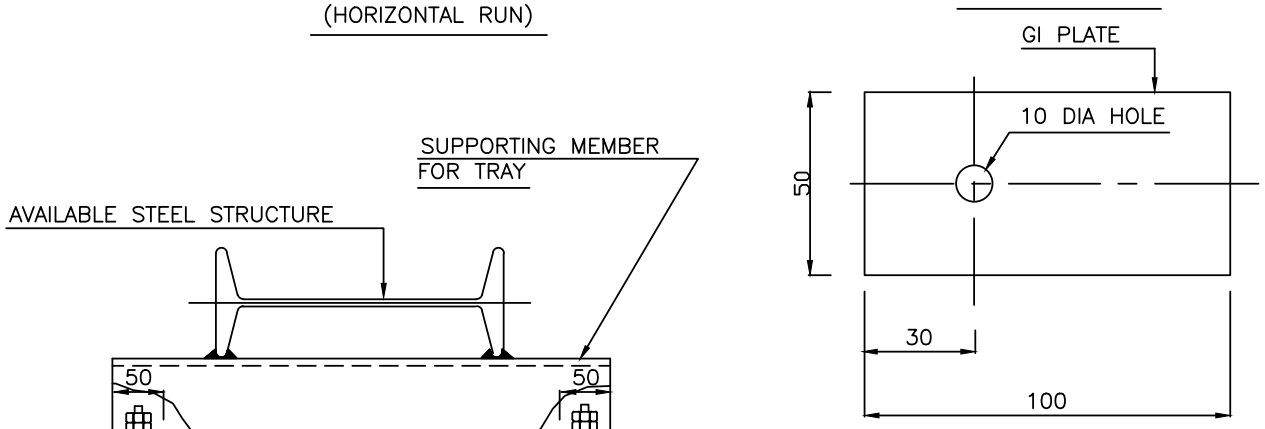
PDIL	PRE–FABRICATED CABLE TRAY FIXING ARRANGEMENT	PC183-PDS:E 537	0
		DOCUMENT NO.	REV.
		SHEET 1 OF 1	



END ELEVATION

(HORIZONTAL RUN)

VIEW AT –X

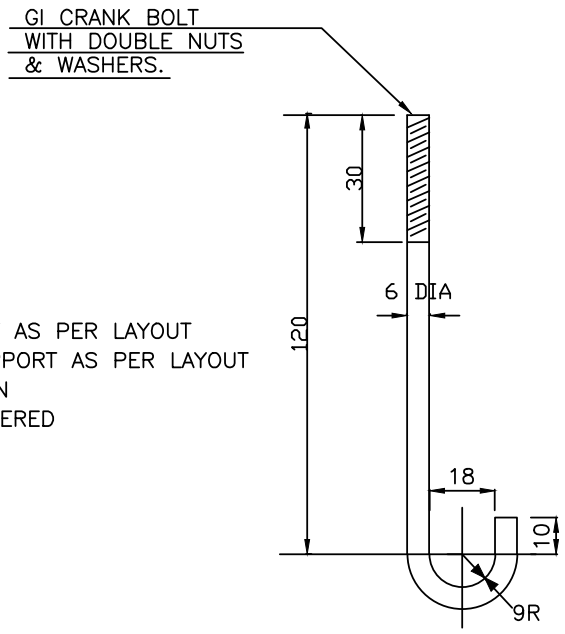


PLAN

DETAIL–E

PLAN

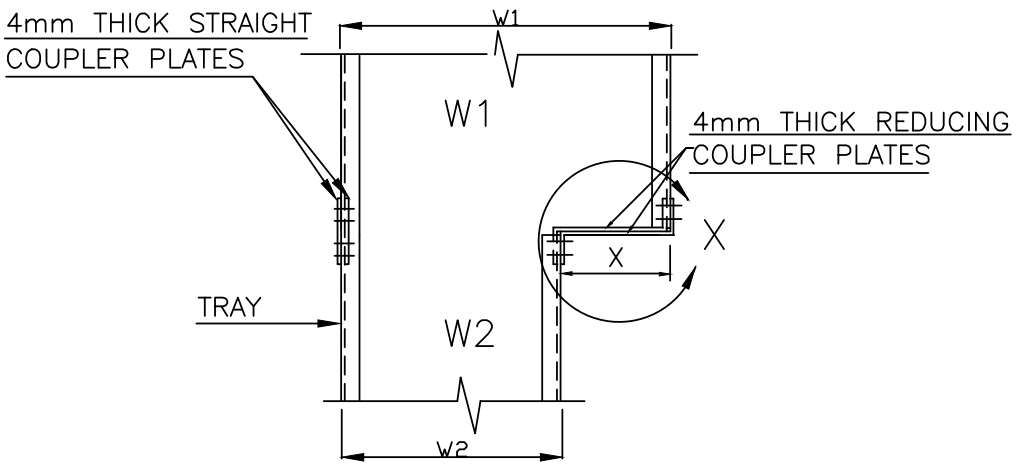
VERTICAL RUN (RISER)



NOTES:–

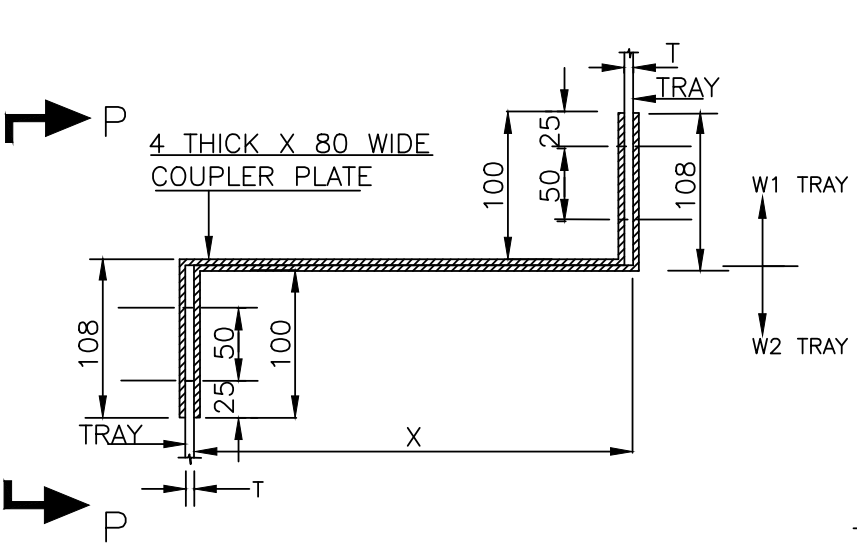
1. HORIZONTAL RUN TO BE CLAMPED WITH EVERY SUPPORT AS PER LAYOUT
2. VERTICAL RUN/ RISER TO BE CLAMPED WITH EVERY SUPPORT AS PER LAYOUT
3. EACH CRANK HOOK SHALL BE SUPPLIED WITH ONE PLAIN WASHER, ONE SPRING WASHER AND TWO DOUBLE CHAMFERED HEX NUTS. THESE SHAL BE GALVANISED ITEMS.
4. ALL DIMENSIONS ARE IN mm.

पी डी आई एल PDIL	PRE–FABRICATED CABLE TRAY REDUCING COUPLER PLATE	PC183–PDS:E 538	0
		DOCUMENT NO.	REV.
		SHEET 1 OF 1	



PLAN

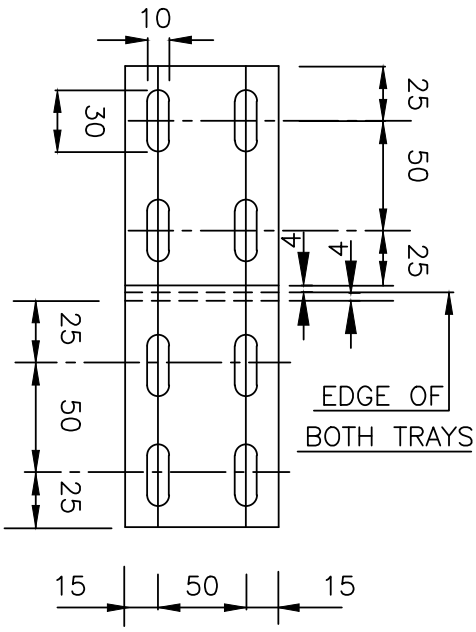
(REDUCING TRAY JOINT)



DETAIL– X

DETAIL OF REDUCING

COUPLER PLATE (4 THICK)



VIEW – P–P

ALL DIMENSIONS ARE IN mm.

SL. NO.	W1	W2	X
1	900	600 450 300	300 450 600
2	600	450 300	150 300
3	450	300 150	150 300

	GENERAL NOTES ON EARTHING AND LIGHTNING PROTECTION	PDSE: 601	0
PDIL		DOCUMENT NO.	REV
		SHEET 1 OF 2	

A. GENERAL

1. EARTHING AND LIGHTNING PROTECTION SHALL BE CARRIED OUT IN ACCORDANCE WITH IS : 3043 AND IS : 2309 RESPECTIVELY AND SHALL ALSO CONFORM TO THE REQUIREMENTS OF INDIAN ELECTRICITY RULES.
2. THESE NOTES SHALL BE READ IN CONJUCTION WITH EARTHING & LIGHTNING PROTECTION LAYOUT DRGS. AND RELEVENT EARTHING STANDARDS (PDSE)
3. THE SIZE OF EARTH CONDUCTORS & SYMBOLS SHOWN IN THE LAYOUT DRGS. SHALL AS PER PDSE: 602
4. AS FAR AS POSSIBLE, THE EARTH CONDUCTORS SHALL BE TAKEN ALONG POWER & CONTROL CABLE ROUTES.
5. EARTHING CONDUCTORS BURIED UNDER THE GROUND SHALL BE LAID ATLEAST 500 MM BELOW THE GROUND LEVEL UNLESS REQUIRED OTHERWISE, e.g FOR CROSSING ANY UNDER GROUND PIPE OR TRENCH ETC. WHERE THE EARTHING CONDUCTORS SHALL RUN AT A MINIMUM DEPTH 300 MM BELOW THE BOTTOM OF THE PIPE/TRENCH.
6. BARE ALUMINIUM CONDUCTORS SHALL NOT BE BURIED DIRECTLY UNDER THE GROUND.
7. TAPPING FROM THE UNDER GROUND EARTH GRID SHALL BE TAKEN ONLY FROM EARTH PIT OR A PIT WITHOUT ELECTRODE PROVIDED FOR THIS PURPOSE.
8. JOINTING OF UNDERGROUND EARTHING STRIPS SHALL BE AVOIDED TO THE EXTENT POSSIBLE. HOWEVER, IF JOINTING IS TO BE DONE DUE TO UNAVOIDABLE REASONS, THIS SHALL BE DONE BY ELECTRIC ARC WELDING.
9. TERMINAL JOINTING & CLAMPING ARRANGEMENT SHALL BE AS SHOWN IN PDSE:603. ALL WELDED OR BOLTED JOINTS SHALL BE PAINTED WITH EPOXY RESIN PAINT OR BITUMINOUS PAINT.
10. EARTH BUSES, AS PER CONVENIENCE, SHALL BE PROVIDED IN PLANTS FOR EARTHING GROUPS OF EQUIPMENT TO EARTHING GRID. THESE EARTH BUSES, SHALL BE AS SHOWN IN PDSE: 615.
11. DETAILS OF EARTH PIT CONNECTIONS & ACCESSORIES FOR EARTH ELECTRODES SHALL BE AS SHOWN IN PDSE :604, 605 , 610 AND 611.
12. EARTH PITS FOR EQUIPMENT EARTHING, SYSTEM NEUTRAL EARTHING & LIGHTNING PROTECTION SHALL BE SEPARATE. HOWEVER, THESE PITS SHALL BE INTERCONNECTED.
13. SPACING BETWEEN TWO EARTH PITS SHALL NOT BE LESS THAN 10 M & THESE MAY BE LOCATED ABOUT 4M AWAY FROM THE BUILDING / STRUCTURE.
14. TYPICAL ARRANGEMENT OF NEUTRAL & EQUIPMENT EARTHING SHALL BE AS SHOWN IN PDSE: 617.

B. SYSTEM NEUTRAL EARTHING

1. THE NEUTRALS OF H.T & L.T SYSTEMS SHALL BE EARTHED BY USING 2 NOS. 150 SQ. MM ALUMINIUM CABLE OF RESPECTIVE VOLTAGE GRADE. EACH EARTH CONNECTION SHALL BE TERMINATED ON SEPERATE EARTH PITS. HOWEVER, FOR ECONOMY REASONS, 2 EARTH CONNECTIONS OF 2 DIFFERENT EQUIPMENT CAN BE TERMINATED ON THE SAME EARTH PIT AS SHOWN IN PDSE: 617.
2. THE NEUTRAL OF H.T. SYSTEM SHALL BE CONNECTED TO EARTH PIT AS ABOVE THROUGH THE NEUTRAL EARTHING RESISTOR (N.E.R.) AS REQUIRED, WHERE AS THE NEUTRAL OF L.T. SYSTEM SHALL BE SOLIDLY EARTHED THROUGH RESPECTIVE L.T. SWITCH BOARD.
3. FOR D.C. SYSTEM, POSITIVE POLE SHALL BE EARTHED THROUGH HIGH IMPEDANCE IN BATTERY CHARGER.

C. ELECTRICAL EQUIPMENT EARTHING

1. ALL EQUIPMENT RATED ABOVE 250V SHALL HAVE TWO EXTERNAL EARTH CONNECTIONS & THOSE RATED 250V & BELOW SHALL HAVE ONE EXTERNAL EARTH CONNECTION.

   FLAME PROOF EQUIPMENT, IN ADDITION, SHALL HAVE ONE INTERNAL EARTH CONNECTION THROUGH ADDITIONAL CORE OF POWER / CONTROL CABLE.

REV	REV.DATE	EFF.DATE	PURPOSE	PREPD	REVWD	APPD
0	03.01.07	15.01.07	ISSUED FOR IMPLEMENTATION	NKR	AV	BB

2. EARTHING CONNECTION TO INDIVIDUAL EQUIPMENT SHALL BE TAPPED ONLY FROM THE EARTHING GRID / RING OR EARTH BUS EXCEPT FOR EQUIPMENT RATED 250V & BELOW, FOR WHICH THE CONNECTION MAY BE TAKEN FROM THE NEAR BY EARTH CONDUCTOR OF A LARGER EQUIPMENT OR FROM THE BODY OF THE LARGER EQPT.
3. EARTHING ARRANGEMENT OF MOTOR AND ASSOCIATED LOCAL CONTROL STATION SHALL BE AS SHOWN IN PDSE: 608.
4. EARTHING ARRANGEMENT OF RAILS SHALL BE AS SHOWN IN PDSE: 609 WITH BOTH ENDS EARTHED.
5. CABLES RACKS/RISERS/TRAYS SHALL BE ELECTRICALLY CONTINUOUS BY BONDING THE JOINTS BETWEEN THE RUNNER MEMBERS OF THE ADJACENT SECTIONS. THE CABLE RACKS SHALL BE CONNECTED TO THE EARTHING GRID AT SUITABLE INTERVALS.
6. EARTHING ARRANGEMENT OF LIGHTING FIXTURES & PLUG SOCKETS RATED 250V AND BELOW SHALL NOT BE SHOWN IN THE EARTHING LAYOUT DRGS. HOWEVER, PLUG SOCKETS SHALL BE EARTHED BY 10 SWG SIZE G.I./AL. CONDUCTOR TAKEN FROM THE NEAREST EARTHING GRID/CONDUCTOR AND LIGHTING FIXTURES SHALL BE PROVIDED EARTHING THROUGH CABLE ARMOURS.
7. IN SWITCH YARD AND GENERATING STATIONS SUITABLE EARTHING MAT SHALL BE PROVIDED TO REDUCE THE VALUE OF STEP/TOUCH POTENTIAL TO PERMISSIBLE VALUE.
8. SWITCH YARD FENCE SHALL BE CONNECTED TO EARTH AT A REGULAR INTERVAL, NOT EXCEEDING 10 M.

D. STATIC EARTHING

1. ALL PROCESS EQUIPMENT WHICH ARE LIKELY TO GET STATICALLY CHARGED, e.g. STORAGE TANKS, HIGH PRESSURE & MIDIUM PRESSURE VESSELS/PIPES, HIGH PRESSURE COMPRESSORS. HIGH PRESSURE STEAM EJECTORS ETC. SHALL BE EARTHED AGAINST STATIC CHARGE ACCUMULATION.
2. EARTHING ARRANGEMENT ACROSS PIPE JOINTS/VALVES SHALL BE AS SHOWN IN PDSE: 612
3. DETAILS OF EARTHING OF VESSELS SHALL BE AS SHOWN IN PDSE: 613.
4. MOBILE EQUIPMENT, REQUIRING EARTHING AGAINST STATIC CHARGE, SHALL BE TEMPORARILY EARTHED AS SHOWN IN PDSE: 608.
5. PIPE TRESTLE CARRYING PIPES WITH HYDRO CARBONS SHALL BE CONNECTED TO EARTH GRID AT REGULAR INTERVALS, NOT EXCEEDING 25 M.
6. WHEREVER PROCESS EQUIPMENT ARE MOUNTED ON STEEL STRUCTURE, THE BASE OF THE STRUCTURES SHALL BE EARTHED INSTEAD OF EARTHING THE INDIVIDUAL EQUIPMENT.

E. LIGHTNING PROTECTION

1. FIXING ARRANGEMENT ON AIR TERMINATION AND ROOF/DOWN CONDUCTOR FOR LIGHTNING PROTECTION SYSTEM SHALL BE AS SHOWN IN PDSE: 614.
2. FOR LIGHTNING PROTECTION OF TALL STEEL STRUCTURES/VESSELS/TANKS, DOWN CONDUCTOR SHALL BE TAKEN FROM THE BASE AND CONNECTED TO EARTH PITS. AIR TERMINATION ROD SHALL NOT BE REQUIRED.
3. LIFT SHAFT SHALL NOT BE USED FOR FIXING THE DOWN CONDUCTOR.
4. IN CASE EARTH PITS FOR CONNECTING THE DOWN CONDUCTORS ARE NOT AVAILABLE IN THE BEGINNING OF FABRICATION/ERECTION OF SUCH STRUCTURES/VESSELS / TANKS. THEIR BASES SHALL TEMPORARILY BE CONNECTED TO NEAR BY STEEL COLUMN. ELECTRICAL CONTINUITY OF THE STRUCTURES, HOWEVER, SHALL BE CHECKED AND ENSURED.
5. FOR ALL HIGH RISE CONCRETE STRUCTURES, TEMPORARY LIGHNING PROTECTION NEED BE PROVIDED DURING CONSTRUCTION AND MAINTAINED TILL PERMANENT LIGHTNING PROTECTION IS INSTALLED. FOR THIS PURPOSE THE VERTICAL REINFORCEMENT, PROJECTING OVER EACH LIFT, SHALL BE CONNECTED TO EARTH PITS BY MEANS OF 2 NOS. FLEXIBLE COPPER CONDUCTOR CABLES. EACH OF THE FLEXIBLE CABLE SHALL BE OF 95 Sq. mm SIZE HAVING ONE END PERMANENTLY CONNECTED TO EARTH PIT AND OTHER END PROVIDED WITH A CLAMP FOR CONNECTING TO THE EXPOSED REINFORCEMENT.

SL. No.	EQUIPMENT TO BE EARTHED	FAULT LEVEL (MVA)	G.I.STRIPS/WIRES			ALUMINIUM					REMARKS
			MIN.SIZE (mm^2)	SIZE TO BE USED (mm^2)	SYMBOL	MIN.SIZE (mm^2)	STRIPS/WIRES SIZE TO BE USED (mm^2)	STRIPS/WIRES SYMBOL	1.1kv PVC SINGLE CORE CABLE SIZE (mm^2)	1.1kv PVC SINGLE CORE CABLE SYMBOL	
1A.	FOR PLANTS HAVING SWITCHYARDS/ GENERATING STATION										
I.	SWITCH YARD EQUIPMENT,GENERATORS,H.T.SWITCH BOARDS,TRANSFORMERS,MAIN EARTHING GRID, CONNECTION FROM EARTH BUS TO EARTHING GRID.	750 AT 11KV	706	2-50x8	2 (2)	491	2-38.1x6.35=484	2 (12)	500	21	AS PER CLAUSE 17.3.2 OF IS:3043
II.	SWITCH YARD EQUIPMENT,GENERATORS,H.T.SWITCH BOARDS,TRANSFORMERS,MAIN EARTHING GRID, CONNECTION FROM EARTH BUS TO EARTHING GRID.	500 AT 11KV 300 AT 6.6KV 150 AT 3.3KV	471	60x8	1	328	50.8x6.35=323	11	400	22	-DO-
III.	SWITCH YARD EQUIPMENT,GENERATORS,H.T.SWITCH BOARDS,TRANSFORMERS,MAIN EARTHING GRID, CONNECTION FROM EARTH BUS TO EARTHING GRID.	250 AT 6.6KV 125 AT 3.3KV	392	50x8	2	272	50.8x6.35=323	11	300	23	-DO-
IV.	SWITCH YARD EQUIPMENT,GENERATORS,H.T.SWITCH BOARDS,TRANSFORMERS,MAIN EARTHING GRID, CONNECTION FROM EARTH BUS TO EARTHING GRID.	350 AT 11KV 200 AT 6.6KV 100 AT 3.3KV	330 314 314	50x8	2	229 218 218	38.1x6.35=242	12	240	24	-DO-
V.	SWITCH YARD EQUIPMENT,GENERATORS,H.T.SWITCH BOARDS,TRANSFORMERS,MAIN EARTHING GRID, CONNECTION FROM EARTH BUS TO EARTHING GRID.	250 AT 11KV 150 AT 6.6KV 75 AT 3.3KV	235	50x6	3	163	31.75x4.78=152	13	185	25	-DO-
1B	FOR PLANTS WITHOUT SW.YARD/GENERATING STN. H.T.SWITCH BOARDS,TRANSFORMERS,MAIN EARTHING GRID, CONNECTION FROM EARTH BUS TO EARTHING GRID.	ANY FAULT LEVEL AT ANY VOLTAGE	210	50x6	3	120	38.1x3.18=121	14	120	27	AS PER CLAUSE 12.3.2 OF IS:3043
1C	ALL M.V.SWITCH BOARDS		210	50x6	3	120	38.1x3.18=121	14	120	27	AS PER CLAUSE 12.3.2 OF IS:3043
2	H.V. MOTORS		210	50x6	3	120	38.1x3.18=121	14	120	27	-DO-
3	TRANSFOMER NEUTRALS		–	–	–	120	–		150	26	-
4	M.V. MOTORS RATED 75KW & ABOVE		210	50x6	3	120	38.1x3.18=121	14	120	27	AS PER CLAUSE 12.3.2 OF IS:3043
5	M.V. MOTORS ABOVE 30KW &LESS THAN 75KW		175	35x6	4	93	31.75x3.18=101	15	95	28	-DO-

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EARTHING CONDUCTOR DETAILS

PC183-PDS:E 602

DOCUMENT NO.

REV. 0

SHEET 1 OF 2

SL. No.	EQUIPMENT TO BE EARTHED	FAULT LEVEL (MVA)	G.I.STRIPS/WIRES			ALUMINIUM					REMARKS
			MIN.SIZE (mm^2)	SIZE TO BE USED (mm^2)	SYMBOL	MIN.SIZE (mm^2)	STRIPS/WIRES		1.1kv PVC SINGLE CORE CABLE		
							SIZE TO BE USED (mm^2)	SYMBOL	SIZE (mm^2)	SYMBOL	
6	M.V.MOTORS ABOVE 5.5KW & LESS THAN 30KW 63A SW.SOCKETS,BATTERY CHARGERS,LIGHTING SUB–DIST.BDS.,D.C.BDS.		44	25x6	5	25	2 SWG=38.6	17	25	29	AS PER CLAUSE 12.3.2 OF IS:3043
7	M.V.MOTORS RATED 5.5KW & BELOW		7	8 SWG= 13	6	5	10 SWG=8.3	18	6	30	–DO–
8	ALL MINOR EQUIPMENT RATED FOR 250V & BELOW		–	10 SWG= 8.3	7	–	10 SWG=8.3	18	6	30	
9	NON ELECTRICAL EQUIPMENT,SUCH AS VESSELS STRUCTURES IN HAZARDOUS AREA & LIGHTNING PROTECTION CONDUCTORS		32x6	35x6	4	–	25.4x3.18=81	16	–	–	AS PER IS:2309

NOTE:–EARTHING CODUCTOR SIZES FOR ITEMS AT SL.No.4,5,6 & 7 SHOULD BE CHOSEN AS HALF THE POWER CABLE SIZES ACTUALLY USED.

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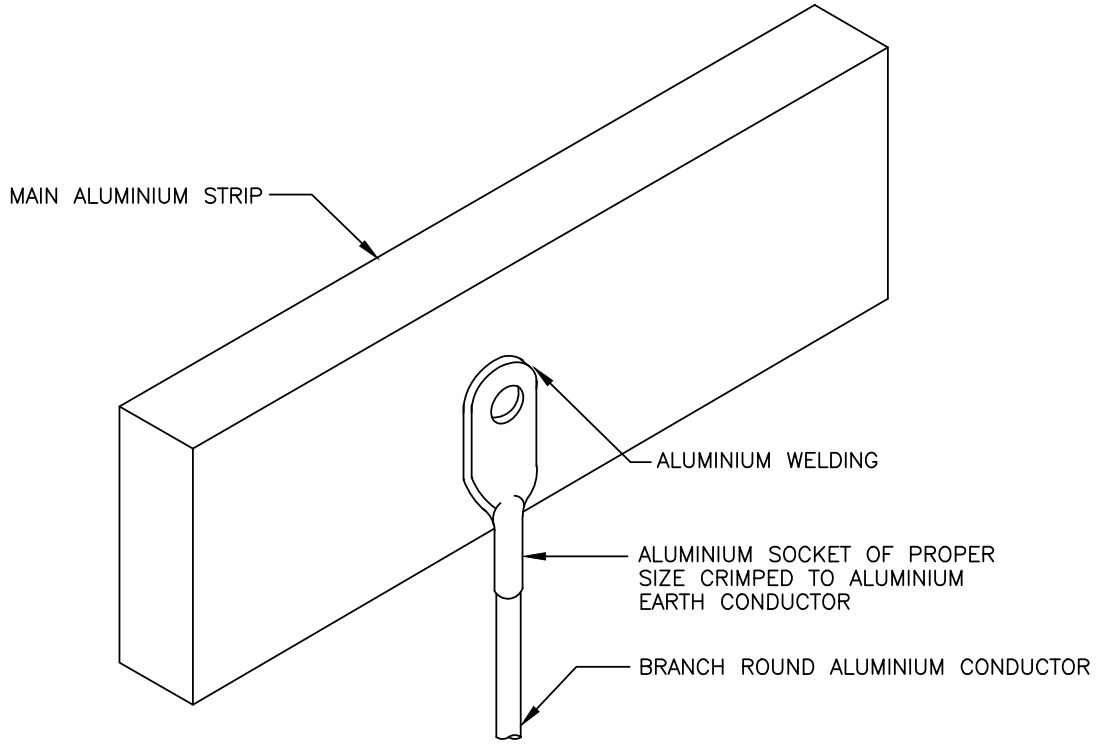
EARTHING CONDUCTOR DETAILS

PC183–PDS:E 602

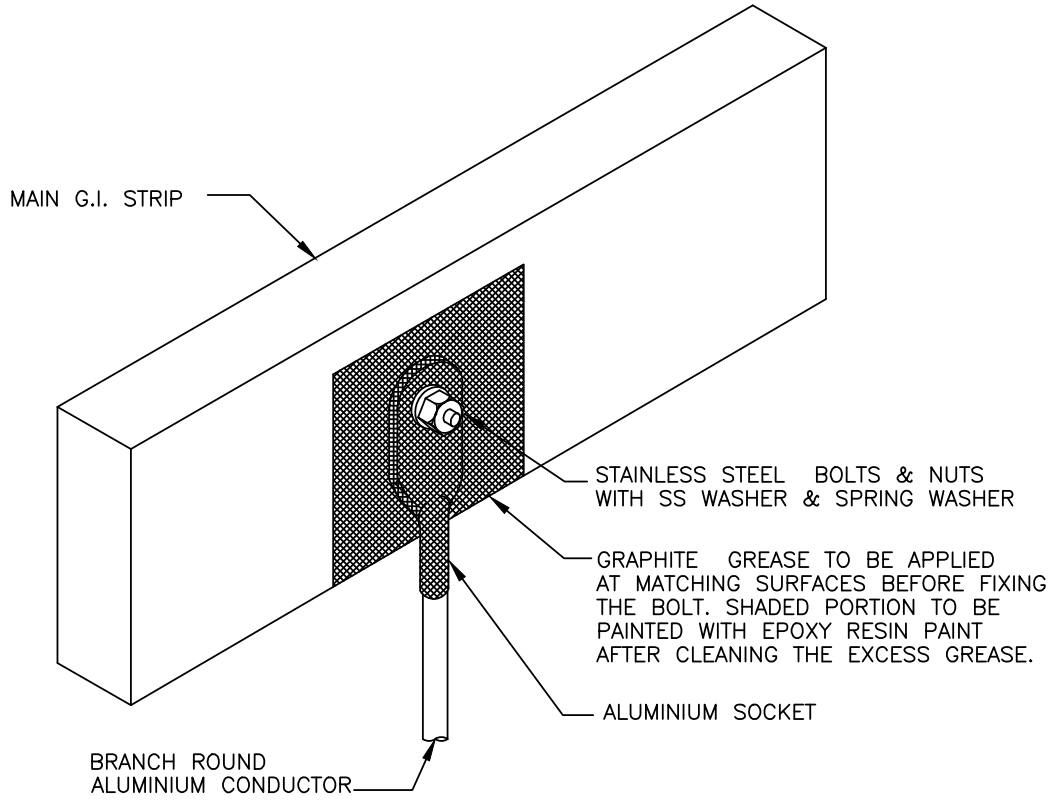
DOCUMENT NO.

REV. 0

SHEET 2 OF 2



' T ' JOINT ALUMINIUM STRIP TO ROUND ALUMINIUM CONDUCTOR



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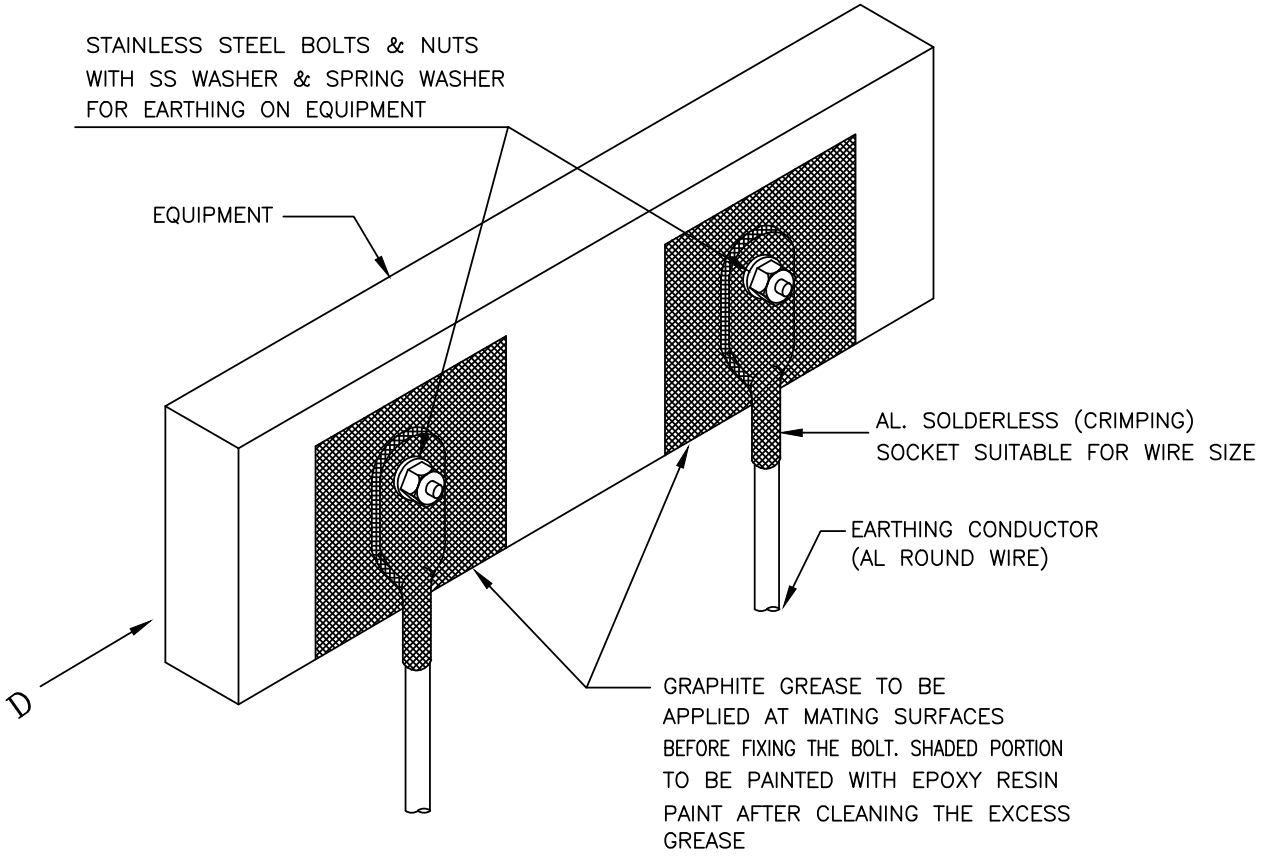
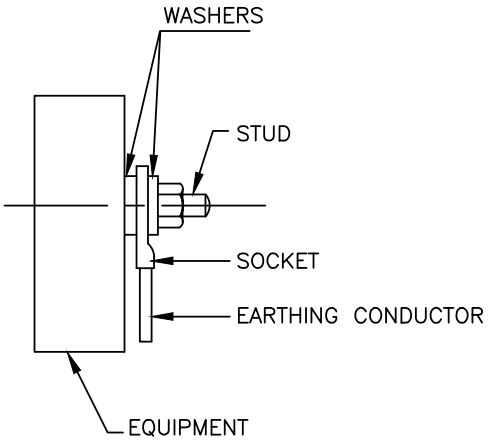
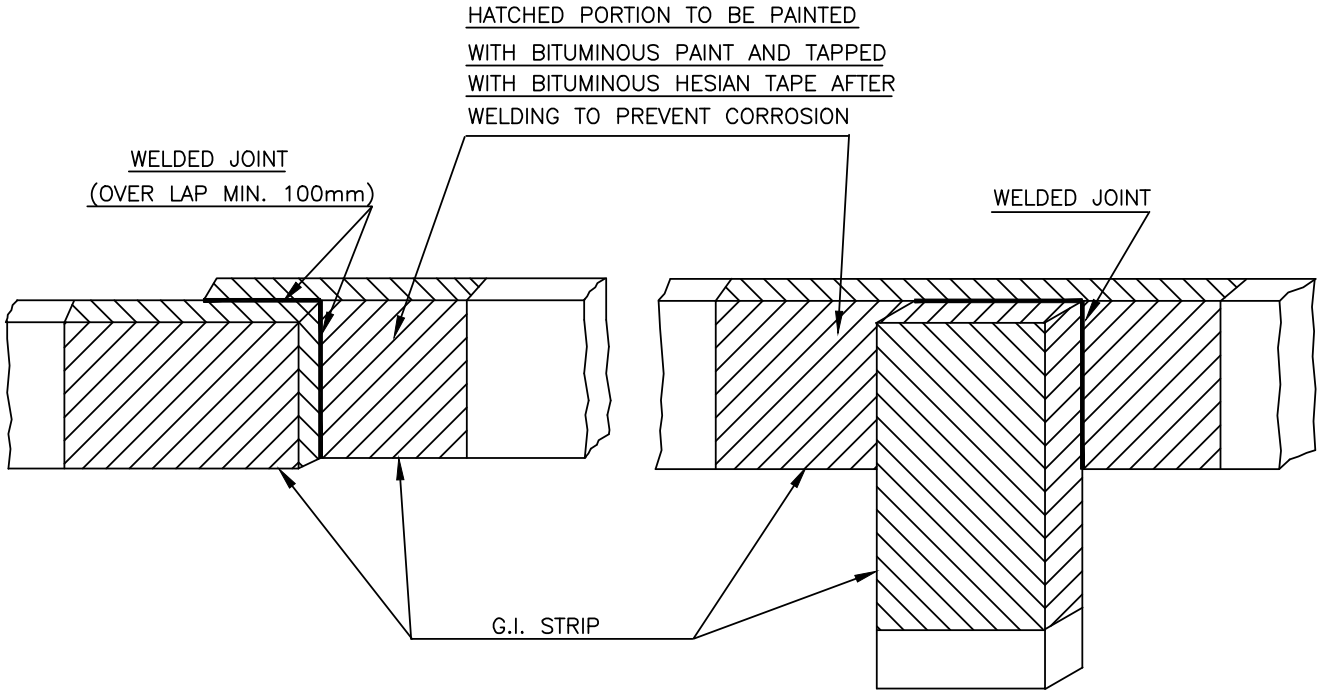


ARRANGEMENT OF DOUBLE EARTH CONNECTIONS TO EQUIPMENT

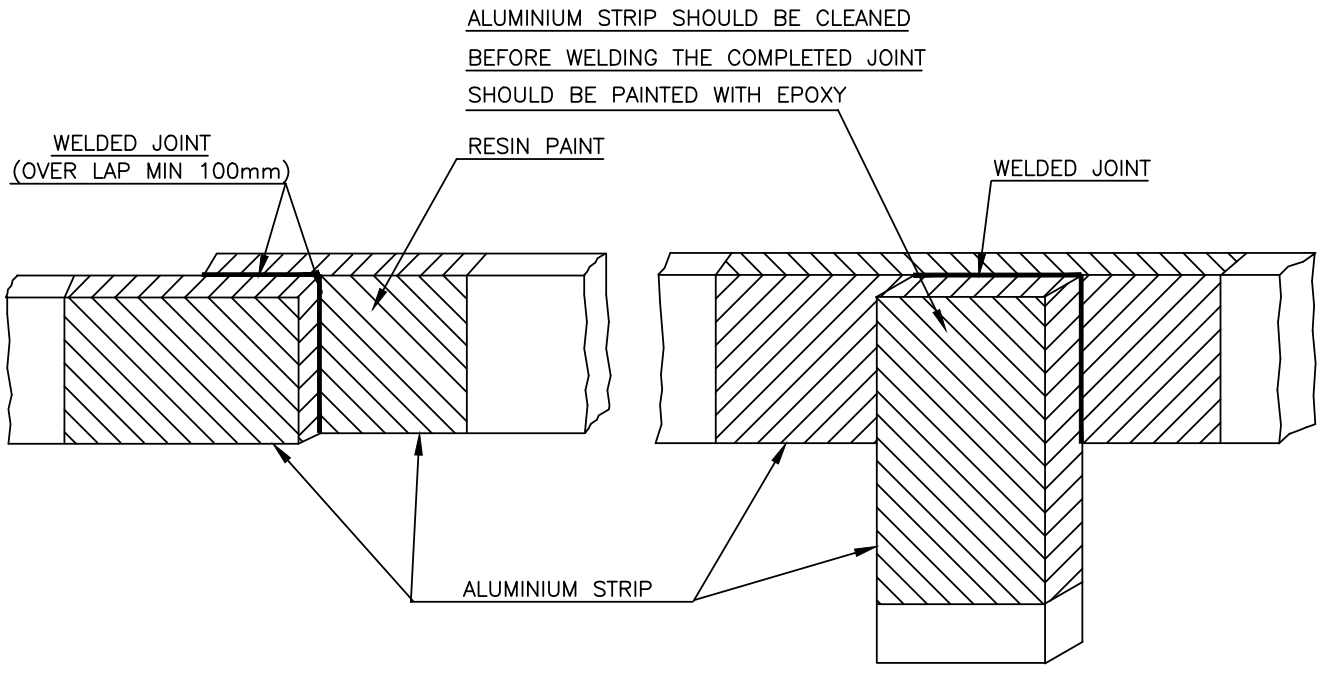


V I E W F R O M – D



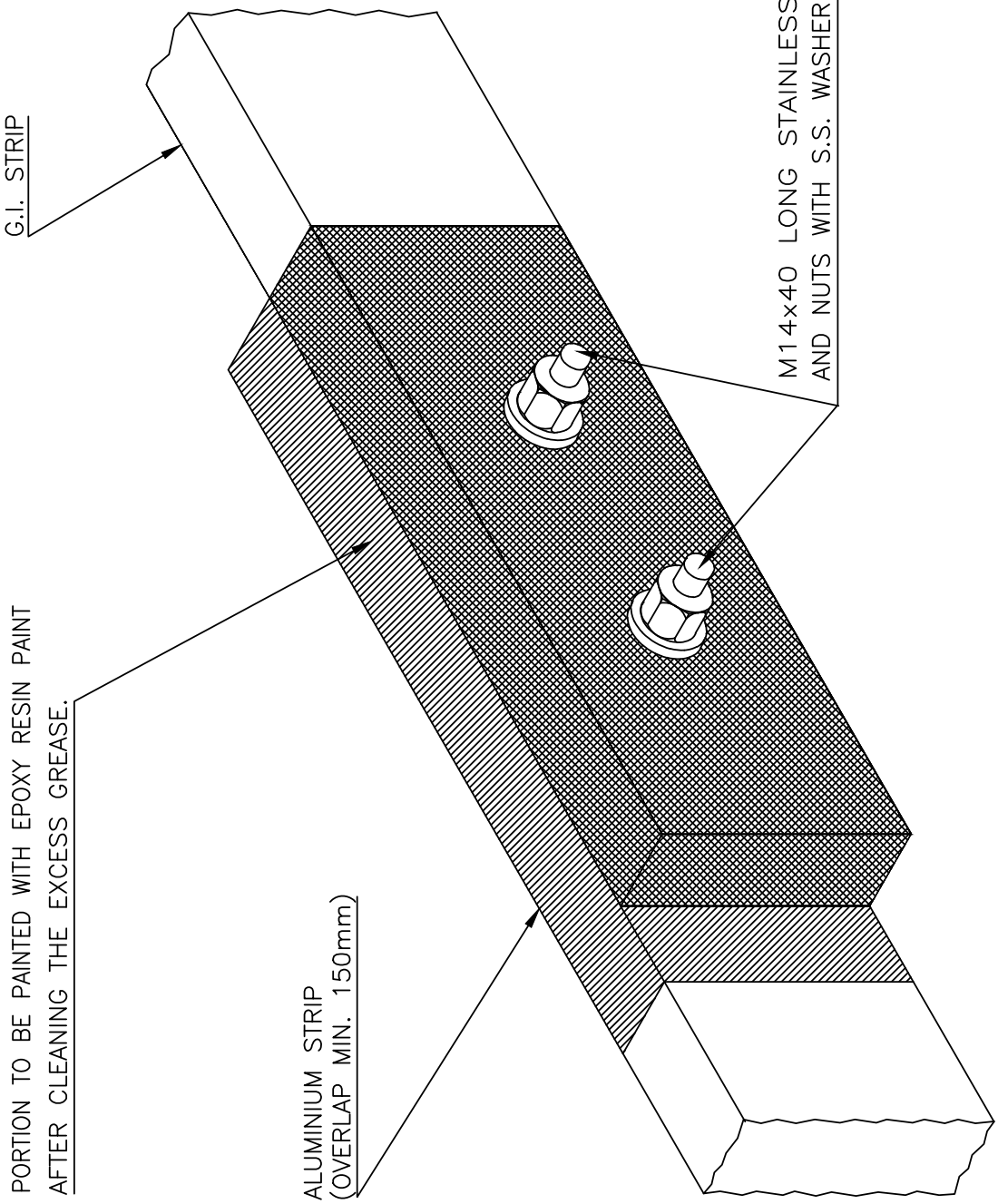
STRAIGHT JOINT G.I TO G.I. STRIP

" T " JOINT G.I. TO G.I. STRIP



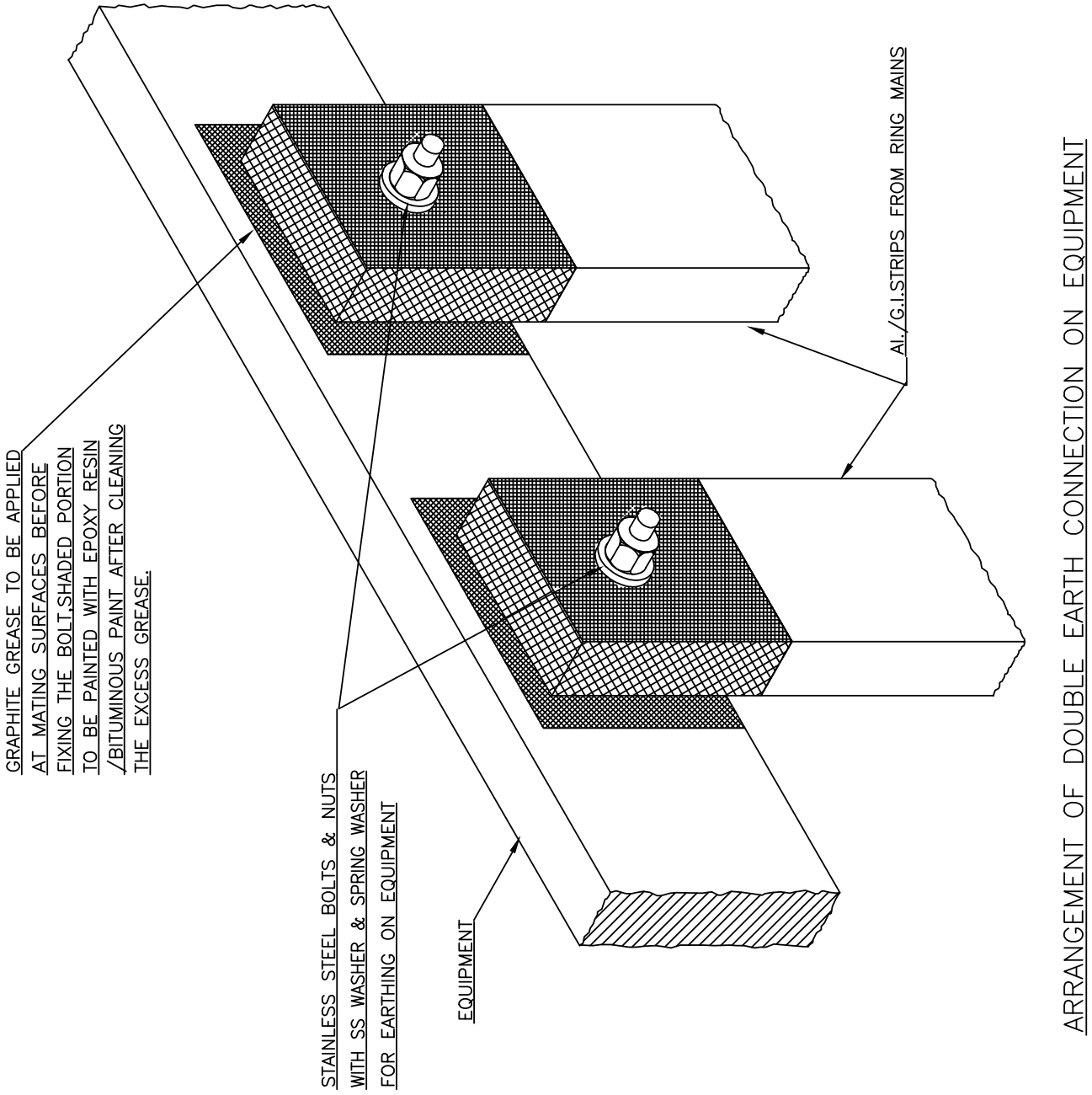
STRAIGHT JOINT AL. TO AL. STRIP

" T " JOINT AL TO AL STRIP



ARRANGEMENT OF LAP JOINT BETWEEN

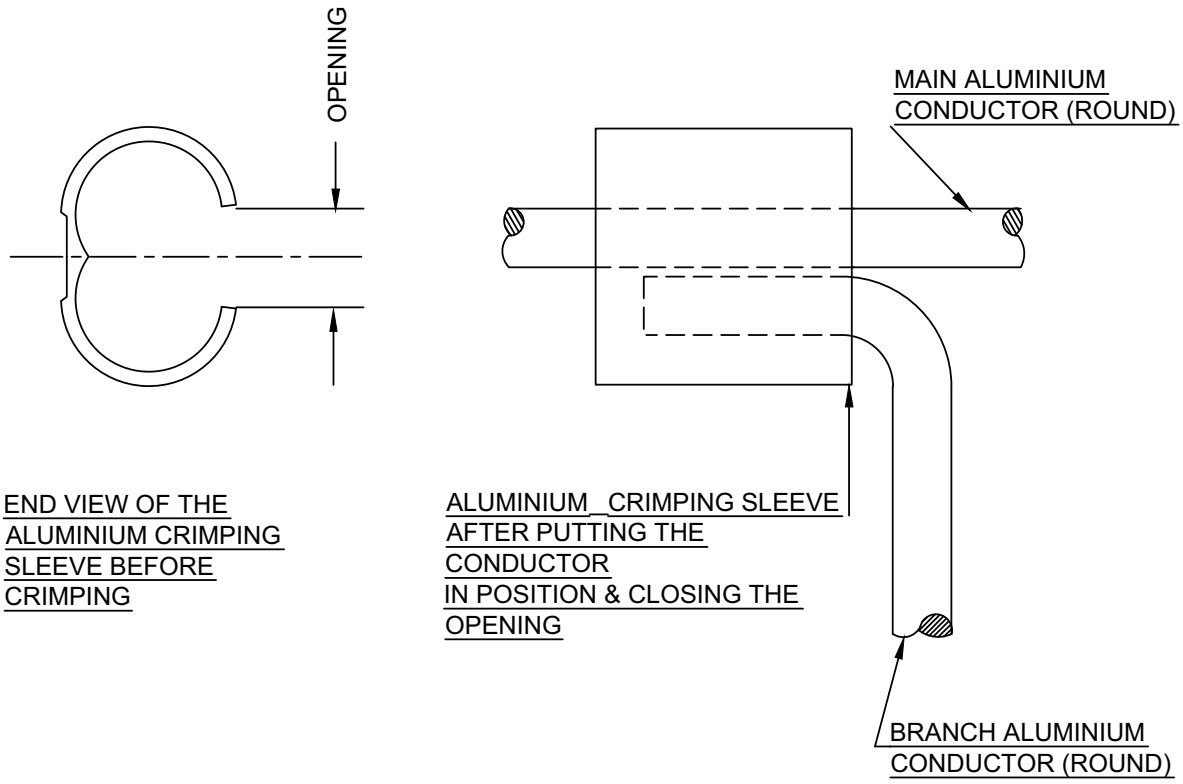
AI. EARTH STRIP TO G.I. EARTH STRIP



ARRANGEMENT OF DOUBLE EARTH CONNECTION ON EQUIPMENT

NOTE:-

EPOXY RESIN PAINT SHALL BE USED FOR AL STRIP AND BITUMINOUS PAINT FOR G.I.STRIP.

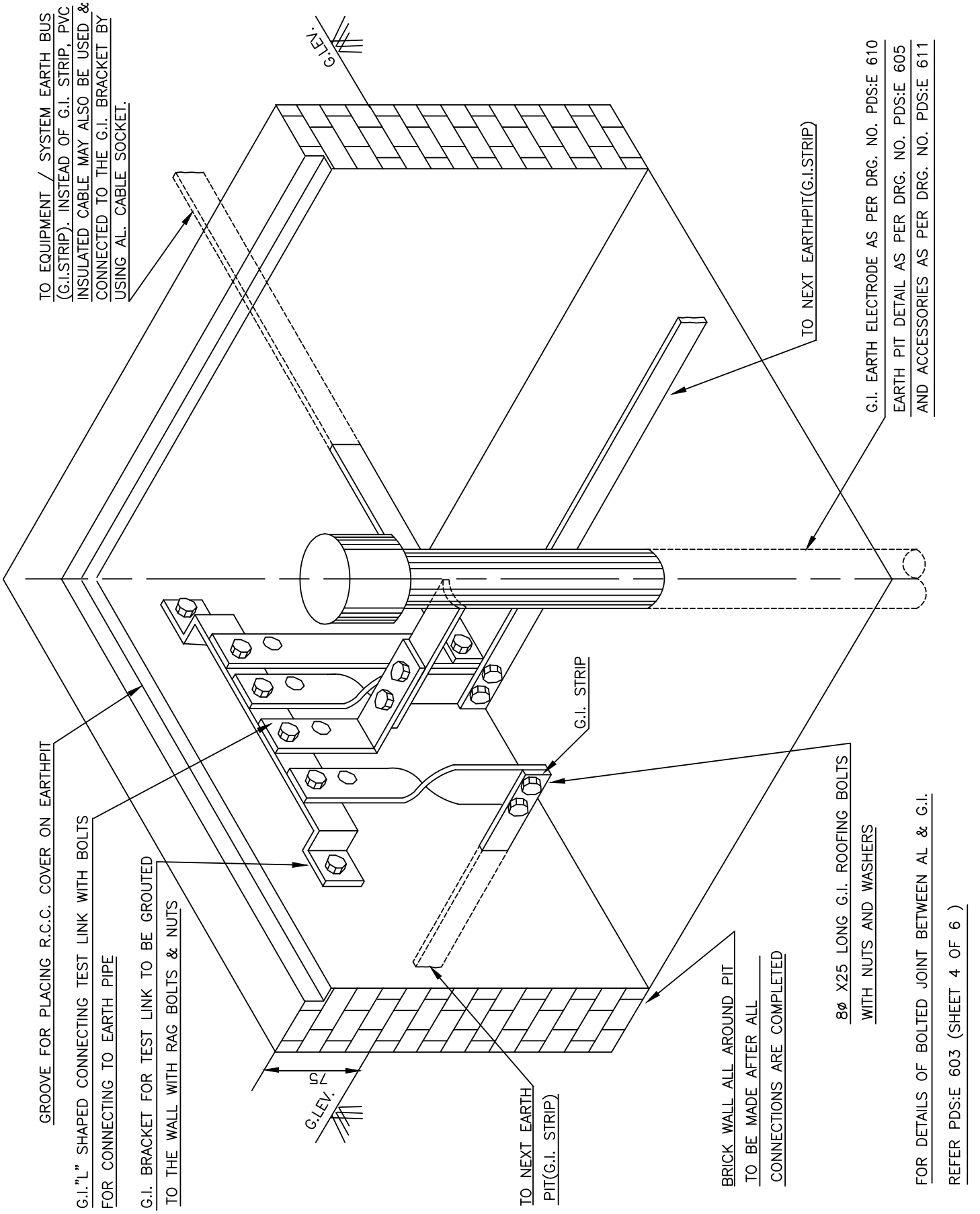


"T" JOINT ROUND ALUMINIUM CONDUCTOR TO ROUND ALUMINIUM CONDUCTOR (CRIMPING TYPE)

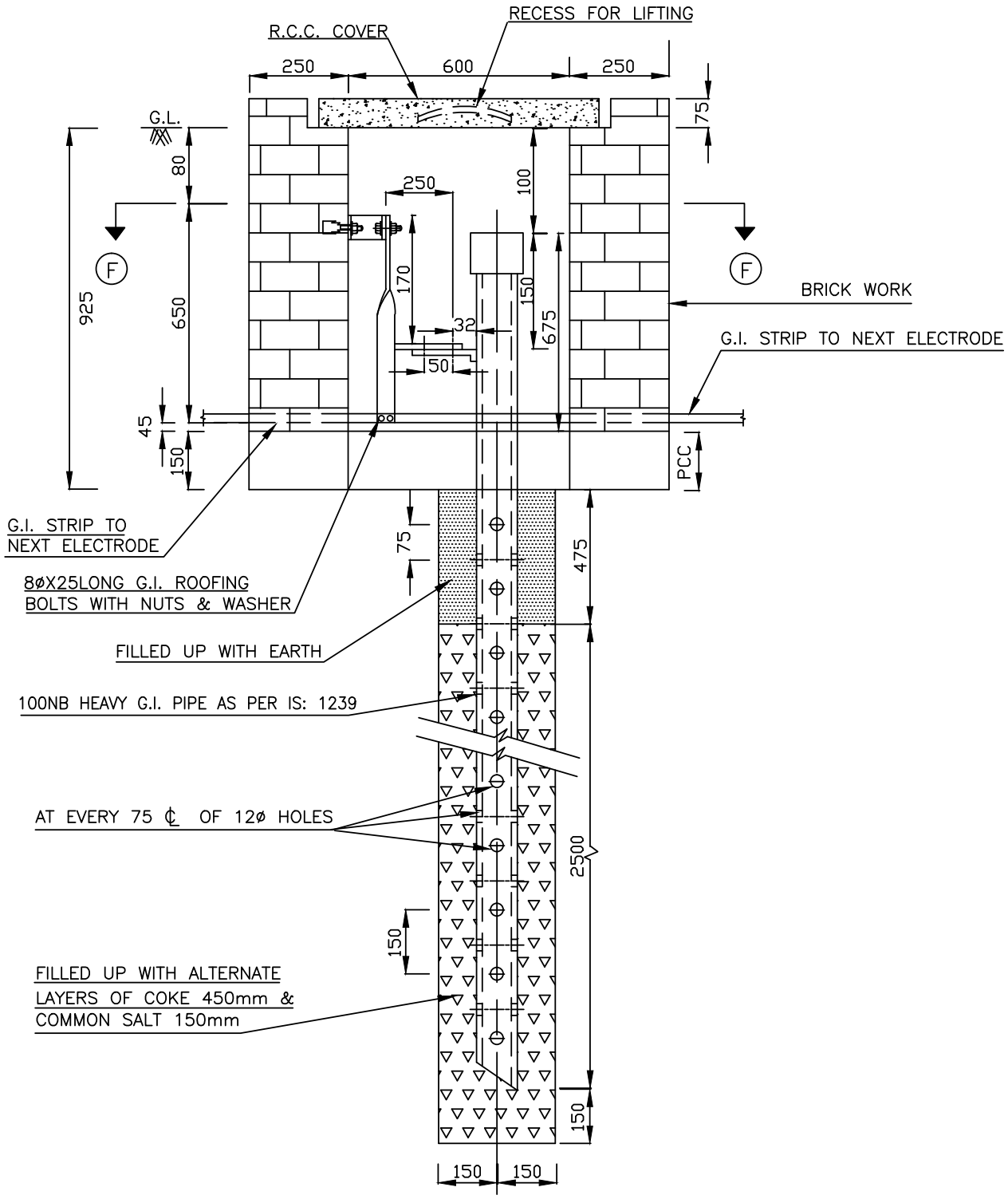
NOTE :-

USE CORRECT SIZE OF COMPRESSION DIES.

पी डी आई एल PDIL	TYPICAL DETAILS OF CONNECTIONS IN EARTH PIT	PC183-PDS:E 604	0
		DOCUMENT NO.	REV.
		SHEET 1 OF 1	

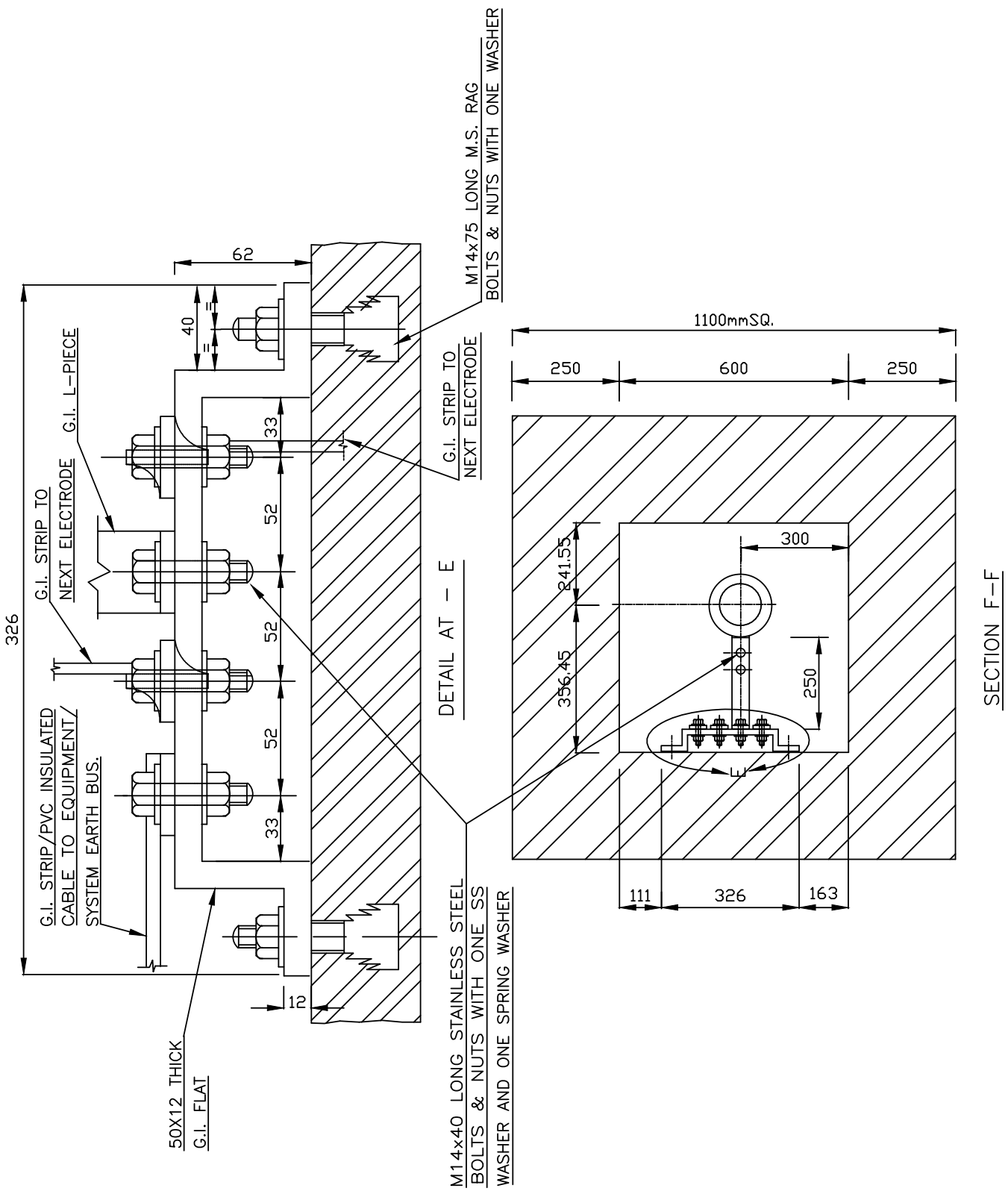


पी डी आई एल PDIL	EARTH PIT DETAILS	PC183-PDS:E 605	0
		DOCUMENT NO.	REV.
		SHEET 1 OF 2	

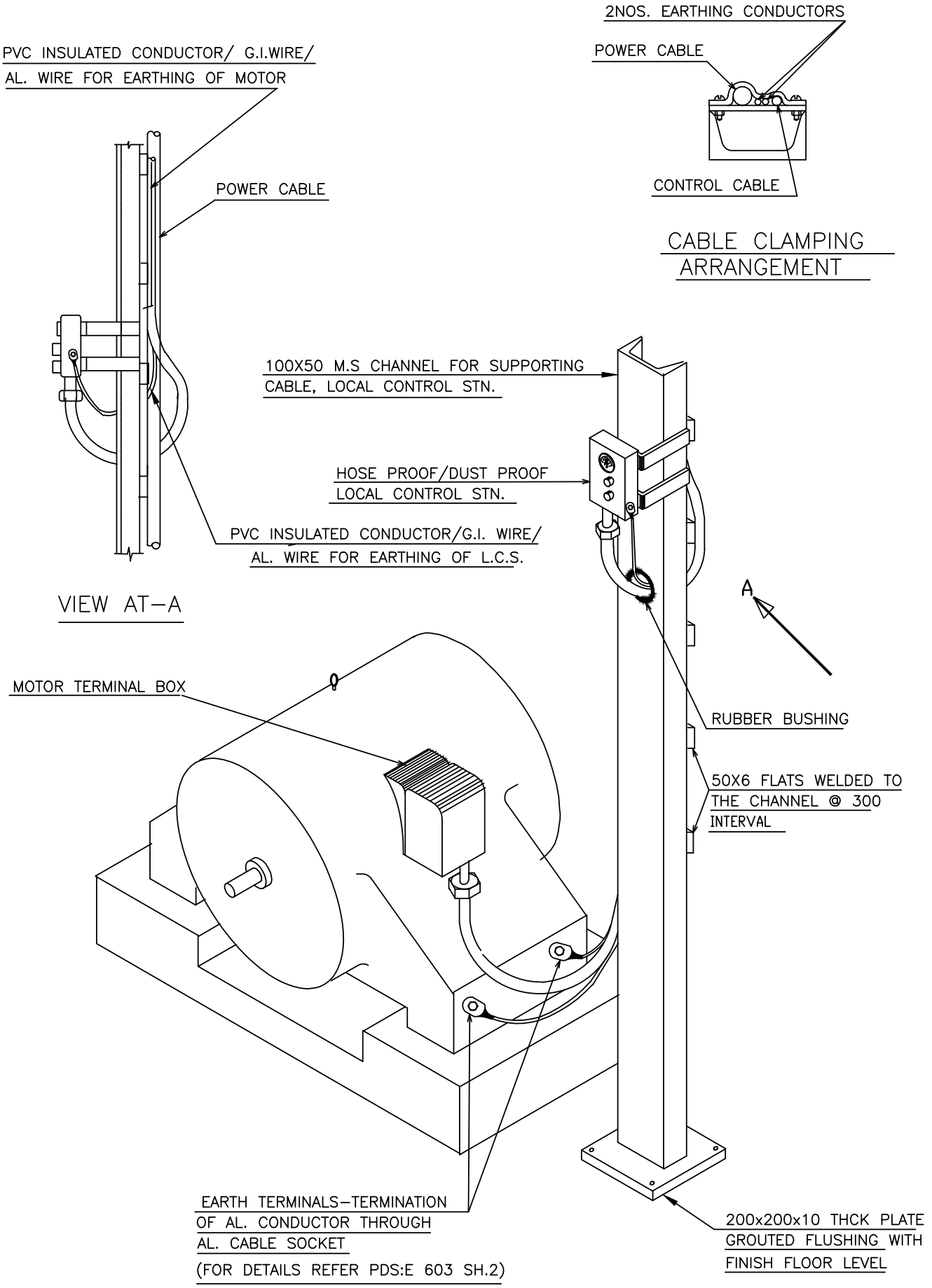


SECTIONAL ELEVATION OF EARTH PIT

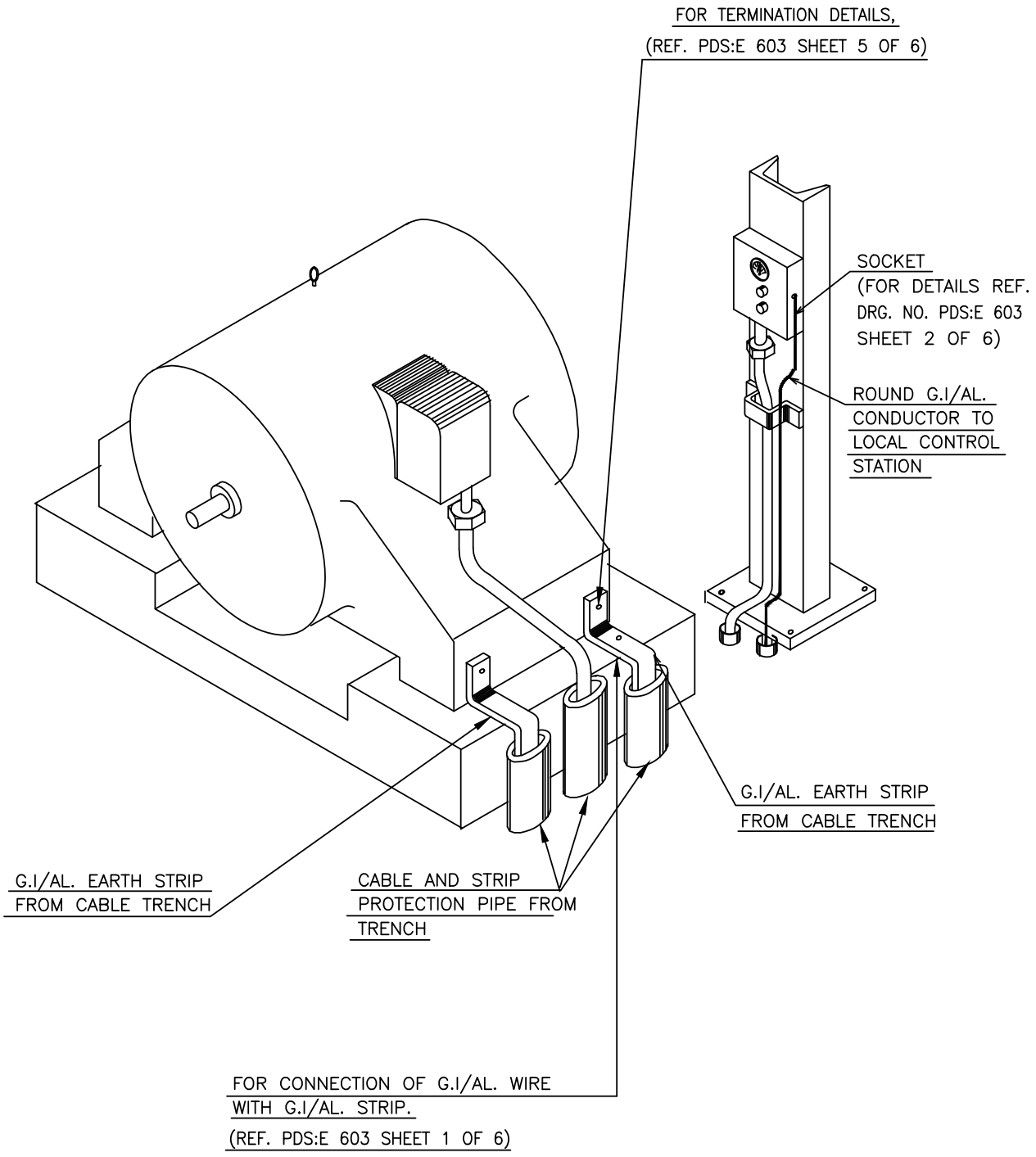
पी डी आई एल PDIL	EARTH PIT DETAILS	PC183-PDS:E 605	0
		DOCUMENT NO.	REV.
		SHEET 2 OF 2	

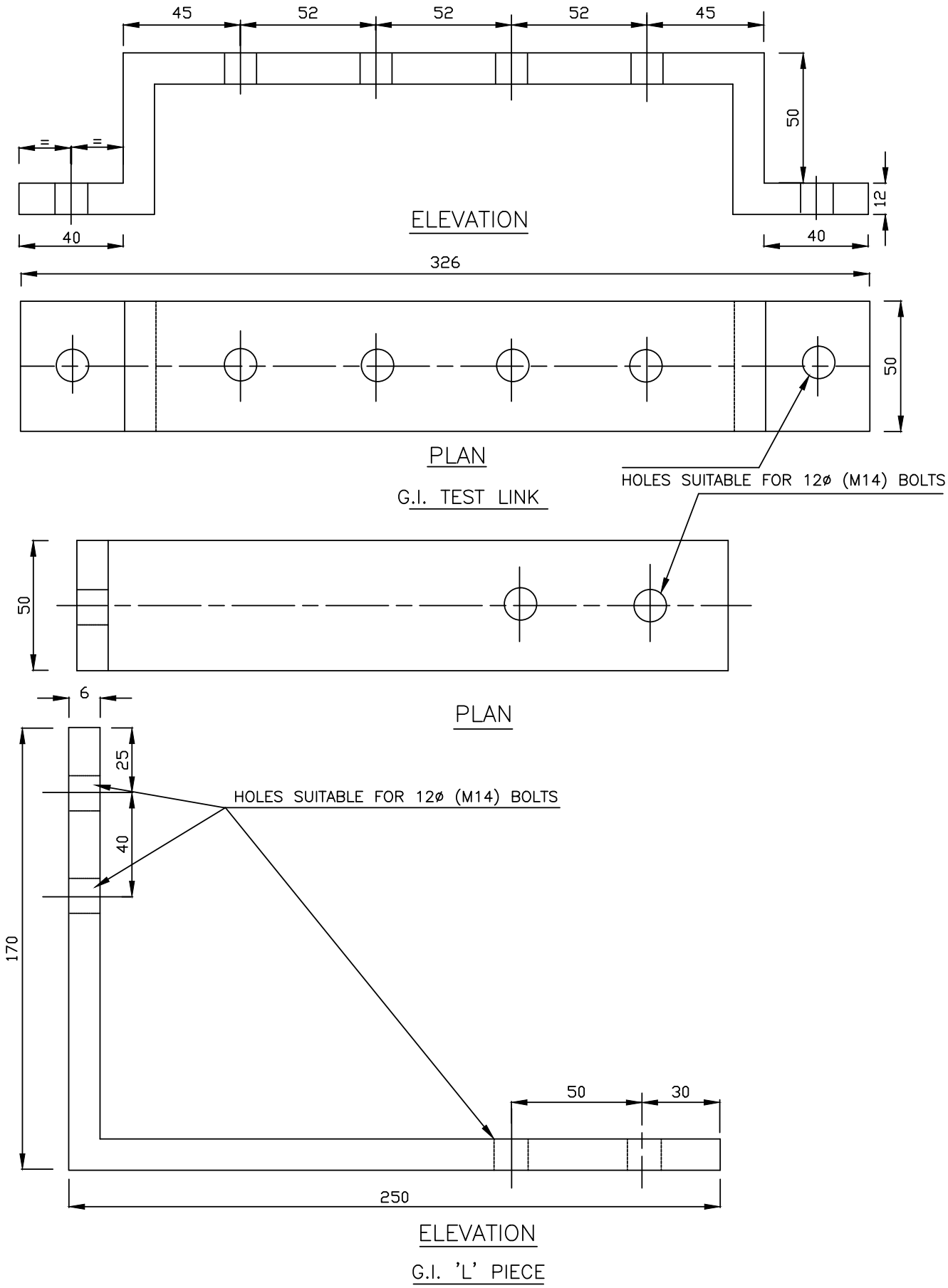


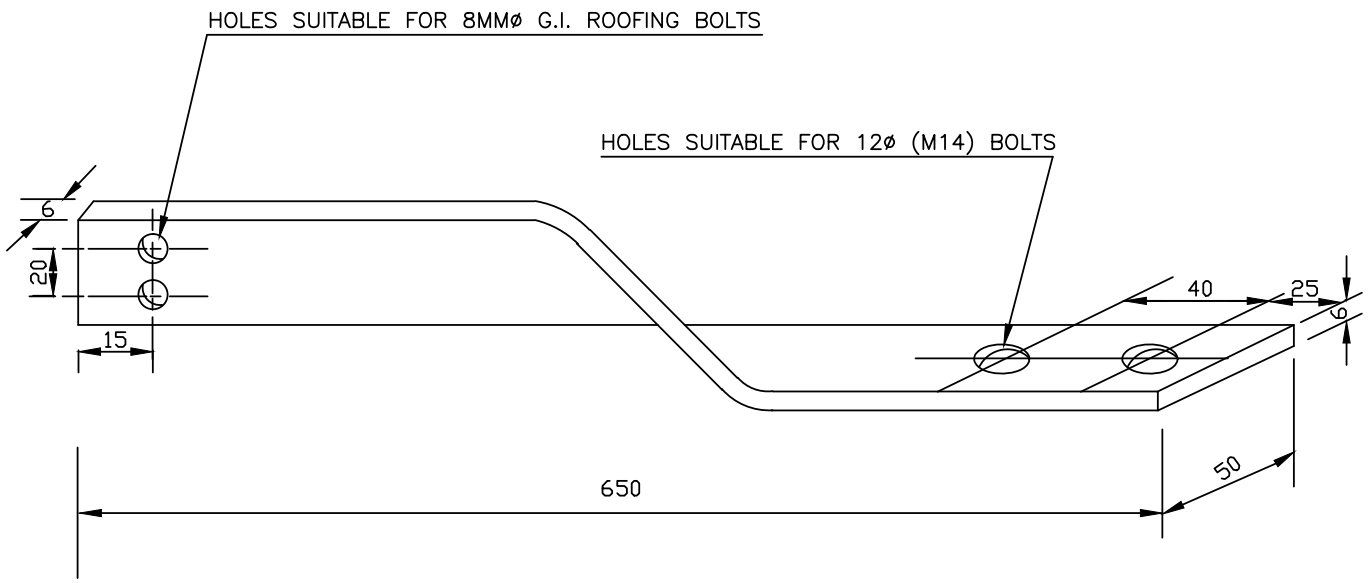
पी डी आई एल PDIL	TYPICAL ARRANGEMENT OF EARTHING FOR MOTOR AND START STOP PUSH BUTTON STATION	PC183–PDS:E 606	0
		DOCUMENT NO.	REV.
		SHEET 1 OF 2	



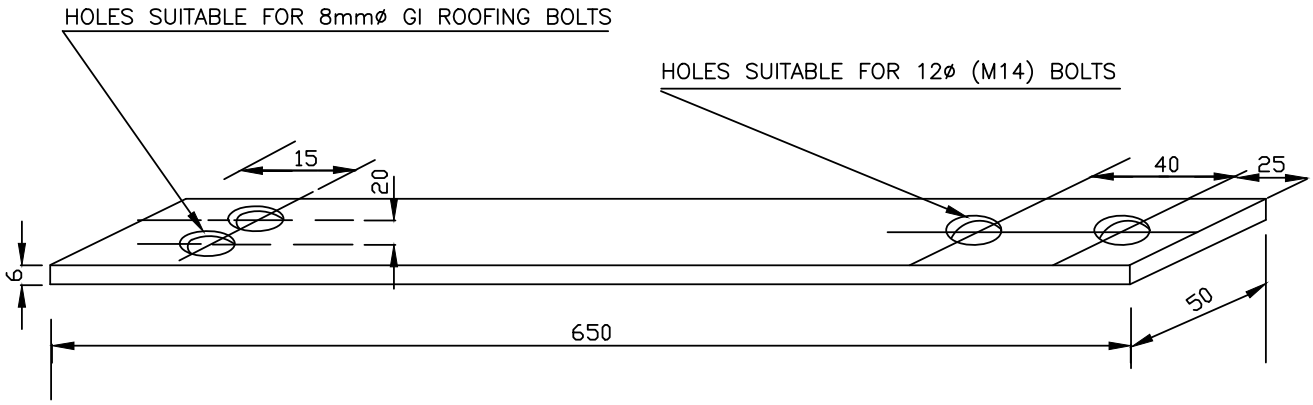
पी डी आई एल PDIL	TYPICAL ARRANGEMENT OF EARTHING FOR MOTOR AND START STOP PUSH BUTTON STATION	PC183-PDS:E 606	0
		DOCUMENT NO.	REV.
		SHEET 2 OF 2	




45
52
52
52
45
50
12
40
40
ELEVATION
326
50
PLAN
G.I. TEST LINK
HOLES SUITABLE FOR 12ø (M14) BOLTS
50
PLAN
6
25
40
HOLES SUITABLE FOR 12ø (M14) BOLTS
170
50
30
250
ELEVATION
G.I. 'L' PIECE

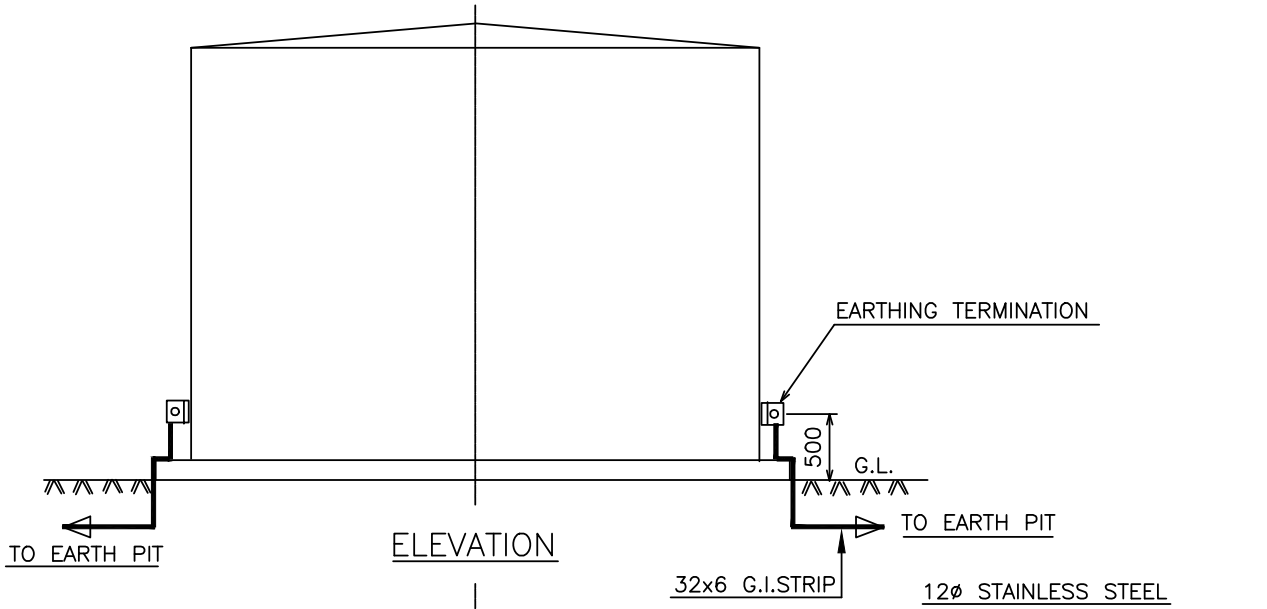


CONNECTING TWISTED ALUMINIUM FLAT PIECE

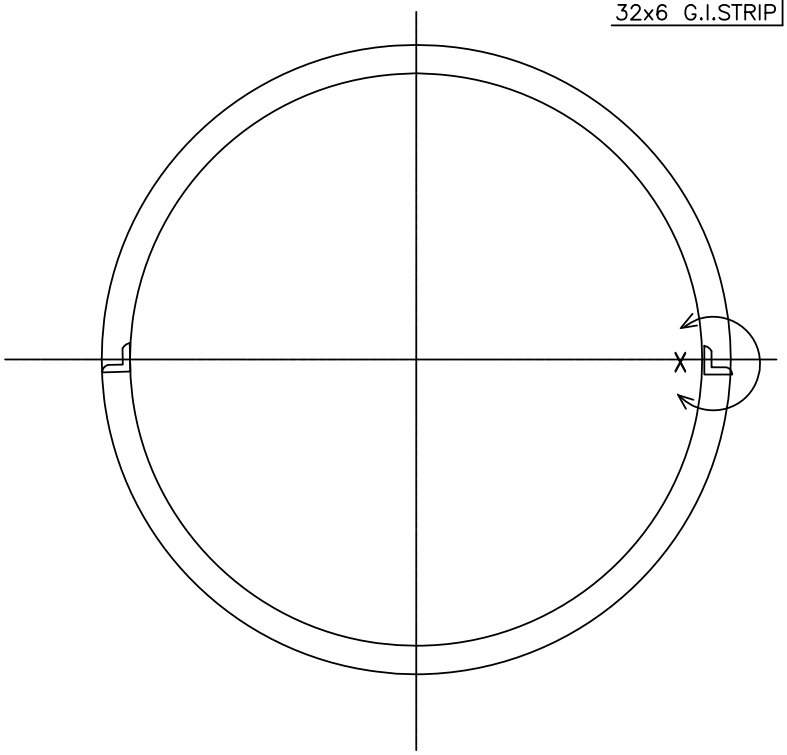


CONNECTING ALUMINIUM / G.I. FLAT PIECE

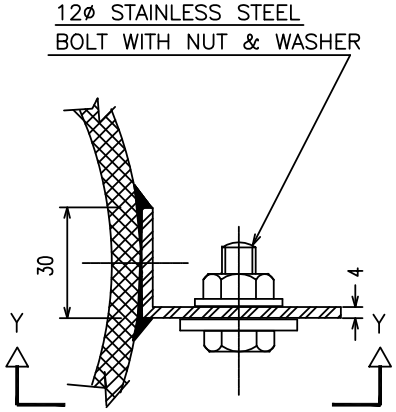
पी डी आई एल PDIL	EARTHING OF STORAGE TANK & VESSEL	PC183–PDS:E 613	0
		DOCUMENT NO.	REV.
		SHEET 1 OF 1	



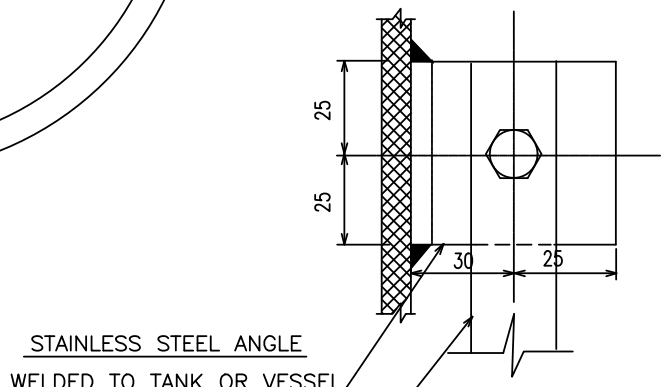
ELEVATION



PLAN



DETAIL –'X'



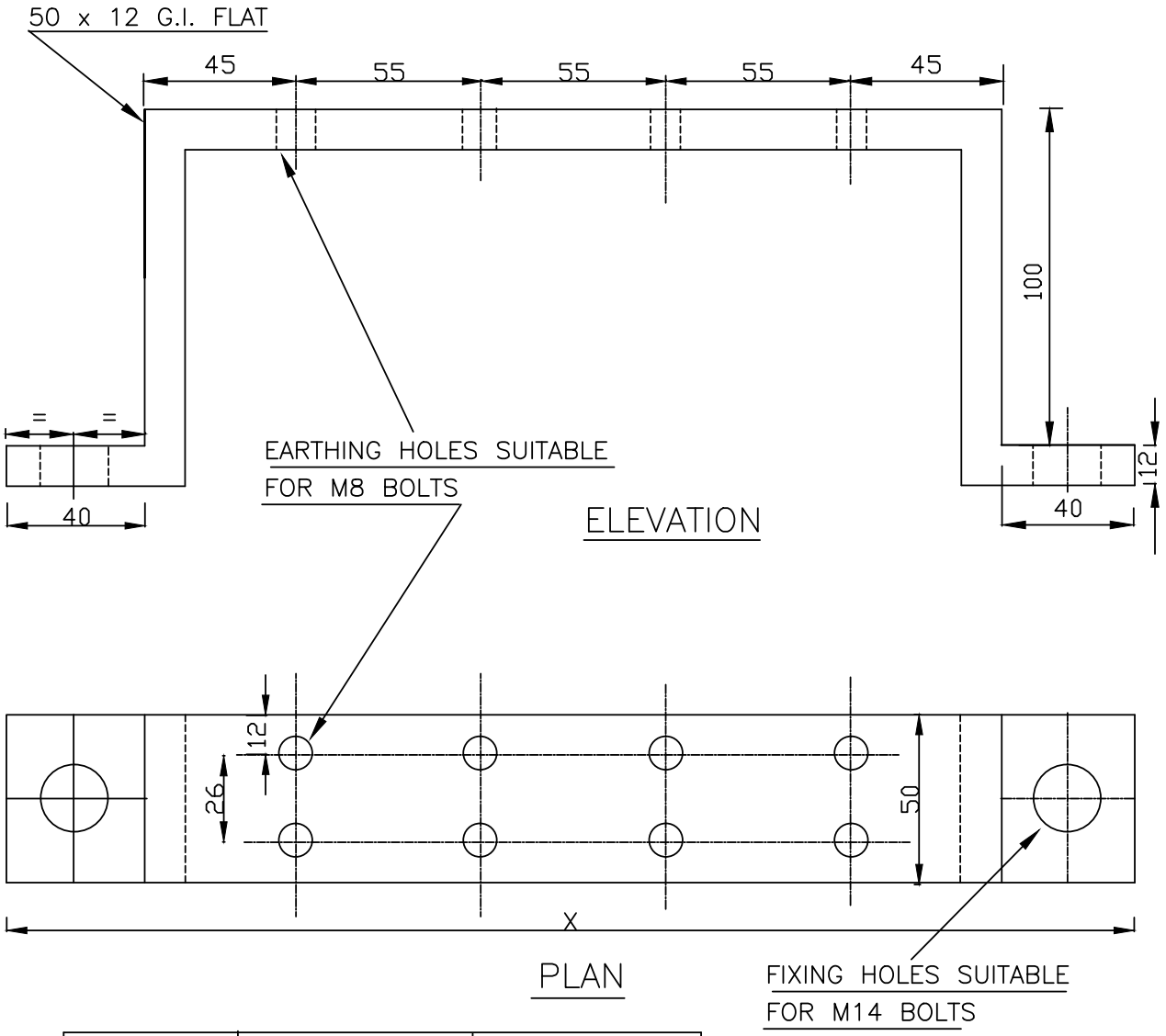
VIEW –Y Y

DIMENSIONS ARE IN MM

THE NO. OF EARTH CONDUCTOR SHALL BE AS FOLLOWS

EQUIPMENT WITH ANY DIMENSION	HAZARDOUS AREA	NON–HAZARDOUS AREA
≤ 3 Mts.	1	1
> 3 Mts. ≤ 30 Mts.	2	1
> 30 Mts.	3	2

पी डी आई एल PDIL	G.I. EARTH BUS	PC183-PDS:E 615	0
		DOCUMENT NO.	REV.
		SHEET 1 OF 1	

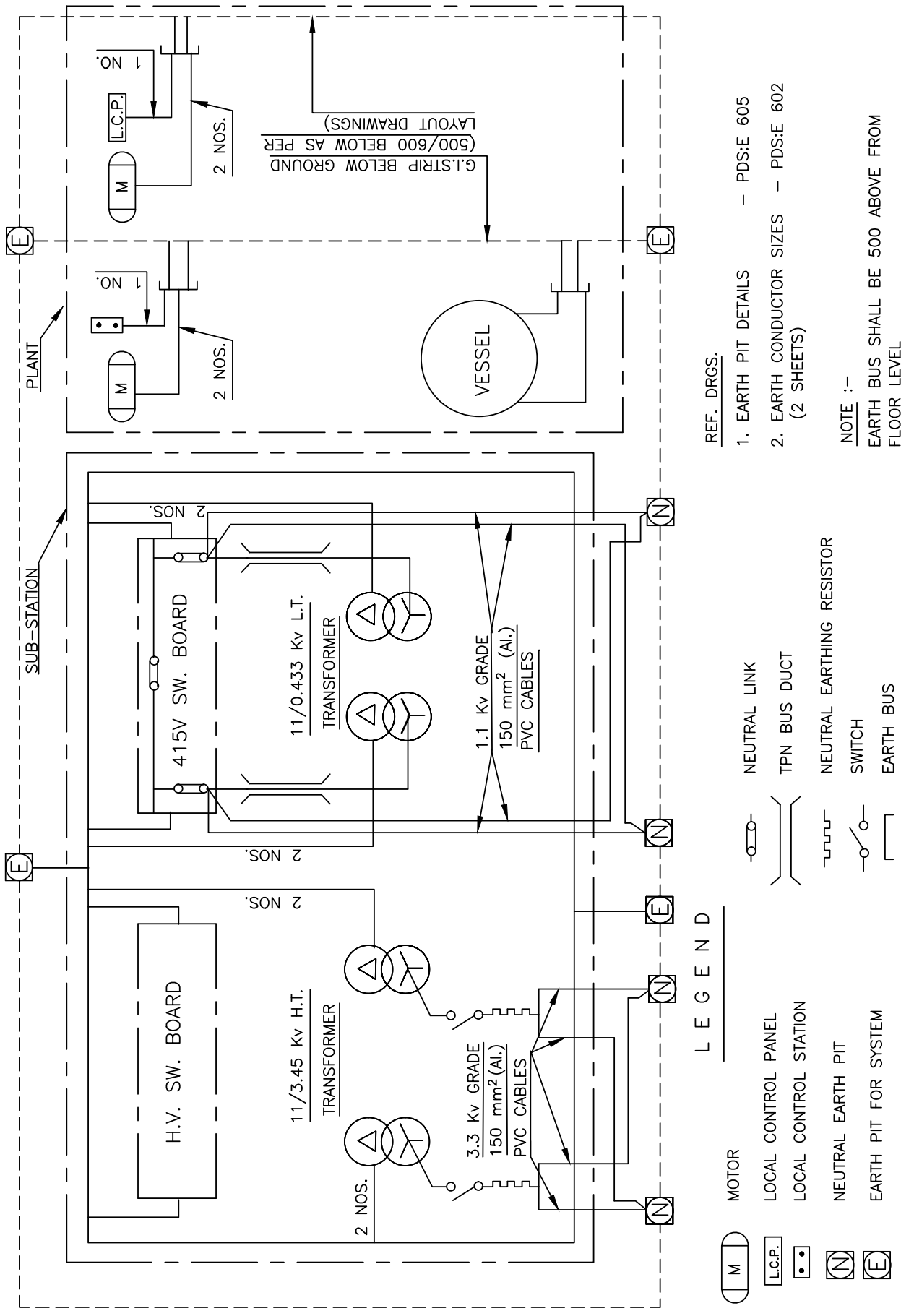


TYPE OF EARTH BUS	NO.OF EARTHING HOLES	OVERALL LENGTH x (mm)
1	8	335
2	10	390

NOTES:-

1. LOCATION OF EARTH BUS TO BE DECIDED AS PER EQUIPMENT POSITION AT SITE.
2. EARTH BUSES SHALL BE LOCATED ON STRUCTURES/COLUMNS WALLS/EQUIPMENT FOUNDATION ETC.
3. MOUNTING HEIGHT OF EARTH BUS SHALL NOT BE LESS THAN 500mm FROM FINISHED FLOOR LEVEL
4. ALL DIMENSIONS ARE IN mm

पी डी आई एल PDIL	TYPICAL ARRANGEMENT FOR NEUTRAL AND EQUIPMENT EARTHING	PC183 – PDS:E 617	0
		DOCUMENT NO.	REV.
		SHEET 1 OF 1	



SECTION VI–3.4

DESIGN SPECIFICATION - INSTRUMENTATION

UREA HANDLING & BAGGING PACKAGE

[UREA (NEEM OIL COATED) HANDLING SYSTEM, BULK SILO AND BAGGING SYSTEM INCLUDING FILLED BAGS STACKING/ LOADING TO WAGON & TRUCK]

PROJECT: INTEGRATED COAL BASED FERTILISER COMPLEX, AT TALCHER, ANGUL DISTRICT, ODISHA (INDIA)

0	27.07.2020	27.07.2020	ISSUED FOR REVIEW	AK	SG	RKR
REV	**REV DATE**	**EFF DATE**	**PURPOSE**	**PREPD**	**REVWD**	**APPD**

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A. List of Annexure:

B. List General Specification

1.0 INSTRUMENT AND CONTROL PHILOSOPHY

SCOPE : The Instrumentation and Control System shall consist of but not limited to the following:

This section outlines the general requirements and specifications for Instrumentation and Control System for Design, Engineering, Manufacture, Shop test, third party Inspection, Supply, erection and commissioning of urea handling system, bulk silo, neem coating system and bagging system including filled bags stacking/ loading to wagon & truck along with associated facilities for Talcher Fertilizers LTD.

The Instrumentation and Control System shall consist of but not limited to the following:

Control System: (PLC based control system (TMR/DMR)

- Bidder also note that only ONE control system to be considered for complete plant . All signals shall be terminated in ONE control system & control system shall be located in control room equipped with Air conditoning / HVAC. Scan time of the controllers shall not be more than 250 msec.

- Control system shall be considered for all sections/units. This control system will accommodate all control/trip and monitoring signal/functions for Urea Handling and Bagging Package ***i.e. Urea Handling System (Conveyer System with all facilities) , Bulk Storage in Silo, Neem Coating recovery facility(Neem coating skid shall be supplied by others but all cables , termination , cable erection , laying etc. shall be scope of bidder) , Bagging system (Weighing , Stitching/Tipping system, filled bags stacking/loading to wagon & truck etc.***) With all associated facilities as specified in this tender. Control system shall be based on Fail Safe architecture Irrespective of process hazards/safety class.

- Bidder to ensure segregation of individual plant/units/sections level signals at AI/AO/DI/DO card level so as to ensure the reliability of the system.
- The Complete PLC control system i.e. Marshalling panels, HMI/Consoles, printers, furniture etc. for the above package shall be housed in Urea Product Control Room. (Located at Urea Bagging Building) .
    - 4 nos. OS dual LED monitors and 1 no. ES cum OS (including SOE) LED monitors will be used for controlling/trip & monitoring for above packages facilities as per following :-
        - 3 Nos. OS for complete Urea Handling & Bagging Package
        - 1 No. ES cum OS (including SOE) with Dual personality station for complete Urea Handling & Bagging Package
    - Two No. A-4 Laser Printers B/W

- One for Control Room
- One for Weigh Bridge Operator room

o 1 no. ES cum OS LED monitors with Dual personality station at Weigh Bridge Operator room

o One view only station dual LED monitors with console in Central Control Room (interface through serial interface redundant port (MODBUS TCP/IP)/OPC server) , all cables , erection, termination, any requirement etc. to shall be in bidder's scope. Console space shall be provided in CCR.

o Annunciation / Alarm/ Mimic panel

o Above OS/ES/SOE/Panel requirements are minimum requirements. Bidder may propose / add additional monitoring stations , if required.

- Bidder to submit system configuration with the bid as per above requirements.
- All the required protections & interlocks shall be carried out in control system. All the features such as graphics, alarms, and process parameters display diagnosis for plant equipment shall be displayed in package's operator station.
- Bidder to provide communication redundant port (MODBUS TCP/IP)/OPC server for communication to Client's System / Third party interface.
- The Instruments in general shall be Electronic Micro processor based type with latest revision of software. The field instrumentation i.e. Load cell , Level instrument , Flowmeters, Transmitters, Smart Positioner, etc. shall have HART protocol latest version as minimum.
- All equipments/instruments/system oriented items (with all its sub-systems) shall be of field proven quality both with respect to design and materials. Prototype instruments or instruments of an experimental nature shall not be offered or supplied. In general, all the supplied items by supplier shall have a well proven performance record of operating satisfactorily in a Product Handling facilities for minimum of one year. No instrument requiring special maintenance or operating facilities shall be offered or supplied as far as possible. PTR for field instruments shall be considered min for 2 years.

  Bidder to carry out :

- Preparation of engineering and construction documents like functional schematics, I/O list, logic diagrams for interlocks as per ISA 5.2 with functional descriptions, configuration diagram, electrical load list, cable schedule, cable tray/trench layout, instrument air requirement, nameplate schedule, JB schedule, instrument location layout, electrical instrument signal interface, instrument index, layout drawings,

loop diagrams, primary and secondary sketches and bill of materials, any other drawing or documents which is required for package erection & commissioning and SAT as well.

- Preparation of all engineering documents for control system like graphic schemes, instrument loop data base, log formats and any other documents necessary to carry out the system engineering of control system .

- Co-ordination with Control system vendor / third party vendor for system engineering, implementation, software testing, supply and final commissioning and site acceptance tests , if any .

- Co-ordination with all instrumentation vendors for obtaining sufficient information in the form of documents, drawings for engineering and approval from OWNER.(If applicable).

- Preparation of specification for erection materials like cables (Signal, power, control, Optical fiber, Ethernet cable, CAT-6 etc), cable trays, pipe & pipe fittings, air tubing, junction boxes, air distribution pots etc.

- No copper or copper alloy shall be used for the parts coming either in contact with process fluid or outside atmosphere.

- Package vendor shall be responsible for all local/field instruments, controls, local panels, installation & wiring, trays & cable laying & termination to Package control system and execution.

- All instruments and equipments shall be suitable for use for specified site climatic conditions and urea storage area / Urea dust area / corrosive gases and/or chemicals may be present. As a minimum, all instruments and enclosures in field shall be dust proof and weatherproof to IP-67 as per IEC-60529 or equivalent NEMA 4X enclosure rating or better and secure against the ingress of fumes, dampness, insects and vermin. All external surfaces shall be suitably treated to provide protection against dusty/corrosive plant atmosphere. All Inst JB's shall be SS316L with 2 mm plate thickness and cable entry shall be from bottom only.

- The design of electronic instruments shall be in compliance with the electromagnetic compatibility requirements as per IEC 61000-4 "Electromagnetic compatibility for Industrial Process measurement and Control equipment".

- Process switches, shall be realized through field transmitters only. If for some packages, process switches are unavoidable same shall be provided with sealed micro switch contacts rated for the specified application. Contacts shall be 1 no. DPDT preferably. Otherwise 2 nos. SPDT can be considered. All switch contacts except those used in intrinsically safe circuits shall be silver plated. Contacts used in intrinsically safe circuits shall be suitable for the applications. Switches shall be hermetically sealed type. Switches shall be connected through interposing relays.

- All Field transmitter supports should be properly clamped with SS304 accessories to the pipe for pre-fabricated wherever required and closed couple installation. No air gap shall be kept between support clamp and pipe.

- All Solenoid valves shall be Intrinsically Safe type (24 V DC), SIL3 certified with details inside the design basis. Solenoid valve body material shall be SS316. All critical loops must have redundant SOV's.

- Pull cord switches, Bay Sway Switches, Zero Speed Switches & vertical ground take-up switch shall be considered as safety control of the whole system.

- Mushroom type Emergency PB station with hooters shall be mounted at strategic location for any emergency situation like all TT towers, filling area , stitching area , wagon loading area , truck loading area etc.

- Any stop including Emergency Stop push button, normal Stop push button shall be configured in 2oo3 configuration. Final stop going to MCC if any, shall be looped back as DI for SOE punching through IRP (spare contact shall be use as DI)

- Interface between MCC and PLC system shall be through IRP panel and located at control room. RIO is not acceptable.

- Electronic weigh bridge interface , Truck loading system interface , Wagon loading interface etc. with package control system with redundant serial interface / OFC / TCP/IP. Printer shall be installed with OS at Weigh Bridge for invoice purpose.

- Railway siding will be developed by the other. Wagon weight (empty / fill), in time ,out time other relevant information will required. For this, third party interface will required with redundant serial interface / TCP/IP/OFC with third party vendor. All related hardware, software , co-ordinate with Rail side's developer etc. shall be done the bidder. Invoice generation for wagon shall be from bagging control room.

- Total bags filled count and weight, bag counts and weight from truck loading , bag counts and weight from wagon , on floor bags count, hourly, six hours , 12hours , daily , weekly , monthly , yearly etc. basis.

- All cable trays with cover, cables, junction box, cable termination , cable glands , accessories, cable tray mounting supports, all erection material etc. from UPH Control Room to CCR _Central Control Room for third party interface / main DCS system interface , telephone system, LAN system cables, FA system requirement is also in bidder scope. Refer layout for distance, route and other information.

- All instrumentation cables shall be laid through (inside) conveyer gantry up to control room. All instrumentation cable shall be laid only cable trays. Bidder to note that all cables, cable laying , termination , cable trays along with the structure support , any minor civil work , all erection material etc. shall be as per tender in bidder scope. Any cable laying from UPH control to Central Control Room (

interface with any third party system) as per tender, shall be also in bidder scope with all activities

- Fire Detection & Alarm system including detectors (smoke, heat etc.) of suitable type to be considered for all buildings and hook up / interface with redundant configuration with main fire alarm system located in central fire station. All engineering, design, erection , commissioning , cable laying etc. Shall be done by the bidder. For details regarding Fire alarm system ,refer corresponding chapter of electrical discipline .

- Suitable Clean Agent System as per NFPA 2001 & hooking of the clean agent system with fire alarm system for actuation on detection of smoke/fire,automatic actuation and total flooding of clean agent in the required building area shall be provided in control room. For details regarding clean agent system ,refer corresponding chapter of piping (mechanical) discipline .

- Telephone system & LAN system for this package shall be in bidder scope as per tender requirement and these system shall be installed in Urea Handling & Bagging Control Room . All related hardware, software , erection material etc. for system operation shall be in bidder scope. Individual single point connectivity for both system shall be given by the client at Main control room (CCR) or specified location at plant premises. All cables laying , supply , hardware, software, erection material etc. for both side shall be bidder scope.

- Complete CCTV system as specified in this tender and interface with main CCTV system located at main Central Control Room with redundant OFC. All cables laying , supply , hardware, software, erection material etc. for both side shall be bidder scope. Cameras shall be mounted at strategic location like all TT tower , Filling area , Truck IN/OUT , Weigh bridge area , railway platform , silo etc. No. Of cameras to be proposed by Bidder and shall be finalised subject to PDIL/OWNER'S approval.

- GPS based time synchronization system shall be considered for with redundancy at master clock, comparator, and power supply level. This GPS based time synchronization system shall be synchronize with main GPS system. All activity including supply & erection shall in bidder's scope.

- Neem coating system is excluded from bidder's scope. However, all cables supply & laying, cable trays & support strutures, power supply from MCC, LCS, IO cards / system controller (30 IOs minimum) including all erection material etc. shall be considered by the bagging bidder.

- In the event of any conflict between this specification, related standards and codes, any other attachment to this package or process packages, the contractor shall follow the following documents in the order of their priority:

This specification

General Standard specification attached

Licensor's recommendation

Statutory requirements and codes & standards

2.0 DOCUMENTATION – Vendor Data requirement

SL No	Document Description	Document to be submitted *		
		With Bid	After order for approval	Final
1	List of Instruments (tag wise) indicating type of Instrument, make, model no., quantity etc.	Yes	Yes	Yes
2	Instrument mounting and connection details		Yes	Yes
3	Instrument layout drawings		Yes	Yes
4	Catalogue of Instruments & System	Yes		Yes
5	List of spares (item wise and quantity) for Commissioning and 2 years of operation	Yes	Yes	Yes
6	Specification of Instruments	Yes	Yes	Yes
7	Detail wiring/ interconnection diagram		Yes	Yes
8	P and I Diagram	Yes	Yes	Yes
9	I/O list	Yes	Yes	Yes
10	Loop Diagram		Yes	Yes
11	Logic Diagram for interlock & safety (if any)	Yes	Yes	Yes
12	J.B. termination drawings		Yes	Yes
13	Instrumentation, operating, maintenance manuals			Yes
14	Instrument Test Certificate			Yes
15	Vendor to indicate power requirement (if any) for the control system	Yes	Yes	Yes
16	Other documents necessary to have a clear understanding of the system	Yes	Yes	Yes
17	List of alarms	Yes	Yes	Yes
18	Schematic drawings for controls	Yes	Yes	Yes
19	Control Room Layout	Yes	Yes	Yes
20	System Architecture	Yes	Yes	Yes
21	Instrument Air Consumption Requirement	Yes	Yes	Yes
22	Bill of Material	Yes	Yes	Yes
23	Civil cut-out dimensions for Control Room#	Yes	Yes	Yes
24	IRP/IRC panel requirement at control room	Yes	Yes	Yes

Note: * Indicates number of sets shall be as mentioned in the main ITB
- Control Room at First Floor , all cables shall be go through from ground floor to first floor. Cut-out dimensions are required for civil work (other scope).

3.0 CONTROL PHILOSOPHY (GENERAL)

3.1 Design and installation of instrumentation shall comply with codes and recommendations listed in item 4.0.

3.2 The instrumentation shall be designed to provide stable and accurate plant control ensure safe plant operation and to facilitate plant maintenance, Control and Monitoring. The operating interface to the process shall be colour single screen 22" LED TFT Colour (Minimum) display units with touch facility, presenting overview, group and point displays as well as process graphics with live data. The operator will manipulate all facilities through dedicated operator's keyboard and using the touch panel. All operating consoles for control system shall be located inside the control room.

3.3 I/O units, marshalling cabinets, power distribution cabinets shall be housed in UPH control room located at bagging building.

3.4 Control System

Bidder to provide control system with redundancy at all levels and with latest model. It shall have provision to communicate with main DCS system / Third party system through Modbus protocol/TCP/IP/Ethernet and connected by Serial cable/OFC in redundant mode. Control system for specified package including marshalling cabinets, relay cabinets, MCC Interface cabinets, power supply distribution cabinets, instrument isolator, alarm cards, terminals, relays with accessories duly mounted, wired & tested to meet specified requirements.

3.5 DIs/DOs from MCC to PLC or from PLC to MCC shall be with relays only (no fuse shall be considered). Separate panels for DI/DO and AI/AO. The details will be discussed during detailed engineering.

3.6 Emergency stop / normal stop – Any stop including Emergency Stop push button, normal Stop push button shall be configured in 2oo3 configuration. Final stop going to MCC if any, shall be looped back as DI for SOE punching. Emergency stop (mushroom type PB station) shall be placed all strategic location as per safe & smooth operation i.e. through out conveyer belt (at each 50 meter) , filling area , wagon loader , railway platform , truck loader etc.(bidder to confirm)

3.7 Alarm and Annunciation System:

Annunciation system is used to indicate and sound alarm for any process abnormality, trip/status change of Electric drive. Annunciation system shall be of modular design & programmable type. Electrical circuit is designed to read the change of state of discrete signal and generate the output to illuminate the window and give the alarm. The alarm can be silenced by acknowledge switch. Window light can be reset after acknowledgement and, when the state of signal returns to the prior alarm state. Annunciation system can be configured for any of sequences of ISA standard. There shall be a provision in circuit design to change the state of signal required to generate alarm (from Open to Close or vice versa) simply by changing the jumper position on circuit board. Lamps in window shall be replaceable from the front.

Hooter in general, shall be solid state type with audibility of the order of 100 dB at the distance of 3 meters. An interruption of power supply up to 20 msec shall not affect the functioning of unit.

A hard-wired mosaic/annunciator panel with LED that clearly displays status of trip alarms, key/switch bypasses, trip-groups, etc. with a first-out alarm shall be incorporated near the operator work stations. The operator shall also be informed of trip conditions by means of a warning sound that differs from the audible signal from the alarm system. However operation of override switches to be included in operator action log.

3.8 The minimum instrument accuracy shall be as defined in Annexure-1.

3.9 All the instruments in the SIL loop (if applicable) shall be SIL certified as per SIL study. However irrespective of SIL Study, all field instruments shall be minimum as per following list :-

- All Smart Positioners, SIL 2
- All Transmitters - SIL2
- All Solenoids – SIL 3
- All Gas Detectors – SIL2
- All switches – SIL-3 or maximum SIL rating available

3.10 Universal HART Protocol with Latest Revision shall be used in all cases.

3.11 Card mounted Relays are acceptable but cards must have redundant power facility, with its power healthiness indication in diagnostic graphics.

3.12 Cable entry to control room, substations shall be through MCT blocks with SS MOC only.

3.13 Entry into the Marshalling Panels in the control room shall be through bottom mounted MCT blocks.

3.14 General Earthing & Instrument Earthing shall be provided separately (Panel and power earthing, PLC system earth and Instrument signal earth is minimum envisaged).

3.15 All wetted part materials for all instruments including sensing elements shall be min SS316.

3.16 All Contacts shall be 2 SPDT or 1DPDT.

3.17 No Direct Process Switches (Pressure / Level/ Flow / Temp.) shall be used.

3.18 All Field transmitters for pressure, d/p, level and flow shall be microprocessor based (dual compartment) SMART transmitters with “UNIVERSAL HART” protocol with latest revision. The transmitter selection shall be such that the operating maximum upper limit shall be around 70% of the total measurement range of the transmitter.

3.19 PCS (Pull chord switch) & BSS (Bay Sway Switch) shall be in laid parallel configuration for more reliability of the system. All switches shall be terminated individual to PLC. PCS & BSS switches shall be at distance of 20-25 meters maximum.

3.20 Package vendor shall provide a common laptop (latest configuration with anti-virus and other engineering software) for configuration of control system.

3.21 All equipment/materials supply shall include spares required for 2 years operation and separate consumable for commissioning and recommended spares by the vendor.

3.22 Motor / electrical equipment control philosophy ,as minimum

a. Field :

- Ready to START (Lamp)
- START
- STOP
- L/R Switch

b. For control system

- STOP Command
- Discrepancy Alarm
- Running Indication
- Motor Fault Alarm

- Current Indication (All motor > 5KW)
- L/R Switch Indication
- Ready to START F/B

c. For start / stop of all electrical equipments, local/remote selector switch shall be located in field, A/M (Auto/ Manual) and stop push buttons on consoles in control room..

d. Local stop push button on LCS (local control station) shall be always effective.

e. In remote mode, motor can be stopped from control system.

f. In LOCAL mode, both START and STOP shall be possible only from LOCAL. Only in REMOTE, stopping is possible from control system.

g. Auto / manual selection shall be in Control System.

3.23 For all motors current indication shall be provided in control system for rating more than 5 KW.

3.24 Local indicators, start /stop switches, emergency stop switches shall also be provided near package units/rotating machines where local start up of the equipment is advisable.

3.25 For instrumentation electrical interface, input and output contacts shall be in separate multicables (should be signal cables).

3.26 All trip interlocks must be designed on 2oo3 philosophy.

3.27 Emergency stop and critical stops must have transparent protective cover.

3.28 PB's , Annunciator , EPB must be available on console placed in CCR.

3.29 Air fail to open, Close or Hold of any control valve / flapper gate shall be as per tender document, to take care of process, plant and human safety. For Piston actuators necessary air volume chambers and lock up relay shall be provided to achieve the fail-safe condition.

3.30 All the pneumatic accessories shall be SIL-2 minimum.

3.31 All control valves / On–Off Valves / MOVs shall be flanged type.

3.32 Control valve / on-off valve, pneumatic valve shall be designed for minimum 4 Kg/cm2 air pressure.

3.33 Actuator design shall be of 1.5 times of shut off pressure or design pressure, whichever is higher.

3.34 Valve body MOC in steam service shall be of WCC or better irrespective of pipe class.

3.35 Air distribution pots shall be of stainless steel (SS304). Inst. Impulse pipes / tube for process parameters shall be in accordance with piping specifications.

3.36 Hart Compatible gas-detectors to be provided. Electrochemical type gas detectors shall not be considered. Bidder to submit suitable gas detectors as per OEM recommendation/ as per ITB as specified elsewhere. Bidder to submit gas detectors quantity calculation along with layout. Bidder to provided hooters (electric type) & beacon (rotating type with light flash).

3.37 All line mounted instruments like in-line SOVs, Magnetic flow meter, Rotameter, Mass flow meters etc shall be provided with block & bypass arrangement, with their indications in system as per requirement, which will be discussed in detailed engineering.

3.38 FRP Canopies (UV stabilized 3 mm thick), 2" Pipe mountable, are required for Transmitter, JBs, LCPs, Control Valve positioner, Temp Elements, Proximity level switch, remote mounted electronics, mass flowmeter, ultrasonic flowmeter etc. FRP Canopy shall be Prefabricated type. Canopy for transmitters shall cover top and 3 sides. SS canopy instead of FRP, if offered by package vendor, shall also be acceptable. No separate canopy shall be required for instruments located under shed like compressor shed etc.

3.39 System / Marshalling/ Packages cabinet size shall be 2100 (H) X 1200 / 800 (W) X 800 (D) Rittal make.

3.40 Separate Tapping shall be used for each instrument coming for trip, control & monitoring, local display. Not more than 3 set of taps are allowed.

3.41 Smart positioner shall be considered for all Control Valves. For high temperature services (Above 200 Deg C design temp) remote mounting shall be used for the smart positioner.

3.42 Positioner shall be of valve OEM or as per approved vendor list.

3.43 For all Local panels rain cover to be provided. The gasket of local panels must be acid resistant preferably Silicone/EPDM or better which will be discussed during detailed engineering.

3.44 No level Switches to be used. GWR / Ultrasonic LT shall be used.

3.45 Fibre optic cables shall be armoured, multicore type. All fibre optics cable must be laid through HDPE conduit. The make of fibre optic cables shall be Belden / Leoni.

3.46 All cables inside package battery limit shall be supplied and laid by Package vendor through instrument cable trays supplied by Package vendor. All cables inside skids/modules shall be supplied in pre-wired & pre-tested condition.

3.47 All Instrument Hookups shall be approved by owner/PMC.

3.48 All fittings shall be SS316 and in inch only.

3.49 All tubing shall be SS316 and must be made from hot extrusion process only.

3.50 The manifolds (3 valve/5-valve/2 valve) material shall be SS316L.

3.51 All the soft parts of Local panels/JB/SOVs etc shall be of acid resistance, preferably silicone, EPDM or better which will be discussed during detailed engineering.

3.52 Level measurement in the acids tanks/hopper/bunkers shall be of ultrasonic type.

3.53 Load cell shall be used bunker weighing as specified in tender.

3.54 All bunkers (60 MT capacity each) with load cells and ultrasonic level indicator, vibrators (electric type), Electric operated gate etc.

3.55 Detailed control philosophy as per tender requirement shall be submitted by the bidder.

4.0 INSTRUMENTATION CODE AND PRACTICES

IEC 13	Diagrams, Charts and Tables, Preparation of Logic Diagrams
IEC 534	Industrial - Process Control Valves
IEC 584	Thermocouples
IEC 605	Equipment Reliability Testing elements
IEC 611-12	Part 12 Graphical Symbols for Diagrams. Binary Logic
IEC 654	Measurement and Control equipment
IEC 751	Industrial Platinum Resistance Thermometer Sensor
IEC 801	Electromagnetic Compatibility for Industrial Process measurement and Control Eqpt.
IEC 848	Preparation of Function Charts for Control Systems
IEC 902	Industrial Measurement and Control Terms and Definitions
ISA S-5 .1	Instrumentation Symbols and Identification
ISA S-5.2	Binary Logic Diagrams for Process Operation
ISA S-5 3	Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic and Computer Symbols
ISA-S20	Instrumentation specification formats
ANSI/ISA S 5.1	Process Instrumentation Terminology
ANSI/ ISA S71.04	Environmental conditions
ANSI/ ISA S75.01	Control Valve Equations
ANSI/ ISA S75.02	Control Valve Procedure Capacity Test
ANSI/ ISA S75.03	Face-to-Face Dimensions for Flanged Globe Style Control Valve Bodies
ANSI/	Quality Control Standard for Control Valve Seat
FCI 70.02	Leakage
BS 6020	Instruments for the Detection of Combustible Gases
DIN 43760	Measurement Standard for RTD.
DIN 19243	Measurement and Control Electrical Sensors, Electrical Position Sensors and Signal Converters used for Intrinsically safe two-wire DC System.

EN-50-014/020	Electrical Apparatus for Potentially Explosive Atmospheres
EN 54 Part I	Components of Automatic Fire Detection System Introduction.
EN 54 Part 5	Heat sensitive Detectors - Point Detectors containing a Static Element.
ISO 3511.1	Process Measurement Control Functions and Instrumentation Representation Part I: Basic requirements.
ISO 3511.2	Process Measurement Control Functions and Instrumentation Representation Part 2: Extension of Basic Requirements.
ISO 3511.4	Process Measurement Control Functions and Instrumentation Representation Part 4: BasicSymbol for Process Computer, Interface and shared Display/Control Systems.
ISO 4200	Plain End Steel Tubes, Welded and Seamless - General Table of Dimensions and Masses per Unit Length.
ISO 5167	Measurement of Fluid by Means of Orifice Plates, Nozzles and Venturi Tubes Inserted in Circular cross-section Conduits Running Full.
API RP 520	Sizing, selection and Installation of Pressure relieving devices in Refineries
API RP 521	Guide for Pressure Relieving and Depressuring System
API RP 2000	Venting Atmospheric and low-pressure storage tanks
API-RP-550	Manual on Installation of refinery Instruments Part I and Control System
ANSI - B 16.104	Control Valve seat leakage
ISA-S 75.01	Control Valve sizing
ISA S 18.1	Specifications and guides for the use of general Annunciators.
IEC 529	Environmental Protection of equipment
ANSI B 2.1	Pipe threads
ANSI B 16.5	Steel pipe flanges, flanged valves and fittings
IEC 79.11/	Intrinsic safety code and practice
IEC-79.14	International Boiler Regulation
IS 2148	Flameproof enclosure of electrical apparatus

5.0 HAZARDOUUS AREA CLASSIFICATION & ELECTRICAL EXECUTION

5.1 Irrespective of area classification, the execution of instrumentation shall be as per area Zone 2, group IIC, T6, EExib and Protection.

Electrical / Electronic instruments	IP 67
Sensors; RTD, T/C, etc.	IP 65
Local Gauges; PG, etc.	IP 55
Pneumatic instruments	IP 54
Solenoid valves	IP 67
Local Panel / Skid Mounted Panels	IP 55

EMC compatibility and electrical safety as per latest IEC standard.

5.2 Electrical instrument equipment shall be designed for and supplied as intrinsic safe certified.

Analysers, solenoid valves and other equipment that cannot be classified intrinsic safe shall be ex-proof in accordance with the above mentioned electrical specification.

In general, Intrinsic philosophy shall be followed for all the instruments. Where ever intrinsically safe philosophy is not available, Exproof/Flame proof philosophy shall be followed.

Certification for installation in hazardous areas in accordance with IEC 60079 series is shown below:

Transmitters, positioners, Limit Switches, etc.: EEx ib IIC T6

Field Switches:	EEx de IIC T6
Analysers and Panels:	Ex p IIC T6
Solenoid Valves:	EEx ib IIC T6 (Ex md not allowed)
Junction Boxes and Cable Glands:	Exe/Exd

6.0 ELECTRICAL SUPPLY

The electrical supply will be as follows:

S.No.	Description	110 V AC 50Hz UPS	110 V DC	24V DC	110 V AC Non UPS	240V AC 50Hz (Non UPS)	415 V AC-3 phase	Remarks
1	Control System	YES						
2	Package Units	YES				YES		Non UPS for Lighting only
3	Alarm Annunciator	YES						
5	Solenoid Valves			YES				
6	Smart Positioners, I/P, Transmitters			YE S				
7	I/P Interrogation Voltage			YE S				
8	Gas Detectors			YE S				
9	Analyzers and Analyzer System	YES						
11	Level Gauge Illumination					YES		
12	Cabinets Fan					YES		
13	Cabinets Lighting					YES		
14	Control Room					YES		
15	Local Panel	YES		YES		YES		Non UPS for Lighting only
16	CCTV	YES						
17	Analyzer Cabinet Air Conditioning	YES						
18	Analyzer Shelter HVAC						YES	
19	Normal AC for Field Operator Room					YES		

Where 24V DC is needed, it will be generated by local rectifier units (bulk power supply with MOSFET O-ring), which are part of the instrumentation supply. The power supply to these units shall be taken from the UPS.

Where 24V DC are used for Safety Circuits, the rectifier units shall be duplicated and with high reliability and form a part of DCS/PLC vendor. The bulk power supply shall be with MOSFET O-ring.

There shall be minimum 4 (two no. Of each type; total 8 nos.) separate earth pits for signal (IS) , Non IS, Panel and chassis (system) grounding for DCS/PLC Earthing system at Control Room with different cable colour codes. All earth shall be less than 2 Ohm or OEM specific, if better. The size of Earthing Cable shall be 50 sq.mm minimum and should be routed in proper HDPE conduit, outside the control room building. All above instrument earth pits shall be separate from Electrical earth pits and must have separate colour identification from electrical earths. Minimum 2 nos. Of earth pits of each type (total 8 nos) shall be constructed by the bidder.

Supply of earth electrodes, grounding cables (separate for signal grounding and instrument grounding) and other related accessories required for barrier earth, system earth and installation shall also be in the scope of work Contractor. Copper conductor shall be of 1Cx10 Sq mm as minimum. For surge protection devices separate earthing shall be used.

Grounding requirement for other system to be taken care by Contractor

Earthing of all new equipments / instruments located at control room for New PLANT of new earth pit at control room with all cables, electrode, pit shall be provided by contractor.

UPS supplies shall not be used for utilities supplies cooling fans, panel/cabinet lighting etc. A separate non-UPS supply shall be used for the same.

A summary of all critical UPS alarms, 24V DC supply, Panel supplies, diode o rings healthiness shall necessarily provided in control system system and hardwired annunciation in control room or any manned location

Only copper cables & tin-plated copper lugs shall be considered for instrumentation power distribution system.

One number of redundant feeder for UPS supply be provided by the client. UPS shall be in bidders scope. Further distribution to the bidder system in the CR, Field operator room

and in the field shall be in the bidder scope. Therefore necessary PDB shall be provided by the bidder to distribute power supply.

Protection coordination with respect to fuse/MCB ratings from the supply source ACDB/DCDB to downstream distribution panels shall be thoroughly studied by the system designers/OEM and documented as a part of the system documentation and be implemented accordingly.

MCB's must have DI contact's which must be wired to DCS/PLC and available in diagnostic graphics.

7.0 FIELD INSTRUMENTS

7.1 (Specific for Urea Handling and Bagging Package) , for other related instruments/system/erection/installation etc. refer relevant sections of this design specification. All instrument shall be suitable for dusty / urea / corrosive environment as minimum.

7.1.1 Ultrasonic Non- Contact Type Level Transmitter for bunker level measurement

Housing Material - Die cast Al. with Epoxy LM6 with IP 68 Protection
Accuracy – 0.25 % of reading
Measuring range – 10 meter
Power supply- 2-wire system 24VDC loop powered
Display – Remote mounted LED 2 Line X 8 digit Alphanumeric
Output – 4-20 mA , HART latest version
Material (Flange & cone) - SS316 minimum
Temperature Compensation – Required , inbuilt
Hazardous Area – Zone 2, group IIC, T6, EExib
With all mounting accessories

7.1.2 Load cell with Digital Weight Indicator

Load cell
Type: Double Ended Shear Beam Load cell
Housing – Hermetically Sealed IP 68 Minimum
Material – SS316
Supply Voltage – 24 VDC loop powered
Capacity – As specified in tender
Zero balance – less than +/-1% of FS
Temperature effect- Negligible
Side Load effect – Negligible
Gasket – EPDM /Silicon
Combined Error – 0.015% of FS

Digital Weight Indicator
Type: Microprocessor based field mounted
Input from – Load cell
Linearity - <0.01% of FS
Material – SS316
Gasket – EPDM /Silicon

Supply Voltage – 24 VDC loop powered
Display with status LED & Keyboard – 8 Digit LED type
Output – 4-20 mA HART latest version , RS-485 SI

Hazardous Area – Zone 2, group IIC, T6, EExib
With all mounting accessories , hooks SS , tying clips SS , FRP canopies etc. to full fill all tender requirements.

7.1.3 Zero Speed Switch (Sensor & Control Unit)

Sensor - non-contact Inductive type sensor , Intrinsically Safe
Supply voltage – 24 VDC from control unit
Sensing distance – 10-12mm +/- 10% (Vendor to confirm)
Sensor material – SS316
Housing – Die Cast aluminium with epoxy paint suitable for Urea environment
Protection – IP 68

Control Unit
Power supply - 240 VCAC / 24 VDC
Speed Range – By Vendor , minimum 4 flags [Refer conveyer speed as specified]
Time Range (Initial time delay) – 1-20 sec
Speed Accuracy- 2%
Housing – Die Cast aluminium with epoxy paint suitable for Urea environment
Protection – IP 68
Output - 2 NO+2 NC
Gasket – EPDM /Silicon

LED indication for Supply ON , Sensor ON & Relay ON as minimum.
Hazardous Area – Zone 2, group IIC, T6, EExib

With all mounting accessories , hooks SS , tying clips SS , FRP canopies etc. to full fill all tender requirements.

7.1.4 Pull Cord switches (Both side of conveyer belt) – Parallel configuration , maximum 20 meters. All PCC shall terminate control system individual . Multi drop is NOT acceptable.

Type – Bi-directional
Housing – Die Cast aluminium with epoxy paint suitable for Urea environment
Protection – IP 68
Output - 2 NO+2 NC
Reset- Manual

LED indication for Supply ON
Internals – SS316
Gasket – EPDM /Silicon
Pull cord – SS PVC cover
Power supply – 24 VDC
Hazardous Area – Zone 2, group IIC, T6, EExib

With all mounting accessories , hooks SS , tying clips SS , FRP canopies etc. to full fill all tender requirements.

7.1.5 Belt Sway Switch (BSS)- (both sides and near the edge of the conveyor belt) 2 cam model (1 cam for alarm and one for trip) , Parallel configuration , maximum 20 meters. All PCC shall terminate control system individual . Multi drop is NOT acceptable

Housing – Die Cast aluminium with epoxy paint suitable for Urea environment
Protection – IP 68
Output - 2 NO+2 NC
Reset- Auto
LED indication for Supply ON
Internals – SS316
Gasket – EPDM /Silicon
Pull cord – SS PVC cover
Power supply – 24 VDC
With all mounting accessories , hooks SS , tying clips SS , FRP canopies etc. to full fill all tender requirements.

7.1.6 **Vertical Gravity take-up switches , as specified elsewhere in this tender**

Housing – Die Cast aluminium with epoxy paint suitable for Urea environment
Protection – IP 68
Output - 2 NO+2 NC
Reset- Manual
LED indication for Supply ON
Internals – SS316
Gasket – EPDM /Silicon
Pull cord – SS PVC cover
Power supply – 24 VDC
With all mounting accessories , hooks SS , tying clips SS , FRP canopies etc. to full fill all tender requirements.

ACCESSORIES

7.1.7 Sensor Cable and Junction Box

- Bidder shall supply special cable for connecting sensor to the transmitter along with SS316 double compression cable glands at both ends.
- Cable length shall be as specified. Where specified length is not available, bidder shall supply junction box for connecting sensor cable and the extension cable.
- Cable gland – SS316 DC Ex proof
- Canopy , Mounting bracket , tying clips etc. as required

7.2 Flow Instruments

7.2.1 Flow Transmitters

D/P cells shall have measuring method on the floating capacitance technology. The signal transmitter shall normally be a 2-wire system and shall be capable of delivering rated current into external load of at least 600 ohms when powered with 24 V d.c. Protection against short circuit and reverse voltage shall be provided. Bodies shall normally be in stainless steel with SS316L internals. Integral 3- valve manifold similar to AGCO make model 4A shall be used for mounting transmitters on manifold for ease of maintenance. Material of manifold in general shall be SS316L but may vary depending upon service. Digital output indication shall be preferable on the integral output meter with the transmitter. All flow transmitters shall have sq.root extraction function.

Pressure elements in austenitic stainless steel is a requirement. The transmitter shall be furnished with an output meter or gauge with a sqrt scale. Smart type transmitters will be used with Hart latest protocol. Overall accuracy for SMART transmitters shall be +/- 0.050% or better. Process connection size shall be 1/2” NPT.

All field transmitters shall be 2 wire type, 24 Volt DC, SMART with HART protocol, and shall be equipped with Local LCD type digital indicator. 2” pipe mounting, SS304 MOC brackets and other accessories, as applicable, Accuracy 0.050% of Span , Rangeability 1:100, Local Display configurable, SS MOC, Double Compression SS 316 cable glands, EExib IIA/B/T6, IP67, Wetted MOC SS316L, SS316L MOC Manifold, Housing Die-Cast Aluminium Epoxy Painted, Universal Hart Protocol with Latest Revision is required.

7.2.2 Rotameter

Rotameters or variable area meters may be used in pipe sizes from 1 1/2” and smaller. The meter shall be selected for normal flow at 50 to 60% of the span. In applications with

toxic or inflammable fluids, glass tubes must not be used except for low pressure analyser sample flows. They may be used for severe corrosive services and of fluid of high viscosity. The metal tube meters shall be of stainless steel, PTFE lined or any other suitable lining for the service. The Indicator assembly shall be magnetically coupled and mounted with Rotameter body. Transmitters or Indicators on float extension are not recommended except for cryogenic services. The switch assembly shall be of proximity type. All Rotametres shall be metal tube type with transmitter. The rotameter transmitters shall have 4-20 mA output at 24V d.c. power on two wire system, which must wired to control system.

7.2.3 PRIMARY DIFFERENTIAL PRODUCERS

7.2.3.1 Orifice Plates

Orifice plates of the square edged concentric type shall be specified except where unsatisfactory for the application. Materials of orifice plate shall normally be AISI 316 unless special materials are required for the service. The maximum ratio of orifice to inside pipe diameter of 0.70 and minimum ratio of 0.30.

Orifice plates dimensions and calculations shall be in accordance with ISO 5167-1980. Minimum orifice plate thickness shall be 3.16mm.

The flow range shall be selected such that normal flow rates are between 50% and 70% of the flow upper range value.

Material of construction of orifice plate shall be 316L SS except where this material is unsuitable for the service because of corrosion or erosion considerations, in which case an alloy shall be chosen whose corrosion allowance is equal to or better than line material. Orifice plates dimensions, finishing, flatness, tolerances for dimensions and identification information shall be in accordance with ISO standard. Orifice plate shall be provided with tab handle, which is welded on the orifice plate and engraved with following information on the upstream of the tab handle:

- UPSTREAM or UP
- Instrument tag number
    - Orifice diameter
    - NPS (Nominal Pipe Size) and ANSI flange class

- Material of the orifice plate
- DP range & Meter (Flow) range

The tab shall also be in line with the Drain or Vent hole and shall indicate the direction of flow.

BIDDER shall submit the sizing calculations for orifice plates for review.

Pressure drop for orifice sizing shall generally be selected among the following values: 125, 250, 500, 625, 1250, 2500, 5000 and 10000 mm H2O with standard selection at 2500 mmH2O.

Orifice plates shall be installed on horizontal lines when practical. Vertical meter runs may be used for down flow of vapour and up flow of liquids.

Differential ranges for all liquid flow meters shall not exceed 5000 mm water. Typical ranges for gas, steam or vapour meters are as follows:

Static Pressure	Diff. Range
(in Kg/Cm2g)	(in mmwc)
0.35 to 2.5	500-1200
2.6 to 6	1250-2500
Above 6	2500-5000

Orifice bore with diameter less than 0.125” shall be avoided.

a) Flange taps orifice shall generally be used for line sizes 2” to and including 18”. Above 18”line size, D and D/2 taps shall be used. Integral Orifice assembly with transmitter shall be used for line size 1 1/2 “or below (as per standard BS-1042)

Orifice assembly shall be provided with two sets of “Flange Taps” located in accordance with latest AGA standards. The orifice assembly shall be provided with jack screw for removal of orifice plate. In case of 2 out of 3 logic requirement, three different transmitters shall be used and no two transmitters shall share the common tapping. In such case six set of taps (independent tapping from Flange Itself , NO TEE / Elbow shall be used) shall be provided in orifice assembly. Instrument tapping connections shall be 1/2”NPT (F).ONE Set of spare flange ts required for 2oo3 configuration i.e. total FOUR

Sets (8 Nos.) Of flanges tapping.

b) Orifice flanges shall be in accordance with the ANSI B16.36, ANSI B16.36a and applicable piping specification and shall generally be of weld-neck type only. The minimum pressure rating of flanges shall be ANSI 300 lbs.

Flanges larger than 3" shall have a pair of jack-screws. The mating flanged shall be aligned in such a way that jack-screws will be diametrically opposite.

Orifice flanges used at pressure ratings up to 600 Ib. shall be tapped ½" NPT(F) tap for 900 # above ¾" NPT(F). Orifice connections for Vena contracta taps or pipe taps ½" socket with schedule/MOC as per piping specs

c) For line size below 2" Integral orifice with corner taps shall be supplied as an integral assembly consisting of upstream and downstream straight pipes, integral orifice of 316L SS (as a minimum) installed along with H type manifold and SMART, 2 wire 24 V DC, DP transmitters with latest HART protocol (refer 7.2.1 for tx details). End flanges shall be as per piping specifications. Upstream and downstream pipes shall be honed from inside to achieve smooth surface. Integral orifice meters, when used, shall be installed with block and bypass valves.

d) Upstream and downstream straight length shall be provided based on maximum d/D ratio of 0.70, in general. Where it is difficult to meet this requirement, the actual d/D can be considered for reducing the straight length as permitted by ' recommended practice shall be as per API-MPMS Recommended Practices and AGA Report No.3. The piping layout, where possible, shall be arranged such that straightening vanes are not required.

e) Orifice plates with RTJ flange connections above 2" shall be supplied with Carrier rings / Plate holder. Holder MOC shall be same as Plate material as minimum.

f) Meter taps shall be horizontal for liquids, condensable vapors and steam. The tap shall be on top for gas, non-condensable vapor, or liquids, which boils at maximum design ambient temperature at operating pressure.

g) The Meter Range flow shall be equal to the 1.5 times of normal flow or 1.3 times of the maximum flow and it shall be nearest higher multiple of 50/100/1000s of units of measure (in Engg. Unit) in round figures. This meter max range criteria specified is applicable to all other type of flow transmitters also.

7.2.3.2 Nozzles

ISA 1932 Nozzles may be used in high and medium pressure steam and BFW piping. Materials for nozzle element shall normally be AISI 316L steel unless special materials are required for the service. Dimensions and calculations shall be in accordance with ISO 5167-1980. Generally, branch pipe is required with the nozzle the same shall be machined from higher schedule pipe than the one used for the service or forged branch pipe shall be used if higher schedule pipe is not available. The branch pipe bore shall be same as that of nozzle ID and shall have mirror finish.

7.2.3.3 Venturi Tubes

Venturi Tubes or nozzles as per ISO 5167-1980 or similar type elements may be used to measure the flow of low pressure gases or liquids where loss of pressure is an important consideration.

7.2.3.4 Averaging Pitot tube/Annubar (Not to be used)

7.2.3.5 Local Flow Indicator

Motion balance (Barton cell type) type differential pressure indicator shall be used for local flow indication. Body and internals shall be of 316L SS. Process connection shall be 1/2” NPT(F) . SS316L 5-valve manifold with 1/2” NPT connection shall be used with the meter.

7.2.4 OTHER FLOW METERS

7.2.4.1 Mass Flowmeter

Coriolis type mass flow meter with local digital display of flow shall be used to measure the process flow where high accuracy is required. Normal accuracy for mass flowmeters shall be 0.15% of span. The sensing element shall be straight/U-tube, matl. 316L in general.

7.2.4.2 Vortex Meter

Vortex shedding meters may be used for wide range of flows for gases and liquids. The measured flow shall be temperature compensated.

Insertion type vortex meter may be used in utility services for line size more than 6” inplace of Pitot /Annubar/Pitot Venturi tubes.

7.2.4.3 Ultrasonic Flowmeter

Ultrasonic flow meters (non- insertion probes preferred) based on the "time-of-flight" method shall be used. Meters based on the "Doppler" principle are less accurate and shall not be used. Ultrasonic flow meters shall be considered for large turn downs and where pressure drop is not permitted. Upstream and downstream straight lengths shall be as per standard.

7.2.4.4 Electro-Magnetic Flowmeter

Electromagnetic Flowmeter with ceramic lining shall be used for the measurement of flow with high accuracy for highly viscous and corrosive services. Instrument shall be suitable for Acid and alkaline measurement.

7.3 LEVEL INSTRUMENTS

Level Instrument shall be suitable for Acid and alkaline measurement. Guided wave radar type instruments (SMART) shall normally be used for level measurement up to 2400 mm, wherever guided wave radar cannot be used then only external displacer type transmitter to be used**.** Differential pressure transmitter (Capillary type) shall be used for level measurement above 2400 mm and for services requiring purge or where liquid might boil in external portion. Capillary type DPTs shall not be used in vacuum services. Internal displacer type of level transmitters shall be not be used. Remote Seal PT/DPT shall be with min 5 mtr Capillary with SS armoured in PVC sheath of Protection with DRIP RING and with Ball type Isolation Valve. For Vessel/Equipment requiring more than 5 m capillary electronic remote seal shall be provided. Process connections shall normally be 3" flanged.

7.3.1 External Displacement

Displacer type level instrument shall be avoided and guided wave radar type or remote diaphragm seal DP shall be used in their place if suitable to process condition.

If unavoidable External displacement type instruments shall generally be used (with owner/PMC approval) for small spans only (The standard ranges shall be: 350 mm, 810 mm., 1200 mm). The cage material shall normally be forged material conforming to the service requirements. Where the vessels are of alloy steel construction, the body material shall be equivalent or of a better material. The displacer shall be in stainless steel (SS316L) and the torque tube in inconel. If LVDT type transmitter in place of torque tube is selected then the range spring of such transmitters shall be Inconel and cannot

be used for temp. more than 330 degree C. Process connections shall normally be 2" flanged with side-side connections.

For high temperature as well as low temperature and cryogenic services, torque tube heat insulation extension or torque tube extensions shall be applied. Radiation fins or extensions shall be used for temperature above 200 degree C or below 0 degree C.

7.3.2 LEVEL GAUGE GLASS

Gauge Glasses

Glass gauges shall be avoided and magnetic type level gauges shall be used if suitable to process condition. If unavoidable Gauge Glasses shall normally be reflex type for all process services, except for boiler drums bicolour types shall be used, and in corrosive services. Where transparent gauges with glass protection and illuminators shall be used, Illuminators shall be explosion-proof in hazardous areas. Gauge glass columns will not exceed 1500 mm. Multiple level gauges shall be used for visible lengths more than 1500 mm.

Transparent type gauge glasses (double glass) will be used for services in which a level may not be distinguishable, such as interface services, between different liquids, where mica shields are required and fluids of high viscosity or high solid content.

For corrosive services, such as strong acids or alkalies, special devices such as magnetic followers or plastic ("KelF") coated glasses shall be used.

Level gauges shall be supplied with a pair of off-set shut off valves with ball check with SS304, or material suitable to process, as its MOC.

For cold services where temperature is below 0 deg C a non-frosting gauge will be used. Glass tube level gauges shall be avoided.

Gauge glass columns will not exceed 1500 mm. Multiple level gauges shall be used for visible lengths more than 1500 mm.

7.3.3 Non Contact Radar/Guided Wave Radar

Displacer type level instrument shall be avoided and guided wave radar type shall be used in their place if suitable to process condition.

Ultrasonic / Radar type Instrument shall be used for large liquid storage tanks. Guided Wave Radar type level instruments, where used, shall be external type with side / side connections and rotatable transmitter head. Vent and drain valves shall be provided. Non-Contact Radar type level shall be used on corrosive, congealing, slurry services where diaphragm seal type transmitter cannot be used. Dip tube can be used in above services where radar cannot be used. In case of heavy congealing service (sticky liquid) rigid single lead type GWR shall be used. All guided wave radar will be coaxial type, where high accuracy or interface level measurement is required. However single rod design to be avoided to extent possible).

Guided Wave Radar Level transmitter shall be applicable for liquids or slurries, hydrocarbons too water- based media. In absence of dielectric constant for the process fluid, Bidder shall confirm the suitability of Guided Wave radar Level Transmitter for such applications and Bidder shall suggest the suitable model for the same. Bidder shall suggest the suitable model for Interface applications like oil on water, Hydrocarbon on water, etc. Electronics shall be capable of measuring upper liquid and interface level simultaneously. Selection shall be available for analog output signal from level transmitter corresponding to upper liquid or Interface. Process connections shall normally be 2" flanged with side-side connections.

For sump levels, Guided wave radar for DCS and non- contact type radar level instrument for interlock shall be used within accuracy ±3mm. For servo gauges where used, calibration chamber with access for removing the displacer for maintenance purpose shall be provided.

7.3.4 Magnetic Level Gauges

Magnetic type level gauges shall be considered for:

- Cryogenic services
- Fluids that attack glass (e.g., strong acids, alkalies, boiler feed water)
- Light ends services
- Toxic services
- Pressures above 500 psig (3450 kPa) special consideration must be given to the design of float for high pressure

Magnetic- type level gauges shall consist of a liquid chamber enclosing a float which is magnetically coupled to a rotary wafer-type indicator. It shall be top or side

mounted type. The liquid chamber shall be one- piece construction with a minimum internal diameter of 50 mm, provided with a bottom flange for removal of the float, vent and drain connections. Indicator shall be adjustable around the chamber with provisions to indicate float failure.

The indication shall consist of bi-colour (red/white, silver/black) magnetic rollers mounted on outside the magnet chamber. As the float rises or falls with the liquid level each roller rotates 180 Deg and so presents a contrasting colour.

Floats shall be designed and manufactured for suitable to the process parameters. It shall be designed to be adequate for hydrostatic test conditions. Floats shall be hermetically sealed, no vented or pressure equalized construction shall be allowed.

7.4 PRESSURE INSTRUMENTS

7.4.1 Pressure Transmitters

Pressure Transmitters and differential pressure transmitters shall be modern inherent motion-free type. Bodies shall normally be in stainless steel with pressure elements in SS316L. Two valve integral manifold of SS316L material in general shall be used with pressure transmitters.

The signal transmission should normally be a 2-wire system and shall be capable of delivering rated current into external load of atleast 600 ohms when powered with 24 V. Protection against short circuit and reverse voltage shall be provided. Pressure transmitters shall normally be electronic type and shall have digital transmitter.. Smart type transmitters will be used with Hart V protocol. Overall accuracy for SMART transmitters shall be +/- 0.050% or better. Process connection size shall be 1/2” NPT.

All field transmitters shall be 2 wire type, 24 Volt DC, SMART with HART protocol, and shall be equipped with Local LED type digital indicator. 2” pipe mounting, SS304 MOC brackets and other accessories, as applicable, Accuracy 0.050% of Span , Rangeability 1:100, Local Display configurable, SS MOC, Double Compression SS316 cable glands, EExib IIA/B/T6, IP67, Wetted MOC SS316L, SS316L MOC Manifold, Housing Die-Cast Aluminium .Epoxy Painted, Universal Hart Protocol with Latest Revision is required

7.4.2 Pressure Gauges

Gauges for process and utility services shall be industrial SS316L Bourdon

gauge/diaphragm or spring bellows type as per process requirement with the case in 316L stainless steel. The gauge for 60 kg/cm2 above pressure shall preferably be a safety type with solid front where pointer and glass are partitioned off from the sensor by a solid disc. Pulsation dampeners shall be installed with the gauges where pulsating pressure occurs. Process connection shall be 1/2" NPT (M) bottom in general. Bezel rings shall be screw on pattern. Dial Size minimum 150mm

Blow-out discs are required for all pressure gauges except for instrument air services.

Vibration proof gauges or remote seal type shall be used if the surrounding environment is subject to vibration.

Minimum accuracy for pressure gauges shall be +/- 1%,

Pressure gauges for vibrating services shall be glycerine filled type or with pulsating dampener device.

7.4.3 **Pressure Switch (Not to be used)**

7.4.4 **Diaphragm seal**

Diaphragms or liquid seals shall be inserted between the instrument and the process for

corrosive or highly viscous fluids. For all services element material shall be minimum SS316L.

Pulsation dampeners shall be furnished with pressure transmitters on pulsating services.

All catalyst vessel's dP measurement shall be with ERS (electronic remote seal).

Remote Seal PT/DPT shall be with min 5 mtr Capillary with SS armoured in PVC sheath of Protection with DRIP RING and with SS304 Ball type Isolation Valve. For Vessel/Equipment requiring more than 5 m capillary electronic remote seal shall be provided.

DP transmitters with diaphragm seals are envisaged, where condensing leg required to be filled in normal DP transmitters, at all those locations, remote seal type DP transmitters are to be used. Also, wherever there is a control and interlock on level measurement, one transmitter shall be remote diaphragm seal type and one will be guided radar type with Material: Minimum Inconel. Guided Wave radar may be used for non-critical applications. Process connection will be 3" flanged and sealing liquid must be selected as per process requirement.

7.5 TEMPERATURE INSTRUMENTS (Duplex Type)

7.5.1 Thermocouples

Thermocouples shall normally be the sheathed type with high purity magnesium oxide insulation. The hot junction shall be isolated from ground. Sheath diameter shall normally be 6mm (1/4") Inconel 600 sheath material shall be used for design temperatures above 400 degree C, whereas ordinary SS material can be used below 400 degree C. The nominal wire diameter shall be approximately 0.19 x sheath OD. The casing material must be SS316L.

Inputs from thermocouples shall be provided with cold junction compensation and downscale burns out feature for high temperature shut downs and vice versa for low. A passive alarms shall warn about the burn-out.

In general type K thermocouples shall be used according to IEC 584, class-1. All temperature elements shall be duplex type, one connected and the second one shall be used as spare.

Thermocouple head must be of die cast aluminium with epoxy paint to with stand the corrosive environment.

Unless otherwise specified, thermocouples cable color coding shall be in accordance with the latest edition of ANSI-MC 96.1.

The type of thermocouple shall be selected based on the following guidelines as minimum:

Copper-Constantan (ISA-Type-T)	(-) 200 to 200°C
Chromel-Constantan (ISA-Type-E)	(-) 200 to 600°C
Iron-Constantan (ISA-Type-J)	(-) 40 to 750°C
Chromel-Alumel (ISA-Type-K)	(-) 180 to 800 °C
NiCrSil - NiSil (ISA-Type-N)	0 to 1200 °C
Platinum Rhodium-Platinum (ISA-Type-S or B)	600 to 1600°C

7.5.2 Resistance Temperature Probes

Resistance Temperature Probes shall be considered for applications where very narrow spans and high accuracy are required as well as low temperature service. They shall be 6mm (1.4") stainless steel sheath type similar to the thermocouples and with a Pt 100 ohms (0 degree C) element. The sensors shall be duplex type and shall be spring loaded for vibration proof. The elements shall conform to DIN 43760 or IEC 751. The casing material must be SS316L. RTD head must be of die cast aluminium with epoxy paint to with stand the corrosive environment.

Class 'A' / Class '1' tolerance as per IEC 751 / 584-2 shall be specified for all RTD and thermocouple sensors in complete temperature measurements for all open/closed loops and interlocks/Logic.

7.5.3 Temperature Transmitters

Temperature transmitters shall be Remote mounted type (on 2" Pipe), Smart with latest HART protocol and integral digital output meter, dual compartment type.

Head mounted transmitters shall not be used.

Conventional transmitter shall have universal input for thermocouple / RTD and output 4-20 mA DC for 2 wire system.

Transmitter output signal shall be linear and directly proportional to the measured temperature with overall accuracy of +/- 0.1% FS. TT body must be of die cast aluminium with epoxy paint to with stand the corrosive environment

Thermocouple transmitters shall have cold junction compensation and thermocouple linear characterization. Resistance temperature transmitters shall have resistance element linear characterization.

Burnout protection (selectable Up Scale / Down Scale) must be provided for temperature transmitters.

No temperature switches are to be used. The same is to be achieved through transmitters which shall be directly connected as analog input to DCS / Control System

Temperature transmitters are to be provided for all temperature measurement (closed/open/interlock) loops. All process temperature measurements shall be done through Temp. Transmitters. No temp. Input shall be connected directly to ESD/PACKAGE UNITS. MUX is not allowed.

7.5.4 **Thermometers**

Thermometers shall normally be bi-metallic, heavy duty, weatherproof (IP 65), adjustable angle connected type with 150 mm dial as a minimum, dials of smaller size may be used for auxiliary services on machinery. Casing material shall be SS316L.

Liquid filled indicators will be used only where indication is required to be remote Case and stem shall be in stainless steel. Dials shall be of white, non-rusting metal with black figures.

For local temperature control upto a maximum scale range of 530 deg C, liquid filled sensors with capillary extension shall be used.

Filled system instruments when used shall be fully compensated for ambient temperature variations.

Capillary shall be SS armoured and length of which will not generally exceed 3 mtrs.

Range should be selected so that normal operating temperature is approximately 70% of full scale, and the maximum expected temperature is approximately 90% of full scale.

7.5.5 **Thermowells**

Thermowells shall normally be made from bar stock material.

Flanged thermo well shall be used of 1 1/2" size, threaded thermowell shall not be used, except where accepted by piping specifications, in such case they shall be 1" NPT(M) and real welded. Flanges rating, facing and material shall be in accordance with the equipment or piping standard. Thermowell flange rating shall be 11/2" 300# minimum.

Thermowell shall be used for thermocouples, bimetallic thermometers, filled system and for temperature test points (TW).

Thermowells in vapor-liquid applications, inside columns, shall be located in the liquid phase, unless otherwise dictate by process requirements.

Test wells shall be equipped with threaded plugs and chains.

The preferred mounting position of thermowells, in horizontal pipelines, shall be in the upper half of the pipe.

For lines up to 3 inch size, the pipe shall be enlarged to 4 inches.

Thermowell material in general shall be of AISI 316L SS.

Immersion length of thermowells for different line sizes shall be as follows:-

Line Size	Immersion length (U)
4" to 6"	280 mm
8" and above	320 mm
Vessels	400 mm

Immersion length is based on 200 mm length between flange face and inner well of pipe and approx. 60% insertion in the pipeline. In vessels, where fouling with vessel internals is expected, the immersion length shall be suitably modified. Other sizes and immersion lengths may be considered based on special condition/actual requirements.

The design of the wells shall be verified by means of stress analysis, resulting from stream velocity condition. The wake frequency shall not exceed 66% of the thermowell natural frequency. Wake frequency calculation is required for all thermowells. Bidder has to submit Wake frequency calculations for all thermowells as per latest PTC 19.3. Velocity collars not to be used.

7.6 CONTROL VALVES

Valve types shall be selected, pneumatic diaphragm/piston operated globe, ball or butterfly shall be selected taking into account such factors as piping, operating and design conditions, fluid being handled, tangibility required, allowable leakage, noise and other special requirements. The valves shall have smart electropneumatic positioners of same OEM make as the valve. All control valves shall be provided with SMART valve positioner with valve position signal feedback connected to DCS system by 4 to 20 mA analog signal. It shall be HART compatible. Seat Leakage shall be chosen in accordance with process demands and safe operation of the plant and in accordance with AISI B16.104-1976. However, in general, the globe valves used shall be of class IV leakage minimum as per ANSI B6.104 in general. Metal seated valves shall be preferred instead of soft seated valves. Soft seat requirement shall be evaluated by PMC/Client on case to case basis. However, in general, the globe valves used shall be of class IV leakage minimum as per ANSI B6.104 in general. For vent services the leakage class shall be class V or VI depending upon process requirement.

Safety shutoff valves must not be used in throttling service during normal operation.

Noise abating devices shall be provided with valves where noise level at the outlet of valve at a distance of 1 metre all around is more than 85 DBA for valve which have operating times of 5 minutes or more in general and which are only working during start up and in upset conditions. For continuous operation the allowable sound level shall be 85 dBA. All noise abating plates, expanders, flanges, gaskets, studs & nuts shall be in the scope of valve manufacturer. The noise abating plates shall be of wafer design for easy removal for maintenance. Source treatment for noise shall be preferred over path treatment and for high noise vent applications “DRAG” type trim shall be specified.

All valve bodies shall be cast or forged. Stainless steel bodies shall be acceptable inplace of alloy steel bodies, if not available, for low temperature application.

The valve body, positioner and actuator body material shall be suitable to corrosive environment. Suitable lining shall be provided inside wetted parts as per application.

Flanged bolted type gland packing boxes shall be used, unless other specified. Gland packing shall normally be self-lubricating type. Packing shall be PTFE type up to 200”C. For temperature above 200 “C, grafoil is to be used. Usage of asbestos is not allowed in any part.

Bellows seals shall be used wherever gland leakage is not permissible like toxic / hazardous product like carbon monoxide gas, etc.

As a minimum, trim MOC shall for all control/on-off valves shall be SS316L. By default, all Guide MOC shall be hardened stainless steel like 440 C, 17.4 PH. For erosion service, high pressure drop, cavitating service hard surfacing of plug and seat material, satellite shall be used for all cases as specified in above point 22.1. Special cases valve may require 17.4PH seat and 440C solid plugs or other material like Hastelloy, Monel, Zirconia, duplex steel, etc. for severe services like steam, urea grade, carbamate solution, acid, etc.

Mechanical stopper shall be provided as per process recommendations for Min/Max. Flow condition.

On line replaceable trims shall be considered for all high pressure valves of butt-weld or socket weld connections. Trim characteristics shall be equal percentage, unless otherwise specified. For high erosion service or in steam service where, the delta P is higher than 5 Kg/Cm2, hardened trim with stelliting shall be used. When this alone is not

sufficient, in such cases, special Anti-cavitating trim or shall be selected. In general, for all trims, hardened full stelliting shall be used, as a minimum.

All on-off valves shall be ball type on-off valves only. The ball valves of up to 2" size shall be floating ball design with full bore design, unless otherwise specified. Other ball valves with higher size can be trunnion supported ball type design type.

For all shutdown valves on fire safe applications, air volume tank shall be supplied for the storage of air volume for minimum 3 stroke operation.

Oxygen service valves shall be de-greased completely and certified for oxygen service use. MOC for body shall be Monel and trim shall be Inconel 600 only.

Control / Ball valves bodies used in steam services should be A182 F22/ A217 WC9.

Split body design for ball valves acceptable where top entry ball design has not been considered for economical reasons. Mufflers shall be provided on ball valve vent air lines for noise suppression. Spring loaded seat and hard chrome plated ball shall be a standard feature for ball valves, in general. Wherever springs come into picture, vendor to ensure corrosion resistant spring steels are provided.

All control valves/ Actuators (pneumatic & Motorised) shall be painted with corrosive resistant paint. SS bug screen shall be provided for the exhaust ports.

All valve actuators shall be selected for a minimum operating air pressure of 4.0 kg/cm2g. The actuators shall be diaphragm or piston actuators in general. Diaphragm actuators with single or concentric multi-springs shall be used. volume tank with airlock relay , booster relays shall be avoided as far as possible.

Rotary rack and pinion pneumatic actuators may be used with ball and butterfly valves for on-off services.

In general, if otherwise not specified in the valve data sheet the time for full travel shall not exceed 10 seconds.

Wherever handwheel is required with a valve the same shall be side mounted type.

All split range functions for valve operations shall be carried out in control system and split range provision in valve positioners shall not be necessary.

Butterfly valve bodies shall be of wafer design. Lug type body shall be considered for size above 12". Face to face dimensions shall conform to ANSI B 16.10 and ANSI B 16.47 wherever applicable. Butterfly valves shall be used for high flow, low pressure drop below 10 kg/cm2g.

All instrumentation butterfly control valves shall be triple offset type only.

Non destructive test like radiography, ultrasonic, die penetration and magnetic particle shall be carried out for cast and forged bodies conforming to procedures laid down in ANSI B16.34. Radiography or ultrasonic test, if not specifically mentioned in the data sheet, shall be carried out for cast or forged bodied of rating 900 lb. or above.

Valve bonnets shall be in general of bolted bonnet design as per ASME B 13.3 par 307.2 with minimum four bolts.

Smart E/P positioners with position transmitter along with valve signature software to be provided for all control valves. It shall be HART compatible, The software shall be provided for remote configuration and diagnostic analysis too.

Actuator sizing shall be done at 4 Kg/cm^2.

Handwheel (Side-mounted) for All regulating control valves to be provided

By-pass valve provision shall be as per process licensor requirement.

The control valve % opening shall be at minimum flow 10-20%, for normal flow 50 to 70%, for maximum flow 75 to 85%.

All on – off application valve shall be fixed with necessary limit switches.

Valve Sizing shall be used on a maximum flow rate of approx. 1.5 time normal flow or 1.3 times the max. flow, whichever is greater, and the process conditions that exist at the increased flow (Pressure and differential pressure). Valve lift shall be approximately 70 % for equal percentage and 60 % for linear characteristic plug design at normal flow. It shall be checked that the calculated and the selected valve also covers start-up and stop conditions. In cases where over sizing shall not apply, it will be specifically mentioned in the Instrument Data Sheets.

The fluid velocity at outlet flange shall not exceed 6 m/sec for liquids whereas the velocity of gas or vapor shall not normally exceed 0.3 Mach under operating conditions. To meet

this, valves shall be selected having reduced trim, labyrinth plug or cage trim as manufacturer standards.

Bidder shall submit the sizing calculations for all control valves.

Face to face dimensions of the control valves shall be as per ANSI/ISA-S75.03.

Direction of flow indication shall be engraved or embossed on the body.

Stroke time of the antisurge valves shall be 2-3 seconds and for critical services shall be as defined by process licensor or as mentioned in individual data sheet.

7.6.1 Control Valve Test and Inspections

Valves shall be tested in accordance to individual specification which shall cover but not limited to:

- Visual Inspection and dimensional check

- Liquid Penetrants examination on stellite coating as per ASME B16.34 ann D.

- Radiographic, ultrasonic, magnetic particle as per ASME B16.34

- Hydrostatic Body Test - Duration 3 min. (including all parts in assembled condition like body, gland, all joints)

- Impact test

- Seat leakage test as per ANSI B16.104/FCI 70.2

- Performance tests and Functional tests

- Leakage test from actuators and seals and packings

- Diaphragm head test

- Complete actuator leak test

- Helium leak test for control valve with bellow seals

- Stroke calibration

- Stroke speed test

7.6.2 Limit switches / Position Switches:

7.6.2.1 All type of limit switches shall be 2 wire, proximity type, intrinsically safe certified. Limit switches shall be provided both for close and open positions for all shutdown valves.

7.6.2.2 The make shall be P+F only. The sensor shall be generally cylindrical NAMUR sensor type proximity switch. The diameter and sensing range shall be selected based on application.

The MOC of sensor shall be SS316 or acid resistant body.

All limit switches sensor shall be adjustable with the threaded length and check nut arrangement.

Flying lead type loose connections for NAMUR sensors are not acceptable. All these NAMUR sensors installed on any instruments to sense the position shall be housed in a closed box certified for weatherproof to IP65. The gland size shall be ½" NPT(F).

7.6.2.3 All ON-OFF type application valves taking in part in interlock/shutdown shall be provided with Open and Close type NAMUR sensor as limit switches. The sensors along with enclosure shall be installed in control valve in such a way that it can be removed with ease for maintenance.

7.6.2.4 Limit switches shall not be used for Control Valves.

7.6.3 Actuators

7.6.3.1 Flapper gate & all diverter shall be Motorized Actuator operated. Actuator design shall be as per Area classification . All actuator shall be flame proof as minimum.

Generally, control valve actuator shall be of the spring and diaphragm, pneumatically actuated type. Standard air control signal to positioner shall be 0.2 to 1.0 kg/cm2g. For larger dP shut offs, higher spring range/higher areas shall be considered.

7.6.3.2 Actuators shall be single acting type for all valves.

7.6.3.3 All valve actuators shall be designed with 1.5 times factor of safety.

7.6.3.4 Piston type actuators (spring return type) with or without fail-safe capacity tanks (minimum of 2 strokes to be possible in case of air failure) shall be considered for high-pressure

drop services or if actuator force requirements fall beyond the normal range of diaphragm actuators. All actuators shall be adequate to fully stroke the valve under the maximum differential pressure specified by the process requirements.

7.6.3.5 Air filter Regulator filter to be 5 micron. Miniature type, SS316L body & drain assembly etc as parts of air filter regulator are not acceptable.

7.6.3.6 Actuators must be painted with corrosion resistant paints and all its springs must be corrosion resistant spring steels. SS bug screen shall be provided for the exhaust ports.

7.7 DELETED

7.8 PRESSURE RELIEVING DEVICES

7.8.1 **Pressure Relieving Devices**

All Pressure Relieving Devices shall be sized in accordance with applicable local and national code requirements. Formulas shall be in accordance with API RP 520, 1990 and ASME Codes section I and VIII.

7.8.1.1 Percent Overpressure and Accumulation used in calculation of sizes of relieving devices shall be :

Overpressure

3% - Steam services where ASME Power Boiler Code applies.
10% - Gas or Vapour service.
15% - For liquids and pump discharge lines with 6% system accumulation (Power Boiler Code) and with 10% system accumulation (Pressure Vessel Code)
21% - Fire exposure on unfired pressure vessels.
10% - Liquids for thermal relief of pipelines or vessels Accumulation
10% - Gas , Vapour and liquid where ASME Pressure Vessel Code applies
16% - Gas , Vapour and liquid where ASME Pressure Vessel Code applies and the system is protected by means of multiple valves.

7.8.1.2 **Nomenclature**

Nomenclature used shall be in accordance with API RP 520.

7.8.1.3 **Safety and Relief Valves**

Safety and Relief Valves shall normally be direct spring loaded type. Balanced bellows valves shall normally be furnished for relief into closed flare and slowdown systems, if the developed back-pressure exceeds 10% of the set pressure. Bellows shall also be specified where leakage of gas from the seals are not permitted during normal plant operation. Steam jacketing may be considered necessary to keep some valves and lines warm at all the times to avoid the solidification of the lading fluid.

Full nozzle types of valves shall be specified for sizes 1” or above.

Test gags shall be furnished on all safety and relief valves. Test gags shall be removed and transferred to Owners possession after testing, clearly labelled with the tag number of the valve.

Lifting levers shall be furnished for exposed spring bonnets on valves on steam and hot water services, on air valves and hot water service valves with closed bonnets.

Bonnet construction shall be plain closed bonnet for toxic and inflammable gases as well as vapour and liquids. Exposed bonnet shall be specified for steam service and in Boiler feed water service above 200°C. Bonnet extension shall be used above 400°C.

Springs shall be of carbon steel for normal process operating temperature of (-) 25°C to 200°C and tungsten alloy or high temp. alloy steel above 200°C. Stainless steel spring may be used for services below (-) 25°C. Carbon steel is permitted above 200°C for open bonnets.

Blowdown shall be between 5% to 7%. For steam services under Power Boiler Code as per ASME the blowdown shall be 3% - 4%

All connections shall be flanged in general with facing and rating in accordance with the piping specification or API 526 whichever is higher.

Centre to Centre dimensions shall be in accordance with API 526

7.8.2 Rupture Discs

Rupture discs may be used in lieu of or in combination with safety and relief valves, where applicable or required. For disc rupture trip or alarm disc shall be with bursting sensors.

7.8.3 Pressure and Vacuum Relief Valves

Pressure and Vacuum Relief valves for storage tanks shall normally be of the weight loaded or pilot operated type, and sized in accordance with API RP-2000 Tank Venting Code, or Local Codes if they govern.

7.8.4 Thermal Relief Valves

For thermal relief of accumulated liquids in pipelines and vessels 1" x 2" size valves shall be used in general.

7.8.5 Centre-to-Face

Centre-to-face dimensions shall be in accordance with API 526.

7.9 SWITCHES AND SOLENOID VALVES

7.9.1 Switches

Process switches, shall be realised through field transmitters only. If for some packages, process switches are unavoidable same shall be provided with sealed micro switch contacts rated for the specified application. Contacts shall be 1 no. DPDT preferably. Otherwise 2 nos. SPDT can be considered. All switch contacts except those used in intrinsically safe circuits shall be silver plated. Contacts used in intrinsically safe circuits shall be suitable for the applications. Switches shall be hermetically sealed type. Switches shall be connected through interposing relays**.**

7.9.2 Solenoid Valves

Solenoid valves shall normally be used to actuate other instruments/valves connected directly to the process. The SOVs shall be SIL3, direct acting type (3/2 external pilot operated, universal type, low power intrinsic safe type, with manual override and LED indication). Protective enclosure shall be IP 67 and the coil insulation H class or better suitable for continuous operation in 85 degree C ambient temperature (max. surface temperature in sun) for outdoor service. Body materials shall normally be stainless steel 316. Solenoid valves will be powered by 24V DC or through barrier, insulation class 'H' and orifice size 9 mm. The D.C. solenoids shall not have in built rectifier to operate with A.C voltage. The d.c. solenoids shall be used as an alternative to A/C solenoids only for low current intrinsic safe operations.

All solenoid valves shall be fitted with 1/2" NPT (F) SS 316 double compression cable gland connection. The cable entry should be from bottom only and solenoid coils must be hermetically sealed. SS bug screen shall be provided for the exhaust ports. The sealing

medium of the SOV's will be EPDM or better (will be discussed during the detailed engineering).

8.0 CONTROL SYSTEM

DESIGN CRITERIA

EXPANDABILITY

Systems shall be designed with 20% installed pre-wired spare capacity for all I/O type cards of each category for project development. The sparing supplied shall be for "complete loop"; i.e. corresponding marshalling, power supply, terminals/barriers, interposing relays, pre-fab cables other accessories, etc. and its space, and panel cut outs where appropriate, etc.

To allow for future expansion 20% spare capacity shall be allowed & terminated in multi core cables, junction boxes, marshalling racks, etc,

Communication networks and cables shall have a spare load capacity of 50% as a minimum.

Plant wide networks shall have a node connection spare allowance of 50 % as a minimum.

Local networks shall have a node connection spare allowance of 30% as a minimum**.**

Operators' Keyboard

This shall be used by plant operators along with each Operator station display unit for operation of the plant. It will have multiple assignable keys to directly open pre-programmed display as well as few other system typical templates for selected tags including controller group display, trend, configuration display, alarm summary pages, etc. There shall be both numeric and alphabet keys and dedicated function keys on membrane type operator keyboard each of which must be freely programmable. There shall be one no. of operator keyboard with each of the operator stations.

This shall be membrane type fully dust proof and spill proof & corrosion proof.

Key lock switch / password switch shall be provided for operator/supervisor/engineer security levels.

Dummy Consoles/Filler Panels shall be provided to maintain aesthetic and mounting instruments like indicators, annunciators etc. as well as for push buttons, lamps, key switches, paging system hardware. Entry into the Marshalling Panels shall be through SS316 ET/NPT double compression cable glands only.

CONTROL SYSTEM

8.1 General

The operation and control of **UREA HANDLING & BAGGING** Plant shall be through Process PLC based Control system. The system shall be microprocessor based programmable logic control (PLC) with fault tolerant redundant processors based on DMR/TMR/QUAD technology.

The PLC will be used to provide protection and controls for the entire plant.

Following minimum functions are provided on the OS (Operator station):

1. Area wise display of the plant.
2. Operation of the plant from the OS.
3. The schematics will be having dynamic parameters like valve open / close and motor running/ fault indications

The Control system shall perform any of the following functions for safety of the plant from control room.

- Total Shut Down
- Unit Shut Down

It will perform the following functions also:

Data Display
Process Control
Process and system alarms
Logging
Real Time trends & Historical trend
Dynamic Graphics
Report Generation (shift, daily, weekly, monthly and on demand)
System diagnostics
The following shall be adhered to while selecting the DMR system

a) Redundant CPU's shall be applied.

b) If a CPU fails, the other(s) shall continue to operate. Single CPU operation system to be certified to operate without any time limitation of faulty CPU repair.

c) Dual Redundant buses shall be applied.

d) All closed loop shall be Redundant

e) Redundant communication interfaces shall be supplied.

f) Redundant Power supplies (at least three in parallel) shall be supplied.

g) In the event of a failure of a fault tolerant component, power supply or other function, of the system shall change over to "single mode" operation without causing nuisance trips and also generate alarm on Operator and Engineering console.

h) In case of failure of complete processor system, i.e., system outputs shall take fail safe state automatically unless otherwise specified.

Operator interface for critical trips shall be mosaic display with illuminated push button for trip, reset, inactivation etc. and LED indication for each element of trip & actions.

The operator will be informed about a trip situation by a warning sound (to be different from the audible signal from the alarm system), and a LED display will clearly inform about the alarms in trip position. The first up alarm will flash.
Scan time shall be maximum 250 msec. CPU loading shall not exceed 50%, Bus Communication modules, Power Supply and I/O cards shall have 100% redundancy and fail safe certification.

System Redundancy

Following system redundancy shall be available as a minimum.

1. Controller (CPU for control, I/O communication, network communication) 1:1
2. Communication Bus 1:1
3. I/O communication modules with CPU (I/O bus between CPU and I/O with all necessary hardware) 1:1
4. Main data highway 1:1
5. Communication Cards 1:1
6. System Device 1:1
7. Power supply (Power supply for all CPUs, I/O power supply modules) 1:3

8. History 1:1

9. Modbus/Serial interface 1:1

10. OPC server: OPC server, If applicable shall have RAID-5 configuration with firewall.

11. System server (for server based control system): Redundant (1:1 redundancy)

However, lamp drive cards, supporting mosaic need not be redundant also. Active isolator/barriers need not be certified for fail safe operation.

The operator can bypass trip alarm inputs, which may be necessary in abnormal situations. A lamp shall indicate that the trip alarm is inactivated. The operator will be warned by sound and fast flash if the inactivated circuit goes in alarm status.

The system shall include an event recording system, and it shall be considered to store about 500 events. The system should have SOE backup facility for 30days. Sequence event recorder (SOE) of 1 msec, resolution to be envisaged.

Display colours shall be in accordance with the following:

Alarm and Trip (safety operations) : Red
Pre-alarm for trip (safety operations) : Orange
Indication for by pass of trip (safety operations) : Red
Equipment in operation (alarms and pilot lights) : White
Ready (standby of equipment) : Green
The critical trip shall be displayed on mosaic tiles of 19x19 mm size.

The mosaic panels shall be mounted on auxiliary consoles of operating console.

Consumables like printer paper, cartridges, fuses etc shall be supplied along with the control system for a minimum period of one year duration.

8.2 Control system requirements

a) All systems' all cards shall be supplied with ISA G3 level or equivalent coating for environmental protections.

b) ISOLATIONS

Analog I/Os to Field : Galvanic Isolation through safety barriers

Analog I/Os Module : Channel to Channel Galvanic Isolation

If individual channel to channel isolation is not available with system vendor, then only Isolation shall be provided in a group of 4 channels as per system vendor design. Digital Input to Field : barriers + optical isolators on cards

Digital Output to Field : Interposing relays + smart barriers for monitoring purpose

c) PANELS:

All panels shall be either 1200 mm (wide) x 800 mm (depth) x 2100 mm (height) or as a special case 600 mm(wide) x 800 mm (depth) x 2100 mm (height), RITTAL make, with 100 mm black powder coated metal base frame and with colour shedding of RAL7032 (Siemens Grey) and removable gland plates at bottom only. This applies to all types of instrument panels to be used in the whole project like various PDB, Electrical / Instrument panels, Third party device panels, etc.

d) All A/D converters of system I/O cards shall have resolution of min. 13 bits and all D/A converters of system I/O cards shall have resolution of min. 10 bits

e) There shall be 20% installed spares minimum 1, installed and wired capacity for I/O cards of each category in DCS, including all peripheral termination modules, prefab cables, Relays, Safety barriers, etc

f) All marshalling and system panels shall have minimum 20 % wired spare capacity for future expansion (should be possible with the same wiring philosophy.)

g) I/O cards' Channel density shall not exceed the following limits:

Analog Input	16 Channels
Analog Output	16 Channels
Digital Input	32 Channels
Digital Output	16 Channels

h) Maintenance override switches (MOS) shall be soft type. One hardkey shall be provided in Auxiliary console for the Activation of the MOS.

Process override switches (POS) shall be soft type.

i) Auxiliary Hardwired console

Auxiliary consoles shall be provided for high priority discrete hardwired safety functions, which shall be manually operated. The console shall be installed adjacent the operator station console, near 22" TFT/LED color monitors in the control room. The console shall be equipped with, Mushroom top Emergency push buttons for emergency shut-down action only. All Emergency stop and manual start/stop push buttons shall drive an interposing relay located at IRC. For all critical electricals drives (list will be discussed separately during detailed engineering), the spare contact of final DO command from control system going to MCC, must be connected as DI into control system and configured in SOE for confirmation of command to MCC from control system.

All trip parameters shall have override switches and their output status lamp on console.

j) All interlock and control transmitters shall be separate right from field junction box to marshalling panels

k) Those parameters, which are directly or indirectly tripping the plant or may cause production loss, shall be wired with 2 out of 3 transmitter trip voting interlock in control system. There shall be three separate analog input channels in three different cards. AI cards shall be used for this purpose in system. Same thing is applicable to Digital inputs also.

8.3 System Cabinets

8.3.1 Interlock Marshalling Cabinet

Marshalling cabinet(s) are foreseen for both incoming to Interlock system and outgoing from Inter ('from' and 'to' field) termination. The interlock marshalling cabinet(s) shall also accommodate the repeater power supplies for the field transmitters, galvanic isolators for all inputs, trip amplifiers, output relays etc.

The termination strips shall be arranged or grouped for inputs/outputs 24VDC, 115VAC, etc. both for inputs as well as outputs.

The terminals shall be of the Wago/weidmuller/Phoniex /Klippon make screwless, cage clamp type, single tier design (double tier design shall be avoided). Terminal stack for each unit shall be supplied with approx. 20% extra terminal points as spare/future provision in addition to the existing inputs and outputs.

Physical separation between the terminal stacks/points shall be maintained for the intrinsically safe and normal termination. Also the termination area shall be physically separated from the electronics area there by sealing the latter from dust ingress.

8.3.2 **Sequence of event (SOE) shall be part of ES cum OS.**

Bidder shall provide the Sequence of event recorder function, with a time resolution not above the machine scanning time. This information shall be available, for archiving, filtering and visualization operations to the dedicated SOE workstation, to aid in diagnosis and recognise the first cause of plant or equipment shut-down.

Sizing of the system bulk memory capacity shall be done considering for SOE activities a rate of 500 events/day (or shall be discussed during detail engineering).

8.3.3 **System Clock**

The control system clock shall have facility for synchronising with a GPS based time synchronization system through hardwire DI signal. Bidder shall consider Ethernet port/TCIP for synchronising to Master GPS clock. Additional hardwired or communication connections / networks between control system and control system shall be consider by the bidder.

8.3.4 Network securities shall be provided in all control rooms as per IEC 62443 for protection of the system from both internal and external threat. The requirement includes all USB port blocking (including all monitors/CPU), provision of sufficient firewalls, antivirus updation for one year, patch updation, unauthorized logging recording with events etc. must be addressed by the Contractor.

8.3.5 SOE punching should be directly at I/O Card level. PC timing should not be used for SOE punching. A Separate SOE file (trip log) must be created by the system which includes all the events just before & after the trip.

8.3.6 Control panels/Consoles FFTDU (Fan Failure & temperature detection unit failure) feedback must be considered in the Control System as a separate DI signal.

8.3.7 Any logic designed on limit switch leading to direct or indirect production/safety loss must be 2oo3.

8.3.8 First out must also be mapped to DCS/ Package control system.

8.3.9 All instrument earthing shall be separate from electrical earthing. There shall be minimum 4 types separate earth pits for each System/Panel /Power/Intrinsic safe signals with different cable color codes. System earth shall be less than 2 Ohm or better as per OEM. The size of Earthing Cable shall be 50 sq.mm minimum and should be routed in a conduit.

8.3.10 All trip signals _2oo3 configuration shall be segregated at all levels i.e. JBs, LCP, Marshlling, I/O card, etc.

8.3.11 All the MCC and instrument interface (for all DI/DO/AI/AO signals) shall be connected through a separate shielded cable and not through control cable. (signal cable shall be used).

8.3.12 Start and Stop pushbuttons should be grouped separately and with LED indications on Auxiliary console.

8.3.13 **Power Supply**

All instrumentation shall be fed by an Uninterruptible Power Supply (UPS) system.

An uninterrupted Supply to PLC system shall be provided to the power distribution cabinet of PLC system at 115VAC +/- 10%, 50Hz +/- 3%. UPS feeders from ACDB to DCS/PLC loads shall be redundant whereas UPS feeders for Non-Control system loads shall Non-redundant, The Contractor shall prepare a list Non-Control system UPS load requirement.

110 VAC UPS Power supply feeder failure alarm before PDB shall be provided in PLC by using double pole MCB in PDB. One contact of these MCBs shall be wired to PLC for alarm purpose. Single point Power supply shall be provided at Main Control Room / SS, all cable supply & laying, termination, any work related execution of this package shall be in bidder scope.

In case rectification to DC is involved, rectifiers shall be dual redundant and both shall be 'hot' (on line) so that failure of one rectifier will not cause a system trip. Provision shall be included in the system to annunciate the rectifier/DC power supply failure.

24V DC power supply

i) 24 VDC power supply required for interrogation voltage, solenoid valve supply, lamp, pushbutton, etc and for other packages shall be supplied by contractor using dual redundant Bulk Power Supply (BPS).

ii) Each redundant bulk power supply shall be sized for maximum50% loading of its capacity in normal time; the maximum loading is to be 70% of its capacity of BPS.

iii) All bulk power supply (BPS) shall be provided with surge protection capability. BPS shall also provide with cooling fans and with fan failure alarm indications in DCS/PLC system.

iv) Each BPS shall be provided with Mosfet based redundancy with auto-current balancing and equal loading on both PS.

v) Power supply & redundancy module shall be same make .

vi) Current output (4 to 20 mA) shall be available from the power supply unit and the same shall be wired to DCS/PLC for Power supply health monitoring and indication from all BPS.

Philosophy of power isolation and over load protection (switch fuse units) or only over load protection shall be extended upto individual card level, while designing the system, so that, minor card failures can be localised for easy rectification. Also this will avoid major down time on the system.

Earthing /Grounding bus bars for terminating shields of the cables shall be provided on the cabinet.

Power supply (For all DCS/PLC and Vendor Packages): All BPS Failures shall be connected to DCS/PLC as a separate DI signal. All Diode O rings Failures shall be connected to DCS/PLC as a separate DI signal. All power feed Modules shall be connected to DCS/PLC as a Separate DI signal. All MCB healthiness feedback shall be connected to the DCS/PLC as a Separate DI signal.
Silver/Cu/humidity/temperature monitoring shall be with 2 nos. of C/R with indication in DCS/PLC.

Healthiness of BPS/MOSFET O ring must have LED indications for indicating the healthiness of the module locally. 110 V AC and 24 V DC supplies must have current and voltage transducer wired to PLC.

8.3.14 **Annunciator**

The Annunciator display stations will consists of:

- LED Lamps

- Split type architecture with lamps and electronics separate
- All connections with interlock system cabinet and interlock marshalling cabinet shall be through plug in connectors.
- About 20% spare capacity shall be there
- All switches and status lights indicated below shall be an integral part of Display Modules.
- Supply shall include mounting accessories and about 20% of unassembled extra LED lamps

8.3.15 **Precision & Accuracy**

The isolator, repeater modules/trip amplifiers for analog inputs shall have a total accuracy of less than 0.2% of full span for the measurement circuit.

The accuracy and stability for thermocouple trip amplifiers, if applicable, shall be +/- 0.5%.

8.3.16 control system **Spare Philosophy:**

Installed Spares	I/O Level	20%
	Marshalling	20%
Spare Space	I/O Level	20%
	Processor	50%
	Marshalling	20%
	Rack	

8.3.17 FAT – FACTORY ACCEPTANCE TEST

FAT is inspection for verification that all equipment and devices function properly with integrity.

Prior to notification of FAT to Client/Purchaser, all the involved contractual documentation shall be completed and all the cabinets, equipment and components of control system shall be assembled and installed in one area at one time.

Seller shall demonstrate all the function control system working properly in FAT. Each test shall be carried out on the procedure reviewed and accepted by Client/PMC/Purchaser after submitting Manufacturing Internal Test Certificate.

FAT certificate shall be issued by seller at the successful end of the test activities. All the hardware and software failures and problems shall be documented. All the failures and

problems shall be resolved before shipment to site, All series of actions shall be taken in accordance with the FAT procedure.

FAT will start with Visual Inspection including the following activities as minimum;

- Quantity of all the cabinets, equipment and components.
- Installation of all the cabinets, equipment and components.
- Tagging of all the cabinets, equipment and components.
- Wiring of all the cabinets, equipment and components.

Once Visual Inspection has been successfully completed, Hardware Testing shall start including the following activities as minimum;

Power-On

- Redundancy of Power Supply on failure
- Diagnostics of the main equipment
- Redundancy of the main equipment on failure
- Redundancy of network on failure

- 100% I/O Accuracy Check at 5 point (0%, 50%,100%,50% and 0%) for all the hardwired points (sample check may be allowed if 100% I/O Accuracy has been checked Manufacturer Internal Test)

Once Hardware Testing has been successfully completed, Software Testing shall start including the following activities as minimum;

- I/O Database implementation
- Graphic implementation
- Control implementation
- Logic and sequence implementation
- Historian implementation
- SER implementation
- AMS implementation

8.3.18 SITE ACCEPTANCE TEST (SAT)

SAT is inspection for checking that all the conditions are good after installation at site.

Prior to notice of SAT to Client/Purchaser, seller shall submit all the "As-Shipped" documentation incorporating all the FAT correction.

Prior to start SAT, all the cabinets, equipment and components of control system shall be installed in proper location as designed.

Seller shall demonstrate all the function of control system working properly in SAT. Each test shall be carried out on the procedure and its criteria reviewed and accepted by Client/Purchaser.

Test certificate shall be issued by seller at the successful end of the test activities. All the hardware and software failures and problems shall be documented.

SAT shall be identical to FAT but at reduced amount to check hardware without any damage, installations completed properly and interface working properly. Seller shall provide special tools and test equipments.

9.0 LOCAL CONTROL PANELS

All local panels under the scope of package vendor shall follow the minimum specifications listed below:

9.1 Panels shall be suitable for acidic environment. Sealings of the panel will be Silicone/EPDM or better, which will be freezed during detailed engineering.

9.2 Panel shall be free standing close cabinets, constructed in sections of min. 1000 mm wide. The panel construction shall be welded or bolted frame construction with upright and and additional framing in modular construction. The panel front sheet thickness shall be min. 3 mm. The front of panel shall be stiffened where necessary with profiles tack welded to the rear. Top, sides and doors can be made out of 1.6 mm thick plate.

9.3 The panels shall have environmental protection conforming to IP 55 min.

9.4 Instrument air shall be provided for purging of local panels.

9.5 Panel face, sides and doors shall be sand blasted and cleaned before primer and two coats of paints are applied. The colour of paint shall be bright grey. The final surface shall be semi mat, free from blemishes and paint runs.

9.6 115V A.C. +/- 10%, +/- 3% Hz power at one point to the local panel shall be provided by the client. Any other voltage level if required preferably 24 V, DC, the same shall be

arranged by the vendor. Redundant rectifier units shall be provided for the generation of d.c.by the vendor.

9.7 Earthing lugs for both power and system earthing shall be provided by the vendor.

9.8 The wiring shall preferably contained in polymer ducts. Instrument safe wiring shall be laid separately from others. The colour of IS wiring shall be light blue.

9.9 Wago/weidmuller/Phoniex /Klippon type cage clamp type terminals shall be used for cable termination and wiring. 20% terminals shall be kept as spares in each terminal strip and box. Terminals shall be spring loaded with screws, single tier in general.

9.10 Gland plates shall be provided alongwith cable glands (ex. proof wherever required) in each panel for cable termination.

9.11 A miniature circuit breaker shall be provided for each power supply with DI contact wired to system.

9.12 All panels shall be provided with vibration dampening pads.

9.13 Each panel section shall be provided with illumination level of 300 Lux min.

9.14 Name plate/labels shall be provided for each panel mounted instruments, equipments and accessories mounted in the front or rear of the panel.

9.15 Purged panels shall be provided with purge fail alarm. Purge fail trip shall be provided with a bypass switch

9.16 The local panel must have power segregation at all levels and its gasket must be of EPDM/Silicone only. There shall be clear segregation and isolation of power supplies for all the local panels (115 VAC /240 VAC /24 VDC) with their healthiness monitoring through a feedback in control system.

10.0 PNEUMATIC TRANSMISSION

10.1 Output Signal

Output signal from all pneumatic transmitters shall be 0.2-1kg/cm2g.

10.2 Pneumatic Receiver Instruments

Pneumatic receiver instruments shall have receiver elements design for 0.2-1 kg/cm2g input signal.

10.3 **Pneumatic Transmission Tubing**

Pneumatic transmission tubing for local transmission shall be ½"or ¼" OD stainless steel tubing with SS316 fittings (inch)

10.4 **Instrument Air**

Instrument air required is available at 6.5 kg/cm2g and max. 70 degree C. However, the air pressure can be down to 4.5 kg/cm2g for remote consumers. Design pressure is 10 kg/cm2g. Dew point is -40 degree C at line pressure.

Air Distribution Headers shall be as SS 304.

11.0 ERECTION , INSTALLATION & COMMISSIOING

The bidder shall be responsible for the installation, calibration & testing, commissioning of the complete instrumentation and controls as defined in this specification as minimum. All the instruments & systems installed by the bidder as per scope subject to inspection, checking, calibration & testing to prove their operational fitness. Testing & calibration shall be done by the bidder, if required , all the required tools, tackles, calibration instruments, qualified skilled manpower for conducting these tests shall be provided by the bidder.

Testing & calibration may be witnessed by representative Client/PMC and/or manufacturer's representative.

LETTER WRITING : LETTER WRITING FOR ALPHA-NUMERIC TAGGING (WITH SYNTHETIC ENAMEL). :- Letter writing of different sizes on Instrument Panels/misc. Instruments/ Equipments with synthetic enamel paints (Asian/ Jonson & Nicolson/ Berger /Nerolac Make) suitable for a temp. of 100 degree Celsius for writing of letters, figures etc. Job includes cleaning of surface on panels/instruments/misc. instruments etc. All complete with labour and materials as per drawings, specifications, Name plate schedule and directions of Engineer-in-Charge. (Supply of paints is in contractor scope).

11.1 INSTRUMENT LOCATION

11.1.1 The location of instruments, control valves. Including junction boxes shall permit easy access from grade, permanent platforms or stairways for operation, inspection and maintenance.

11.1.2 The use of portable ladder or mobile platform shall be limited to access root valves, thermowells and line mounted flow meters.

11.1.3 Locations shall be decided to minimize the possibility of damage from passing or falling objects and the possibility of tripping hazard or obstruct on walkway.

11.2 INSTRUMENT CABLE

11.2.1 Overhead Runs

Instrument main cable tray from field junction boxes to main control building or local control room shall generally be laid in aboveground cable tray with protection cover. Tray protection cover shall be provided only for the tray on top of tray layer.

Instrument branched cable runs from junction box or local panel to each instrument in the field shall also be routed aboveground and supported with trays, steel angles and channels.

Perforated aluminium trayshall be used for cable routing between junction boxes & control room and shall be routed in the topmost tier of pipe rack. Trays shall be considered only for branch cable routing.. Single pair cables from instrument to junction box and branch cable tray shall be through perforated aluminium cable trays.

The scope of supply includes aluminium perforated type cable trays, accessories such as

Bends, tees, crosses, reducers & connector plates and accessories like bolts, nuts etc.

For Signal 900mm/ 600mm tray and for power 600mm/ 300 mm tray to be considered or shall be discussed during detail Engineering.

Cable tray segregation shall be based on the voltage level. Cable tray shall be supported at every 3M. 20% spare to be considered in the cable tray filling.

Instrumentation cables that form part of intrinsic safe (IS) circuits, if any, Shall be segregated from other instrument signal cables.

Instrument power supply (AC) cables shall not run in the same tray of instrument signal cables. Cable tray shall be dedicated for laying instrument power cables separately from the signal cable tray.

Alternatively, cable ducts of suitable size shall also be considered for main cables. When common cable ducts are used for running both power and signal cables, necessary air gap partition shall be used to segregate the cables.

11.3 CABLES

The primary insulation material shall be XLPE (cross linked polyethylene) for all types of multi pair cables as per IEC-60502/60840/IS-7098 Part-1. Inner and outer jacket shall be made of extruded flame retardant 90 deg C PVC to IS-5831

All cables shall be FRLS zero halogen as per standard IEC 332-3 Part 3 Cat. A. Fire resistance cables whenever specified shall be as per me 331 Cat. A.

The insulation grade shall be 600 V/1100 V as a minimum arid shall meet insulation resistance, voltage and spark test requirements as per BS-5308 Part-2

All cables shall be armoured. Armour over inner jacket shall be of galvanised steel wire/flat as per IS-1554 part I / lEC 502. All the cores of single pair or multi-pair shall be twisted and numbers of twist shall not be less than 10 per metre.

For signal and control cables, inner jacket colour shall be black. Outer jacket colour shall be light blue, for intrinsically safe application and black for others. For thermocouple extension cables the inner and outer jacket colour shall be as per IS-8784.

L/R ratio of adjacent cores shall not exceed 40 μH/ohm for cables with 1.5 mm2 conductor Electrical Properties of Cables shall be in line with EN50288-7:2005

Contractor shall ensure a minimum of 20% of quantity of each type of cables supplied as spare including any special cable and in each multipair cables 20% pairs shall be kept as spare

Instrument Signal Cable

a) Single pair shielded signal/alarm cables shall be used between all field instruments including switches and junction boxes/local control panels.

b) Triad cable shall be used between GDs/RTDs to JB/Transmitter respectively.

b) Multipair individually and overall shielded signal/alarm cables shall be used between junction boxes/local control panels and control room.

c) The single pair/triad cables shall be 1.5 mm2 conductor size made of annealed electrolytic copper conductor of 7 strands with each strand of 0.53 mm diameter. Multipair cables with 0.75 mm2 conductor size shall have 7 strands of annealed electrolytic grade copper conductor with each strand of 0.3 mm diameter. Multi triad cable or multi pair cable with 1.5 mm2 conductor shall have 7 strand with each strand of 0.53 mm diameter. Colour of core insulation shall be black blue in pair and black, blue and brown in a triad.

d) Shield shall be aluminium backed mylar/polyester tape bonded together with the metallic side down helically applied with either side having 25% overlap and 100% coverage. The minimum shield thickness shall be 0.05 mm in case of single pair/triad and 0.075 mm in case of multipair/triad cable.

e) Drain wire shall be provided for individual pair and overall shield which shall be 0.5 mm2 multi stranded bare tinned annealed copper conductor. The drain wire shall be in continuous contact with aluminium side of the shield.

f) All multi pair cables shall have 6 pair/12 pairs only while multitriad cable shall have 6 triads/8/12 triads only. Size for multipair cable will be 0.75mm2 with drain and overlap as above.

11.3.1 Cables and Multicore Cables for Solenoids etc.

Cables and multicore cables for such items as solenoid valves and flame detectors shall normally have a conductor size of 2.5 mm2. However, conductor sizes for power cables shall be co-ordinated with the Electrical Group to avoid too many different cable types.

Signals (4-20 mA or switch 'contact): 6/12 pair individually and over all shielded (screened) and armoured, twisted, 0.75 mm2 conductor.

11.3.2 Thermocouple Extension Wires

a) Single pair shielded thermocouple extension cables shall be used between thermocouple head and junction boxes transmitters/ local control panel mounted instruments.

b) Multipair individually and overall shielded thermocouple extension cables shall be used between junction boxes and main control room mounted devices.

c) The type of thermocouple extension cables shall be compatible with thermocouple used. In addition the colour coding of the primary insulation shall be as per ANSI.

d) The cable shall have 16 AWG and 18 AWG solid conductors for single and multipairs respectively.

e) All thermocouple extension cable shall be matched and calibrated in accordance with MC-96.1.

f) Shield shall be aluminium backed by mylar/polyester tape bonded together helically applied with the metallic side down with either side having 25% overlap and100 % surface. Minimum shield thickness shall be 0.05 mm for single pair and0.075 mm for multipair cable. Drain wire shall be 0.5-mm2 multi-strand bare tinned annealed copper conductor. The drain wire shall be in continuous contact with the aluminium side of the shield.

g) Inductance shall not exceed 4mH/Km.

h) All multi-pair cables shall have 6 pairs/12 pairs only.

11.3.3 Power supply Cables

All power supply cables shall be as per IS-1554 Part I and shall have copper conductors. Minimum conductor size shall be 2.5 mm2. The cables shall be PVC insulated and armoured. The higher size conductors shall be used incase of long distance power cable where voltage drops more than 3 volts than required supply.

Any other special cable required for instruments that should also be supplied as per requirements. CONTRACTOR shall ensure that these cables are armoured type and shall meet all other requirements.

11.3.4 OPTICAL FIBER CABLE

The Optical Fiber Cable (OFC) used shall conform to the following specification as a minimum:

a) The OFC shall be CSTA (corrugated steel tape armored, electrolytically chrome plated low carbon steel) armored cable.

b) The OFC shall have FRP strength member, loose tubes for single mode optical fibers filled with moisture resistant jelly, moisture barrier of polymer coated Aluminum tape or water swellable tape, inner sheath of HDPE and outer sheath of PVC.

c) Optical fibers shall be single mode fibers compliant to ITU-TG.652 and fibers colours shall correspond to IEC 793-2 and 304. Optical fibers shall be coated with UV cured double acrylic resin. It should not have any reaction with cladding or core material. The coating should provide maximum resistance to micro-bending & abrasion and ensure mechanical & optical strength. The coating shall be easily stripped with mechanical tools.

d) The number of fibers in the OFC shall be decided depending upon the requirement with 8 fibers as a minimum.

e) The cabled fiber attenuation shall be -S 0.37 dB/km for 13] 0 nm wavelength range and 0.22 dB/km for 1550 nm wavelength range.

f) The tensile performance shall be as per . IEC 60794-1-2 E1 and with tensile load of 9.81 x 2.5 W (Where W= mass of 1 km of cable in Kg)Newton Or 2670 N whichever is higher.

11.4 JUNCTION BOX

a) Junction box shall be of die-cast aluminum alloy (LM-6) anti corrosive painted. All junction box shall be weatherproof to IP-65 as well as flameproof. Junction box shall have screwed covers. All cable entries to junction boxes shall be side or bottom.

b) In all JBs, cable entries shall be from Bottom only. Further after commissioning, all JB's should be covered with Aluminum tapes at its periphery to prevent water ingress.

In general a junction box shall contain only signal of same class. The signal class is categorized as following type:

i) Signal Level

- Analog

- Digital
- T/C
- Solenoid Valve
- Instrument Power
- Gas Detectors

ii) Type of protection

- Non IS, Ex d
- IS

c) All JB extra entries shall be plugged with SS316 plug. Each junction box shall be provided with 2 multi-cable entries from the bottom of the junction box with one plugged. All Cable entry shall be at the bottom only, and not from side or top.

d) All spare cable cores shall be terminated in the Junction box, at the marshalling panel end and wired through spare barriers / isolators or relays (as the case may be) right upto the corresponding spare channel of I/O module.

e) All spares hole of JBs, T/C head etc to be plugged with metallic plugs. The metallic plugs, Junction box hinges, Handle, DIN rail, Allen screws shall be SS 316 material of construction.

f) For ease of identification shutdown JB's shall be colored should be marked with RED.

g) Cable glands shall be provided with Cables shrouds. 20% spare terminals shall be supplied in each junction box.

11.5 CABLE GLANDS

a) Contractor shall supply all cable glands required for glanding the above mentioned cables both at field instrument and local control panel side, junction boxes side and at control room side.

b) All cables glands shall be of SS316 ex-proof and they shall be double compression type suitable for armored cables. Glands shall be in line with Area classification

c) Flame proof glands wherever required 'shall be supplied with EX'd' certification.

11.6 INSTRUMENT VALVES AND MANIFOLDS

a) Contractor shall supply instrument valves (miniature type) and valve manifolds wherever required.

b) Body rating shall be as per piping class or better. All valves and manifolds shall be forged type only.

c) Valve body and trim material shall be SS 316L unless otherwise specified. Superior trim material shall be selected as requirement by process conditions. Packing material in general shall be of PTFE.

11.7 INSTRUMENT IMPULSE LINES

a) In general ½" OD annealed seamless SS 316 tubing shall be used in preference to piping.

b) Tubing standard shall be used upto 600 # only where the same is required as per job specification. For rating above 600 # and hydrogen/lethal service, only piping standard shall be used. The tubing shall be 1/2" OD tube with all fittings suitable for the same. Valves used shall be threaded. At the first isolation / root valve end suitable pipe tag to tubing conversion fittings shall be used. For remote installation suitable unions / couplings shall be used.

c) Piping standard shall be used for all installation where specified in job specification. For rating upto 600#, the connection to the transmitters shall be with a male connector and tubing 1/2" OD. For rating higher than 600 #, no tubing shall be used. The connection to the transmitters shall be with 1/2" piping with flanges in between piping standard, all pipes shall be 1/2" NB unless higher sizes required to meet the "requirements, with all fittings suitable for the piping. All the joints shall be welded or flanged as required. For instrument end connection i.e root valve of orifices and other items, level gauges vent and "drain connection, seal welding shall be provided. For non diaphragm seal instruments and instruments where provided with threaded connection, no welding is required at instrument end

d) All instruments shall be provided with isolation, drain and/ or vent valves with vent/drain end duly capped. This isolation valve shall be SS304 GATE type. It shall be in addition to the first isolation /root valve provided on the pipe or vessel at instrument take off.

f) For diaphragm seal type instruments, spacer ring with vent and drain connection along with vent / drain valve with end capped.

g) Contractor shall supply flareless compression type of tube fitting and of three piece construction with design similar to Swagelok/Parker Hannifen etc.

h) Socket-weld type forged pipe fittings of suitable material and rating shall be supplied for pipe fittings. The minimum rating shall be 3000 #. Weld neck fittings shall be used where socket weld type are not allowed by piping class.

i) All pipe fittings shall be according to piping material specification as per piping class of the pipe on which instrument is connected. In case of vessel/equipment / reactor, PMS of equivalent piping class shall be considered.

11.8 INSTRUMENT AIR SUPPLY DISTRIBUTION

Instrument air headers, pipes and distributors shall be of S.S 304. Instrument air manifold shall be used for supplying instrument air to control valves and other instruments. These shall be with 10 nos. of tappings and be with ½" NPT (F), SS 304 valves. From the nearby air manifold, instrument air shall be supplied to the control valves. For the purpose, all tubing shall be used shall be of SS316, ¼", 1/2" OD, seamless tubes, laid in perforated aluminium trays. All intermediate fittings shall be double compression, SS316 MOC, Swaglok /Parker make only.

Instrument air shall be provided at one point at battery limit. Package vendor has to develop air distribution scheme.

11.9 MCT Blocks

Cable entry to main control room shall be through MCT blocks.

Entry into the Panels in the control room shall be through bottom mounted MCT blocks.

Bidder shall provide minimum 8+8x6 MCT frame along with multi-dia blocks with peeling of arrangement and centre plug, with wedge, lubricant, stay plate. Bidder shall provide at least 20% installed spares with mult-dia blocks with peeling of arrangement and centre plug. (Qty of frame shall be submitted by the bidder during bidding stage with typical cable arrangement).

11.10 PROTECTION AND PAINTING

All exposed carbon steel parts to be painted shall be thoroughly cleaned from inside and outside to remove scale rust, dirt and other foreign materials by wire brushing / sand blasting as applicable. Minimum acceptable standard in case of power tool cleaning shall

be St. 3 and in case of blast cleaning shall be SA 2. as per Swedish standard SIS 055900-1967.

- Non – ferrous materials. Austenitic stainless steels, plastic or plastic coated materials.
- Insulated surfaces of equipment and pre-painted items shall need not be painted.
- Stainless steel surfaces, both inside and outside. Shall be pickled and passivated.
- Machined and bearing surfaces shall be protected with varnish or thick coat of grease.

Depending on the environment the following primer and finish coats shall be applied:

S. No.	Environment	Description	Minimum Requirements
1	Normal – Industrial	Primer	2 coats of Red oxide
			Zinc phosphate each 30-35 microns thick
		Finish Coat	2 coats of synthetic enamel, each 25 microns (min.) thick.
2	Corrosive – Industrial	Primer	2 coats of epoxy zinc chromate, Each 35 microns (min.) thick.
		Finish Coat	2 coats of epoxy high build paint, each 100 microns (min.) thick.
3	Coastal and Marine	Primer	2 coats of high build chlorinated rubber. Zinc phosphate, each 50 microns (min.) thick.
		Finish Coat	2 coats of chlorinated rubber coat paint. Each 35 microns (min.) thick.
			(Any values refer to dry film thickness).

Colour Band shall be provided on loading arm as per Product colour code at site.

11.11 THIRD PARTY INSPECTION

Al instrumentation shall be inspected by TPIA as per approved QAP / ITP plan. General specification for Inspection & Testing is attached herewith further bidder to submit detailed QAP/ITP for each item for approval /review by Client/PMC. Client reserves the right to review / inspect / witness the items at any stage of inspection.

The list of approved inspection agency Is:-

a) Projects & Development India Limited for domestic
b) TUV, BV & Lloyds for overseas

11.12 PACKAGING AND IDENTIFICATION

All packaging shall be done in such a manner as to reduce the volume. The equipment shall be dismantled into major components suitable for shipment. All assemblies shall be properly match marked for site erection.

Attachments, spare parts of the equipment and small items shall be packed separately in wooden cases. Each item shall be appropriately tagged with identification of main equipment. Item denomination and reference number of the respective assembly drawing.

Detailed packing list in waterproof envelope shall be inserted in the package together with equipment Each equipment shall have an identification plate giving salient equipment data, make, year of manufacture. Equipment number, name of manufacturer, etc.

12.0 Storage Tank

Instrument design Philosophy shall be same as per section above.

For each storage tank 2 Nos. of Level measurement of two different principles shall be provided.

13.0 CCTV System

Bidder shall design, engineering, supply, install, test and commissioning the true IP based Closed circuit television (CCTV) Surveillance System at the Urea Handling & Bagging Package. The purpose of the CCTV System is to monitor the facility operations & security surveillance from control room to keep eye on facility covering filling area, wagon loading operation area , truck loading area or other strategic locations by installing cameras to monitor resulting to enhancement in the Operational & Safety needs.

It is intended to install CCTV system to track the Material movement, Recognition of persons and objects including vehicles through high quality images in and outside the plant campus by Security. The recording of the scene can be used in investigation, recreating the scene and establishing the truth.

Bidder shall provide approx 15 nos. (Anti dust cameras) of (2MP minimum) PTZ, true IP based digital video camera with inbuilt IR to be installed at strategic location of the Urea Handling & Bagging Package. Cameras shall be suitable for dusty / urea dust area. Dust removal (air/water) provision shall be considered for the cameras.

The CCTV Surveillance System shall include CCTV Cabinet with Network Recording Servers, Layer 2 / 3 switches , Junction box External array of hard disks, Workstations with Displays Monitors, control keyboard, Fiber Optic cables and CAT6 patch cords, Software for operation, control, utility software for infrastructure management, like network & security management, Video Analytics Application Software,Remote Monitoring software with necessary accessories and fitting hardware, poles with mounting brackets, canopies etc. This CCTV system shall be located at UPH Control Room. This CCTV system shall be interface with main CCTV system which is located at CCR (central control room) through TCP/IP /Ethernet switch (redundant port & redundant cable) with OFC, so all the related hardware's and software's required for successful interface of the same shall be in the scope of the bidder (for view only purpose from any OPS). Make of CCTV system including cameras shall be BOSCH / PELCO/ Honeywell. Bidder to offer all the materials accordingly. Minimum requirement is as below:

a) CCTV system including cameras, junction box , layer 2/3 switches etc. shall be design for dusty area / urea dust area , minimum IP 66 weather proof.

b) All cameras shall be ONVIFS with all mounted accessories.

c) Supply and laying of FO & Power cable upto CCR. Armoured FO cable shall be laying through HDPE pipe. / all cable tray supports / laying facilities etc.

d) Any additional requirement of splicing for FO cable

e) Media converter card if any or any other hardware to fulfil the above requirement.

f) The network video recorder (CCTV Server) shall be installed at Control Room/ Server Room shall allow the storage of time-lapse and time stamped digital video images from all cameras. Video images shall be stored on a RAID-5 hard-drive array unit with full watermarking and guarantees against tampered images.

g) The system storage should support continuous recording for all cameras at least for a period of 60 days at a resolution of 1080p @ 15 fps (2MP camera), 2160p @ 15 fps (4kcameras) and Maximum available resolution of cameras @ 15 fps in PAL with H.264/JPEG or better compression format. The system should automatically overwrite the previously recorded video when it exceeds 60 days without any human intervention. The system shall always have recorded video of last 60 days at any given point of time. Bidder to consider the storage capacity accordingly and it should not be less than 5 TB.The cameras should support triple streaming with two simultaneous programmable streams used one for viewing and other for recording. Viewing shall be at 30 fps (min) and recording at 15 fps at maximum resolution.

h) The video output from the NVR/Server shall be viewed through a dedicated LED Monitor provided for the CCTV System. There should be DVD-R/W for memory back –up. A DVD library has to be maintained for taking the back up of recorded video. The recorded DVD can be played back in any location with the supported media player.

i) All interfaces within CCTV shall be based on TCP/IP network protocol connectivity over the Intranet/LAN/WAN. The software shall facilitate viewing of live and recorded images and controlling all cameras for 24 hours a day and 7 days per week local and/or remote monitoring.

j) The system shall be able to select any cameras to any monitors. However, the system administrator shall be able to control the viewing rights of individual users.

k) System redundancy shall be implemented and installed for CCTV servers and OFC /CAT 6 backbone.

l) System should provide inter-operability of hardware, OS, software, networking, printing, database connectivity, reporting, and communication protocols. System expansion should be possible through off-the-shelf available hardware. The system shall include a scalable architecture with hardware expansion capability to support the selection, monitoring and control of system devices possibly using simple user friendly GUI based maps, menus and left/right mouse click commands.

m) Any other hardware / software etc. for execution of CCTV System.

Basic Design Specification

The Closed Circuit Television (CCTV) system shall consist of the following units as a minimum:

a) IP based Colour electronics Digital Video Camera Unit. With day and night viewing under very low light conditions.

b) Video encoders

c) Video management software,Video analysis system along with ONE LED monitors

d) Server with video management software (for minimum 32 No camera) recording, storing and playing, Colour Video Monitors, Mouse-Keyboard, PC for System Administration / Management / Maintenance etc.

e) Network Video Recorder (Network Video Recorder) minimum 32 channels minimum 5 TB hard disk and recording for 60 days.

f) CCTV System cabinet

g) Power supply distribution board

h) Coaxial cables, control cables, optical cables, connector etc. of required type & size , cable glands, connectors and other accessories

i) Network switches- Industrial grade (Layer-2 & 3 Managed) with redundant power module

k) Ceiling hung CCTV monitors (LED type) minimum 55” size or Stand mounted CCTV monitors minimum 55” size such that these can be suitably matched with control room aesthetics by dimensions, appearance etc.

l) Network Video Recorder (NVR), will be located in main Control Room

m) Automatic computer based switching device

n) Media convertors (shall be IP 65 or better)

n) System should be expandable system with provision addition of more NVRs and more cameras (More than 32 cameras)

CAMERA UNIT

Camera unit shall consist of High resolution true IP Based Digital Video Camera with inbuilt IR, camera unit enclosure, remote controlled pan and tilt unit, remote controlled washer and wiper assembly, sun shield -and thermostatically controlled heaters, receiver units, junction boxes etc.

Bidder shall provide 10 nos. (Anti dust cameras) of (2MP minimum) PTZ, true IP based digital video camera with inbuilt IR to be installed at strategic location of the Urea Handling & Bagging Package. Cameras shall be suitable for dusty / urea dust area. Dust removal (air/water) provision shall be considered for the cameras.

Video Camera

a) The video camera shall be colour type comprising of 1/3" CCD/CMOS sensor with wide dynamic range and resolution 540 TVLs as a minimum with Full HD 2MP minimum resolution. 36x Zoom.

b) The camera shall have Automatic Gain Control (AGC) facility with gain adjustment of typically up to 18dBA. The video amplifier shall ensure a signal to noise ratio of 50.

c) The camera shall be able to operate satisfactorily under varied light intensity levels. The light sensitivity of the CCTV camera shall be 0.65 lux low light sensitivity in color/Normal mode, and 0.2 lux low light sensitivity in "night" mode and shall be able to view objects in illumination level of 45 lux at the distance of 50 m as a minimum.

d) Automatic lens iris control facility shall also be provided as per the background light levels.

e) The focal length of the camera shall be based on the distance of the objects from the camera. The lens adjustment for focus control and zoom control shall be motorized and remote controllable.

f) The camera shall have feature of backlight compensation.

Camera unit enclosure

Camera unit enclosures in safe areas shall be weather proof to IP-65 as per IS-13947.
Camera unit enclosures in hazardous areas shall meet the following requirements, as a minimum:

Weather-proof : IP-65 as per IS-13947

Camera unit enclosure shall be suitable for the area classification indicated in the datasheets. Camera unit enclosure shall have factory fitted SS enclosure.

Pan and Tilt Unit

The pan and tilt arrangement shall be able to adjust camera within an angle of 0° to 335° horizontally (i.e. pan range) and a minimum of 180° (±900) vertical (i.e. Tilt range). The movement of the device shall be smooth. Pan speed shall be 6 degrees /sec and tilt speed shall be 3 degree/second as a minimum. Pan and tilt action shall be operable from video management system in control room. Pan and tilt unit shall be suitable for area classification as indicated in the datasheets. Pan and tilt units shall also be weatherproof to lP-65 as per IS13947. 36x Zoom shall be there.

Wiper and Washer

Whenever camera is for outdoor installation or the application necessitates. the glass window shall be provided with a wiper and washer unit. The washer unit shall comprise of washer tank, motor & pump and associated tubing. The washer tank shall be placed in an FRP enclosure near the camera and shall be easily accessible. The tank shall have a water inlet connection, a valve along with ball float actuator, a water outlet connection, necessary tubing & connectors between the water outlet connection, water pump, and nozzle at the camera. The rising water level in the tank shall raise the lever which will close the valve. The pump shall either be located in the explosion proof housing of the camera or placed inside the FRP enclosure of the washer tank. Whenever the pump is placed in the FRP enclosure, it's motor shall be explosion proof certified for the area classification. Vendor shall indicate the media to be used for actual washing with requirements like flow, pressure etc. Whenever specified, the washer tank shall have a capacity of 10 litres as a minimum and the minimum flow rate of the pump shall be 0.5 litres per minute. Inbuilt Wiper shall be provided from OEM.

Space Heater

For outdoor applications and where there is a possibility of condensation on the glass window, the camera unit shall be provided with a thermostatically controlled anti-condensation heater.

Junction Box

The junction boxes for housing the accessories shall be suitable for outdoor installation with minimum IP-65 weatherproof protection and shall be certified for the specified area classification as per datasheets.

Camera Mounting

Cameras shall be provided with suitable mounting accessories for mounting on structures, roofs, poles. If mounted on the pole, the pole shall have ladder for camera maintenance.

VIDEO MANAGEMENT SYSTEMIVIDEO RECORDINGNIDEO ANALYSIS

The system shall support the virtual matrix capability (i.e., software based matrix) to allow the operator to assign any camera to any local or remote monitor on the network. Also it shall be possible to Control and monitor any camera on the network.

The video management system shall be able to permit online selection of:-

a) Camera Units
b) Monitors
c) No. of views on one monitor
d) Recording Commands
e) Pan-tile Control
f) Sequential Switching of image on monitors
g) Focus, wiper, wash and zoom operating for each camera unit.

The monitors shall be 55" colour LED monitors with necessary controls like colour brightness, contrast adjustment and monitor ON/OFF control. These functions shall be possible from the monitor front.

The camera views on the monitor shall be populated based on the operator request. The operator shall be able to view 1/4/9/16 views per monitor. The operator shall be able to enlarge the views.

The operator shall be able to view cameras through simple drag and drop commands.

The system shall be equipped with the web based client software to allow users to view the cameras on the Microsoft explorer browser from any PC on the network, provided if they are given the permission and password.

The user interface shall present the operator with a camera tree that shall show the list of all the cameras and camera sequences that are available to the operator. The Vendor shall present the hierarchy of the camera tree together with the grouping of cameras and the way in which the user! operator shall interact with it.

The NVMS user interface shall have a map to allow viewing the graphical representation of the area together with allowing the operator to place camera icons on the map. The Vendor shall present the full features and operations of the map and shall present the way in which the user/ operator shall interact with the map.

The operator shall be able to perform pan/ tiltt zoom/ washer and wiper unit control for PTZ **cameras.**

The operator shall be able to enable/ disable Motion detection for cameras.

The operator shall be able to write macros/scripts for the cameras to do the following as a minimum:

(i) To define the sequence of cameras to be viewed on a given monitor
(ii) To define the period and start/ stop time for viewing a camera on a monitor

The viewing and control of cameras shall be controlled by use of passwords. Two levels of password shall be provided:

a) The operator level in which the operator shall be able to perform PTZ controls, viewing, recording and playback.
b) The supervisor level in which the supervisor shall be able to make configuration changes in addition to the PTZ controls, viewing, recording and playback.

VIDEO RECORDER

a) Whenever specified the system shall also supplied with video recorder to record video images automatically or on manual demand. The recorder shall meet the following requirements as a minimum.

b) The video recorder shall have disk space to store on-line video storage for duration as specified in the datasheets and access to high capacity archiving mechanisms for removal of stored video to off-line storage media.

c) The vendor shall size the video recorder hard disc space based on the number of cameras, number of days (minimum 30 days) for which the recording has been done, the resolution of recording and the number of frames per second to be recorded, as indicated in the datasheets. Vendor shall submit calculations/ equations for storage requirements. Use of software without supporting calculations shall not be acceptable.

d) The system shall mark the events with time and date stamping during monitoring and recording. The system shall allow the operator to view stored information with respect to time and date of recording with scan and search of the marked events/ timing.

e) The operator shall be able to playback the recorded events in slow and fast motion with variable speed.

f) It shall be possible for the operator to schedule recordings for each individual camera taking place in the future. The operator shall be able to configure the Start and Stop time for the scheduled recording.

g) The operator shall be able to exports previously stored video to DVD or latest storage option as specified in the datasheets.

h) The exported video shall be able to retrieve archived video from DVD or the latest storage option as specified in the datasheets.

i) Captured images or videos shall be easily distributed to any remote locations through the LAN/WAN environment, if required. The operator shall be able to export previously stored video from a recorder to any other network storage devices including a network drive. An exported file must be in MPEG-4/ MJPEG format and, as such, should be readable using any MPEG-4/MJPEG compliant decoding software.

j) Each video recorder shall be of 19" rack mountable type.

k) Video recorder shall support RAID 1 as a minimum.

VIDEO ANALYSIS

a) System shall generate alarm on motion detection in areas where no motion is expected.

b) System shall generate alarm on no motion detection in areas where motion is expected.

c) System shall generate alarm on flare flame failure.

d) System shall generate alarm in case fire is detected.

e) System shall generate alarm when toxic cloud is observed.

ALARMS & EVENTS

a) The operator in the control room shall be able to get an indication of the faults occurring in any of the devices connected over the network. This includes faults occurring in the cameras, video encoders, computers, and video recorders. Faults occurring in each of these devices shall generate an alarm in the operator console.

b) The operator shall be able to view the chronology of events by device, date, time anddescription.

c) The system shall support logging of events for reviewing and analysis in the future.

d) Upon detecting a fault, the system shall be able to automatically send an E-mail alert.

CONFIGURATION

The following facilities shall be provided for configuration of the CCTV system as a minimum:

a) Assign an ID or name to each camera.

b) Add/delete cameras.

c) Change the camera details (e.g. Camera location, Camera ID, Camera number, etc)

d) Configure the camera encoding parameters in terms of number of frames per second.

e) Configure the camera encoding resolution in terms of setting it to CIF, 2ClF, or 4CIF.

f) Creation of schedules for recordings.

g) Configure recording either on demand, continuous recording or based on motion detection.

h) Add/ delete monitors to the system.

i) Add/ delete computers to the system.

j) Creation of a camera group, view a camera group, view a camera sequence, and view a multiple view screen.

k) For an IP based system, assign IP addresses to video encoders, computers of video management system, video recorders, video wall controllers as applicable.

l) Program external outputs based on certain events.

INTERFACING WITH CONTROL SYSTEM

Interfacing with CONTROL SYSTEM shall be done to allow operators to view live video along with control system graphics on the operator consoles. Hardware required for the same shall be provided by vendor. Software required in video management system and control system shall be provided by vendor.

CCTV CABINETS

The CCTV cabinet(s), Rittal make shall house the following components: (i) Computer(s) (ii) video encoder(s), (iii) video recorder(s), (iv) control unit (v)network switches (vi) Transceiver modules, if any (vii) indoor fibre patch panel, if any (viii) VGA boosters, if any(ix) Line drivers, if any (x) Miniature circuit breakers etc. as applicable.

The cabinet(s) shall be fitted with lockable doors and shall have front and rear access. All system cabinets shall be completely wired.

The cabinet shall be free standing, enclosed type and shall be designed for bottom cable entry. Cabinet structure shall be rigid and shall be provided with removable lifting lugs to permit lifting of the cabinets.

Cabinets shall be fabricated from cold rolled sheet steel of minimum 2 mm thickness suitably reinforced to prevent warping and buckling. Doors shall be fabricated from cold rolled steel

sheet of minimum of 1.6 mm thickness. Cabinets shall be thoroughly de-burred and all sharp edges shall be grounded smoothened after fabrication.

Each cabinet shall be of maximum 2100 mm height and 1200 mm width. Construction shall be modular preferably to accommodate 19" standard electrical racks. Maximum swing out for Pivot card racks, doors and drawers shall be limited to 600 mm. Doors of the cabinet shall be equipped with lockable handles and concealed hinges with pull-pins for each door removal.

In order to effectively remove dissipated heat from the cabinets, vent louvers backed by wire-ply screen shall be provided on the cabinet doors. Ventilation fans shall be provided in each cabinet along with fan failure alarm contact.

Fluorescent lamps shall be provided in each cabinet for each cabinet for internal illumination along with door operated micro switches. All lighting shall be on 230v 50Hz normal power supply.

All wiring within the cabinet shall be neatly laid and shall be accessible. Clamping rails shall be provided for incoming cables to present excessive stress on the individual terminals. All metal parts of the cabinet including doors shall be electrically continuous and shall be provided with common grounding lug.

The color of the CCTV cabinets shall be matched with the existing cabinets at control room.

Cable glands shall be provided for cable entry into the CCTV cabinet. Spare cable entries shall be plugged.

OPTICAL FIBER CABLE

The Optical Fiber Cable (OFC) used for the CCTV system shall conform to the following specification as a minimum:

a) The OFC shall be CSTA (corrugated steel tape armored, electrolytically chrome plated low carbon steel) armored cable.

b) The OFC shall have FRP strength member, loose tubes for single mode optical fibers filled with moisture resistant jelly, moisture barrier of polymer coated Aluminum tape or water swellable tape, inner sheath of HOPE and outer sheath of PVC.

c) Optical fibers shall be single mode fibers compliant to ITV-T G 652 and fibers colours shall correspond to IEC 793-2 and 304. Optical fibers shall be coated with UV cured double acrylic resin. It should not have any reaction with cladding or core material. The coating should provide maximum resistance to micro-bending & abrasion and ensure mechanical & optical strength. The coating shall be easily stripped with mechanical tools.

d) The number of fibers in the OFC shall be decided depending upon the requirement with 8 fibers as a minimum.

e) The cabled fiber attenuation shall be -S 0.37 dB/km for 13] 0 nm wavelength range and 0.22 dB/km for 1550 nm wavelength range.

f) The tensile performance shall be as per IEC-794-IEI and with tensile load of9.81 W Newton with attenuation change -S 0.05 dB/km at 1310 nm. W is weight of OFC/km.

NETWORK SWITCH- Industrial grade with redundant power supply

The network switch used for the CCTV system shall conform to the following specification as a minimum:

The network Switch shall be configured to provide communication paths and provide the facility for adaptive packet and message routing through any available communication link. The network Switch shall provide the facility of multiple protocol router and bridge that provides high bandwidth connections into backbone networks for remote sites.

The hardware design shall be based on distributed processing architecture with packets forwarding to be performed on the network interface modules. It shall be based on the modular design and architecture and shall allow new network interface cards to be added in the racks without powering down the unit and ensuring no disruption of service to the network users.

The network Switch shall support both intra-area and inter-area routing for transporting messages between nodes and shall support the network routing! bridging services for OSI, TCP/ IP, X.25, LAT and other industry standard wide area networks/ protocols. The network

switch shall be adaptive 10/100/1000 Mbps interface port, supporting pass through! Crossover adaptation of port. The network switch shall be provided with optical fiber module interface suitable for long distance transmission.

POWER SUPPLY

The system shall operate on 110 VAC/ 240VAC (as required) with the following specifications:

Voltage variation	± 10%
Frequency	50 Hz± 3 Hz

Any other power supply required shall be derived from this power supply by the vendor.

Power Supply distribution for all items related to closed circuit television system shall be carried out from the system cabinet itself. Vendor shall supply any hardware required for conversion/ distribution. Power supply for each item shall be provided with a separate switch and fuse for isolation and protection of the system.

The CCTV camera unit shall be capable of withstanding plant vibration level of 2. 1 G (within the frequency range of 5 Hz to 200 Hz) and sudden shocks of level 5 G (with frequency of 2 Hz).Any vibration pads required to meet this requirement shall be in vendor's scope of supply.

The CCTV system shall have the capability for future expansion to add cameras and additional storage in video recorders.

All cable glands, as required, for camera enclosure, pan! tilt unit, junction boxes, CCTV cabinet etc. shall be SS, dual compression type, suitable for area classification specified in datasheets.

14.0 TELEPHONE EXCHANGE AND ASSOCIATED ACCESSORIES.

BASIS OF DESIGN

The system and all the equipment shall conform with all relevant and the latest edition of Indian, International, OISD and CCITT/ ITU standards as applicable. As a minimum, the following standards shall apply.

a. IS: 2148 Flameproof enclosures for electrical apparatus.
b. IS:13346 General requirements for electrical apparatus for explosive gas atmospheres.
c. IS:5572 Classification of hazardous areas (other than mines) for electrical installation areas having flammable gases & vapors.
d. IEC:79(Applicable parts) Electrical apparatus for explosive gas atmosphere.
e. IS:13408 Code of practice for the selection, installation & maintenance of electrical apparatus for use in potentially explosive atmospheres.
f. IS:13408 Code of practice for the selection, installation & maintenance of electrical apparatus for use in potentially explosive atmospheres.
g. IS:5571 Selection of equipment for Hazardous areas.

The telephony system shall be interconnected with the PA/GA systems such that communications can be automatically established by authorized subscribers of any of the systems without operator intervention

The telephony system shall also be connected to the Public Switched Telephone Network (PSTN) through the PABX, and shall comply with all the telecommunication carrier's requirements; technical compatibility between the public and private networks shall be ensured

SERVICE CONDITIONS

All the equipment shall be suitable for the site conditions as specified in design basis. Indoor equipment shall be installed in a HVAC controlled environment / Split AC room/ Dusty environment / Harsh environment.

AREA CLASSIFICATION

All the out-door equipments shall be suitable for installation in hazardous area and shall be Flameproof to Ex-d IIC/T6 and weatherproof to IP67 as per IEC529, irrespective of plant's hazardous area classification,.

All the outdoor equipments shall have certification for use in Zone-1, Gas group IIC/T6, irrespective of plant's hazardous area classifications and by the recognized testing and certification authorities such as 'CMRI' Dhanbad, BASEEFA (UK), UL (USA) etc., or the relevant authorities of the country of origin.

Indigenous equipment for hazardous areas shall be approved by CCEO and all flameproof equipment shall be under a valid BIS license.

The exchange shall be fit operate on the following power supply.
a) UPS Supply voltage 115 A.C. ±10%
b) Supply frequency 50 Hz ±3%

DETAILS OF DESIGN

DESIGN SPECIFICATIONS:
The system shall comprise of fully microprocessor based digital central exchange(s) consisting of system control hardware, which shall be located at Urea Handling Control Room. It should be an expandable system. The system shall have capacity of 10 extensions .The systems central exchange shall be extending upto 20 telephone lines. It should support IP / Digital / Analogue phones.

A redundant interface for connecting any other Telephone Exchange./ Main Telephone exchange located at CCR – Central Control Room. All related hardware ,

software , cable , cable laying , erection and mounting material etc. shall be part of bidder scope.

An Internet Protocol (IP) based telephony system shall be provided. The Exchange shall have facility of connection to the LAN system with POE/non-POE switches.

The Telephone Exchange shall be interfaced with FA system via 2 wire, RS-485 serial interface over MODBUS. The Telephone Exchange system shall provide general failure alarm signals for presentation on the control system in the Control Room (CR).

The telephony system shall be interconnected with the PA/GA systems such that communications can be automatically established by authorized subscribers of any of the systems without operator intervention

The EPABX and a Main Distribution Frame (MDF) shall be located at the central control room.

CPU and power supply shall be provided with 100% redundancy.

Each office (or equivalent) telephone set shall dispose of two connection possibility points as a minimum. The additional connection points could be used either to change location inside the room or to add further telephone subscribers

The cable supply and installation rules shall follow the same rules than the instrumentation cables.

The telephone JB supply and installation rules shall follow the same rules than the instrumentation items.

The system shall have automatic broad casting of alarm when a fire or gas alarm signal is initiated from the fire and gas system.

Bidder has to provide complete layout of the Telephone network in its scope of the building.

Complete supply, erection of the exchange system shall be in bidder scope.

Bidder has to provide complete system in fully working condition.

TELEPHONE EXCHANGE

The exchanges shall be fully digital, microprocessor based freely programmable exchanges, working independent of each other. Programming shall be by means of user friendly menu driven software via a dedicated lap top, which shall also be supplied by the system vendor. The specification of laptop shall be latest Intel hardaware, Microsoft OS and MS Office software at the time of supply.

It shall be possible to program / re-program the exchange through external laptop PC, using text/graphic editor, via USB/RS 232 or other suitable interface. This shall enable the user to carry out the following operations without any additional software.

It shall be possible to interface the system with Fire Alarm system via RS485 serial interface over MODBUS protocol and with the central EPABX system via EPABX digital lines.

Complete hardware racks related to both these exchanges shall be accommodated inside control room at central cabinet room in a common panel/cabinet. The cabinet shall be fabricated out of minimum 16-gauge sheet steel, naturally ventilated, dust and vermin proof with IP-41 enclosure as a minimum. The panel shall be with swing out assembly of plug-in-card racks.. It shall be possible to locate faults by monitoring from the central cabinet.

The central exchange shall have a processor module for the control of the central exchange. The exchange shall have a completely non-blocking type switching system and associated circuitry for call recognition and acknowledgement.

The offered system shall be flexible and modular in construction with the possibility of expanding to a bigger system in the future.

Each of the central exchanges shall have built-in fault diagnostic unit using test and monitoring modules. It shall be possible to locate faults by visual signalling and monitoring by means of test plugs from the central cabinet.

All hardware necessary for fault isolation and troubleshooting shall be supplied as a part of the cabinet along with each exchange.

Bidder has to supply the following number of telephones as a minimum for all the plant area and closed buildings.

	Flameproof to Ex-d IIC/T6 and weatherproof to IP67 telephone sets with acoustic hood (wall mount),	IP Telephones with with caller id display for indoor use	Weatherproof to IP67 telephone sets with acoustic hood (wall mount),
Bagging Building (Filling Area)	2 Nos		
Control Room		2 Nos	
Operator room (Weigh bridge)		1 Nos	
Substation		1 Nos	
Silo			1 Nos
Loading Area – Wagon	3 Nos		
Loading Area – Truck / Exit /Entry	1 No.		

15.0 LOCAL AREA NETWORK (LAN) FOR Urea Handling & bagging package

The Bidder shall lay the LAN required

FOR Bagging Control Room

BASIS OF DESIGN

Control Room

The system shall have as a minimum the following :-

1. Manageable L2- 8 port switch with 1G/10G port with 8 port Jack panel with cable manager
2. Switch shall have with 2 redundant Fibre optic port for connection to main CCR Plant LAN switch including interface cable , cable laying , erection material etc.
3. Cabling shall be CAT6A cabling

4. 4 Nos 3 m/Cat 6A patch cords
5. 4 Nos 6 m/Cat6a patch cords for end user
6. UTP CAT6A cabling shall be done with one spare cable.
7. Cable and passive components shall be from AMP. I/O – 4 nos, Faceplate with cover 4 Nos
8. Bidder to successfully interface with Main CCR LAN system. All hardware , software , erection material etc. shall be part of bidder's scope.

16.0 Training

Supplier shall train Clients' maintenance engineers as well as operations staff in his works at Vendors Center of Excellence. The training imparted shall be by qualified and experienced staff available. It shall be exhaustive and aimed at making clients' maintenance & operations staff self reliant for most of the day to day applications. For training, supplier shall make available as close a model of the system with all the representative nodes, as the actual system to be installed. It is envisaged that following be covered in the training:

Operating Staff Training

Operating courses include all aspects involved in operating the Control System from operator interface. This shall include operation under normal and abnormal conditions as may result from minor or major system malfunctions such that the trainee can take the appropriate remedial actions. The training shall include but not be limited to the following:

• Overview of the system

• Control philosophy

• User interfaces

• Messages and alarms

• Operator commands

• Generation of reports

• Predictable events and expected operator action

Engineering staff training

Software Design courses shall be provided which would train the Employer's Maintenance and Design staff to be able to identify and remedy software faults, upgrade and implement data and software changes, generate/develop new software for the purpose of improving the system and production of revised or new displays. The training shall include but not be limited to the following:

• Overview of the system architecture, hardware and software

• Software design and organisation

• Database structure, generation and modification

• Generation and modification of the VDU screen

• Customization of report/chart/graph format

• Assembly, compilation, linking, editing, debugging, distributing, testing and integration of program modules

17.0 CONTROL Room (Other Scope –only civil work) but conceptual equipment layout shall be developed by the bidder as per requirements and submitted with bid. Any minor work for if required for full fill tender requirement shall be done by the bidder.

Bidder to confirm the suitability of space.

6 Nos. 2TON complete split AC unit for bagging control room cooling purpose. AC units shall be commercial / industrial grade and suitable for Dusty / Urea environment.

6 Nos. (2 Sets of Three ACs) shall configure in such manner , First set (three ACs for first 8 hours) and Second set (three ACs for next 8 hours) and so on. Timer set for 8 hours for each set.

Bidder to furnish detailed control room equipment layout as per tender requirements:-

- Consoles Area
- Rack Room / Panel space
- UPS room
- Battery room
- Printers
- Annunciator panel
- FA Panel

- Telephone system
- LAN system
- CCTV Panel
- CCTV LED Monitor (Wall mount / hang)
- Any other as per requirement

ANNEXURE -1

INSTRUMENT ACCURACIES

The instrument reference accuracies shall be as per the table below. Accuracy of the Instruments shall be minimum as follows. Custody Transfer accuracies shall be as defined in the ITB in terms of rms.

Type of Instrument	Accuracy
Process Gas Analyzer – All type	+/- 2% FS
Conductivity , pH meters	+/- 0.5 % of Reading
Belt weighers	+/- 0.5 % of range
SILICA Analyzer	+/-0.5 ppb or better
Sodium Analyzer	±5 % of reading or better
Chlorine Analyzer	± 2 % or better
Differential pressure & Pressure transmitter - SMART	± 0.050% of span within TD ratio of 1: 100 or better
Diaphragm seal transmitter & Pressure transmitter - SMART	± 0.050% of span within TD ratio of 1: 100 or better
Variable area type flow meter with transmitter	± 2.0% FS Note (1)
Vortex flow meter	± 0.7 % FS
Positive displacement flow meter	
- Raw material and Product	± 0.2% FS
- Others	± 0.5% FS
- Turbine meter or Mass flow meter	
- Raw material and Product	± 0.2% FS
- Others	± 0.5% FS
- Magnetic type flow meter	± 0.5% FS
- Mass flow meter (Coriolis Type)	± 0.1% FS
- Ultrasonic type flow meter	± 0.5% FS
- Ultrasonic type flow meter(5 – path)	± 0.1% FS
Orifice plate : Normal Application	+/- 2% of flow rate
Orifice plate : Special Application	+/- 1.5% of flow rate

Venturi	+/- 1 % of flow rate
- Displacement type level indicator	± 1.0% FS
- Displacement type level transmitter	± 0.2% FS (Smart)
- Tank gauge (Custody Transfer)	± 1 mm with +/- 1 mm resolution
- Servo type tank gauge	± 2 mm (up to 20 m height)
- Radar type tank gauge	± 1 mm or better for custody transfer ± 5 mm or better for normal application
	± 0.2% of span within TD ratio of 1: 100
- Pressure gauge	± 1.0% of span for Bourdon type , 1.5% for diaphragm
- Temperature Transmitter	± 0.15 % of calibrated span for RTD & T/C
- Filled system/Bimetallic	± 1.0% FS
- Small size pressure gauge	± 3.0% FS
- Draft gauge	± 3.0% FS
- Receiver gauge	± 1.5% FS
- Thermocouple & Resistance Bulb	Applicable Codes/Standards

Note: 1. Vendor's standard accuracy is applied to local indicator type

Remarks: 1. Accuracy of instrument and special articles except for the above mentioned instrument shall be in accordance with the applicable codes/standards, or Vendor's standards as approved by Purchaser.
2. FS: Full scale.
3. Overall rangeability of transmitter except for draft range shall be 1: 100. Draft range transmitter rangeability shall be 1: 30 for the accuracy indicated above.
4. Accuracy for the instruments shall be % of reading and shall be supplied with wet calibration certification.

ANNEXURE -2

Field instrument connections shall be as follows.

Instrument Type	Process / Vessel Connection	Instrumentation Connections
DP Flow Instruments	½" NPT (M)	½" NPT
External Displacer on Vessel (Min. Rating ANSI 300#)	2" Flanged	2" Flanged
Internal Displacer (Min. Rating ANSI 300#)	4" Flanged	4" Flanged
External Ball Float on Vessel (Min. Rating ANSI 300#)	2" Flanged	2" Flanged
Internal Ball Float (Min. Rating ANSI 300#)	4" Flanged	4" flanged
Magnetic Level Gauge (Min. Rating ANSI 300#)	2" Flanged	2" Flanged
D/P Level	½" NPT (M)	½" NPT
D/P Level with Remote Seal Diaphragm (Min. Rating ANSI 300#)	3" Flanged	3" Flanged
D/P Level Direct Vessel Mounted (Min. Rating ANSI 300#)	3" Flanged	3" Flanged
RADAR – Direct Mount on vessel (Min. Rating ANSI 300#)	3" flanged	3" flanged
GW RADAR – Side/Side Chamber Mounted on vessel (Min. Rating ANSI 300#)	2" flanged	2" flanged
Internal GWR on Equipment (Min. Rating ANSI 300#)	4" Flanged	4" flanged
Special Level Instrument on Equipment (Capacitance/ Ultrasonic/R.F.Probe)	2" flanged	2" flanged
Tank Level Instruments (Servo) on Atmospheric tank/ Pressurized Equipment	6" flanged	6" flanged
Tank Level Instruments (Radar) on Atmospheric tank clean service / Pressurized Equipment	8" flanged	8" flanged
Tank Level Instruments (Radar) on Atmospheric tank viscous service / Pressurized Equipment	24" flanged	24" flanged
Tank Level Instruments (Capacitance/ Ultrasonic/R.F.Probe) on Atmospheric tank / Pressurized Equipment	2" flanged	2" flanged
Pressure Instruments	½" NPT (M)	½" NPT
Press.Gauge	½" NPT (M)	½" NPT
Pressure with diaphragm seal, (Min. Rating ANSI 300#)	3" Flanged	3" Flanged

Pressure Instruments on Vessel	1 ½" Flanged	½" NPT
Pressure Instruments on Standpipe	¾" SW/BW/Flanged	½" NPT
Chemical Seal pressure Instrument gauge on Vessel	1 ½" Flanged	½" NPT
Diaphragm Seal pressure Instrument gauge on Vessel	1.5" Flanged	1.5" Flanged
Thermowell (Min. Rating ANSI 300#)	1 ½" Flanged	1 ½" Flanged
Multipoint Temperature Element for Tanks	2" Flanged / 3" Flanged	2" Flanged / 3" Flanged
Standpipe	3" Flanged	-

Note:-

a. There shall be a separate tapping for each of the instruments on any pipeline/vessel. No multiple instruments from one tapping is acceptable (for example PG and PT from single pipe line tapping with single or double mechanical isolation valves are not acceptable). However, as an exception to this, three transmitters on clean gas services from one orifice (with two pairs of tapping) is acceptable, where multiple (2 out of 3, etc.) transmitters are to be installed.
b. All type of instrument tapping flange rating shall be minimum ANSI 300#, irrespective of minimum design pressure. However for pressure rating of 600# class and above, RTJ flange shall be used. At few locations, double isolation valves shall be used as per table given below.

INSTALLATION	**PRESSURE TAPPINGS**	**LEVEL TAPPINGS**	**FLOW ELEMENTS**	**CONTROL VALVE**
RATING				
300 #	SINGLE	SINGLE	SINGLE	SINGLE
600 #	DOUBLE	SINGLE	DOUBLE	SINGLE
900 # / 1500 # / 2500 #	DOUBLE	DOUBLE	DOUBLE	SINGLE

Annexure - 3

SYSTEM CONFIGURATION (Tentative & minimum)

Control system package

- 4 nos. OS and 1 no. ES cum OS (including SOE) with LED monitors will be used for controlling/trip & monitoring for above packages facilities as per following :-
  - 3 Nos. OS dual LED monitors type for complete Urea Handling & Bagging Package
  - 1 No. ES cum OS (including SOE) with dual personality LED monitors type for complete Urea Handling & Bagging Package
- Two No. A-4 Laser Printers B/W
  - One for Control Room
  - One for Weigh Bridge Operator room
- 1 no. ES cum OS with dual personality LED monitors at Weigh Bridge Operator room
- Annunciation / Alarm/ Mimic panel
- Above OS/ES/SOE/Panel requirements are minimum requirements. Bidder may propose / add additional monitoring stations , if required.
- One view only station dual LED monitors with console in Central Control Room (interface through serial interface redundant port (MODBUS TCP/IP)/OPC server) , all cables , erection, termination, any requirement etc. to shall be in bidder's scope. Console space shall be provided in CCR.

ES / OS : 22" TFT, COLOR, LED type dual monitors

1 no. of Membrane Operator's Keyboard and 1 no. of QWERTY engineer's keyboards with mouse with each operator station

1 No. Annunciator with LED lamps with split type architecture

All USB ports must be blocked and the system must have latest anti-virus.

Printers

2 Nos A4 Black and White HP make Laser printer

(All printers shall have wireless facility)

Required furniture of reputed make shall be considered in the offer.

Annexure - 4

OPERATOR STATION SUB-SYSTEM

* Model No. _Note-1___

A. **General Requirement**

1	Number of Operator Consoles	As specified
2	Inter-changeability between operator consoles	Required
3	On-line system diagnostics on Console Monitor	Required at Module level
4	On-line configuration change	Required
5	Console configuration	Single

B. **OPERATOR CONSOLE**

1	Console's basic electronics	Individual electronics for each monitor
	µp Type	64 bit
	µp Manufacturer/ model	Note-1
	Memory size /Cache size	16_GB (Vendor to check the suitability of memory size)
2	Type of Database	Functionally Separate

Database Storage Devices:

Sr. No.	ITEM MODEL No.	FUNCTION	REDUNDANCY (Refer Note)	REMARK
1.	HDD	Note-1	REQUIRED	1 TB Min
2.	Combo drive	Note-1	REQUIRED	
3.	Vendor recommended	Note-1	REQUIRED	
4.			REQUIRED	

(Note: Full Redundancy is required if Centralised global database is provided)

STORAGE DEVICES ARE APPLICABLE IN EACH OPERATOR STATION.

3 Number of Devices (per console)

S. No	TYPE OF DEVICE	Description OF DEVICES REQUIRED	NO. OF DEVICES	REMARKS
1.	MONITOR	22" TFT, COLOR, LED type single monitors	1 per console	
2.	KEYBOARD SETS	1 no. of Membrane Operator's Keyboard and 1 no. of QWERTY engineer's keyboards with mouse.	1 per console	
3.	ALARM & EVENT, LOG A3 PRINTER	1 Nos A3 Heavy duty Colour –HP make	1	
7.	DVD DRIVE		1 per console	
8.	ANNUNCIATOR KEYBOARD	1 No. Annunciator with LED lamps with split type architecture	1	

4 Inter-changeability between Monitors Required

5 Spare memory requirement Min. 40%

6. Keyboard Set

a) Keyboard Security against unauthorized access Required with Key-lock

Note: Key-lock Password shall be provided for each operator console.

b) Maximum number of keystrokes for accessing views as per standard display hierarchy:

S.No.	TYPE OF VIEW	REQUIRED	OFFERED	REMARKS
1.	GROUP VIEW	TWO		
2.	LOOP VIEW	THREE		
3.	LOOP IN ALARM	TWO		
4.	GRAPHICS VIEW	TWO		

c) Assignable function keys for single keystroke access Required

	d) Number of Assignable function keys per Monitor			64	
7	a) Number of devices for cursor control			Two/Monitor	
	b) Devices for cursor control	Keyboard	**[X]**	Mouse	**[X]**

8 Monitors and Displays

a) Size of Monitor 22" diagonal

b) Type of Monitor TFT LED

c) Surface Treatment Hard Coating anti Glare

d) Length of tag number (characters) 16 alphanumeric

e) Length of description (characters) 24 alphanumeric

f) Display update rate 2 s

g) Dynamic graphics Required

h) Multi Window Capability Required

i) Control through dynamic graphics Required

j) Screen displays and Call-up time

S.No.	TYPE OF DISPLAY	REQUIRED	CALL-UP TIME(S)*	REMARKS
1.	OVERVIEW	YES		
2.	GROUP DISPLAY	YES		
3.	LOOP DISPLAY	YES		
4.	DYNAMIC GRAPHICS	YES		
5.	REAL-TIME TREND	YES		
6.	HISTORIC TREND	YES		
7.	ALARM SUMMARY	YES		
8.	ALARM HISTORY	YES		
9.	CONFIGURATION	YES		
10.	DIAGNOSTIC	YES		

k) Display Hierarchy

S. No.	DESCRIPTION	REQUIREMENT	SYSTEM CAPABILITY	REMARKS
1.	NO. OF OVERVIEW PAGES	AS REQD.		
2.	NO. OF GROUPS/OVERVIEW	AS REQD.		
3.	NO. OF LOOPS / GROUP	8		
4.	NO. OF GRAPHIC PAGES	AS REQD.		
5.	NO. OF POINT IN ALARM SUMMARY	AS REQD.		
6.	NO. OF POINTS IN ALARM HISTORY	AS REQD.		
7.	NO. OF TRENDS PER DISPLAYS	AS REQD.		
8.	NO. OF MULTI-TREND DISPLAYS	AS REQD.		
9.	OTHERS	AS REQD.		

l) Multi Windowing facility Required

Note: Opening of more than four windows on the same Monitor shall be restricted by the system .

m) Trending functions: Each Operator Console shall be capable of trending all analog points.

n) Real-time trend

Number of parameters Required for ALL TAGS

o) Historical trend

Number of parameters Required for ALL TAGS

Time period 30 Days

9) Logging Function

a) Number of tags to be logged Required for ALL TAGS

b) Number of log reports:

Alarm History per shift

Event logging

Hourly logs

Shiftly logs

Daily logs

Weekly logs

Shutdown report

Trip initiated log

Others (Note)

Note: Other log reports as required shall be furnished during execution stage.

c) Log formats — User definable

10 System boot-up from — Engineer console

11 Auto boot-up on power On — Required

12 Storage disks

a) Type of storage disk — HDD — Optical (DVD)

b) Number of disks and capacity

Sl. No.	TYPE OF DISC	NUMBER (MINIMUM)	MEMORY CAPACITY PER DISK	REMARKS
1	HDD	One Per Monitor	AS per latest configuration	1 TB Min
2.	OPTICAL	One Per Monitor	AS per latest configuration	
3.	Other			

13 Any other feature available as a standard:

a)_____

b) _____

14 CPU Loading — 60 %

15 Memory Utilization — 60 %

16 Operating System — Latest must have validation with the system

17 Antivirus/Network Security — Required

ENGINEERING Cum OPERATOR STATION SUB-SYSTEM

- Model No. _____

1.	Number of Engineering cum Operator Station	As specified
2.	Number of Monitors per Engg. Station	One
3	Type of electronics	Individual per Monitor
	µP type	64 bit
	Memory size	NOTE-1
	Model No.	NOTE-1
4	Number of engineering keyboards	One per Monitor
5	Number of Operation keyboards	One per Monitor
6	Functional Capability	Same as operator station subsystem

7 Basic functions of Engineering Console

a) System configuration and reconfiguration

b) Group & multi-groups alarm inhibiting

c) Plant views with/ without plant operation

d) Graphic page compilation

e) Setting/ resetting real-time clock

f) Loop tuning on selectable basis

g) System maintenance and diagnostics

8	Monitor specification	As per operator station subsystem
9	Keyboard specification	As per operator station subsystem

10 Data storage Devices and capacity

Sr. No.	TYPE OF DISC	NUMBER (MINIMUM)	MEMORY CAPACITY PER DISK	REMARKS
1	HDD	One	As per Latest configuration	1 TB Min
2.	DVD writer	One		
3.	OPTICAL(DVD)	One	As per Latest configuration	
5.	OTHER			

11. Antivirus/Network SecurityRequired

SEQUENCE OF EVENT (SOE) [Part of ES]

*Model No._____

Offered System Details

1 Dedicated Sequence of Event Station **Required**

SPECIFICATIONS

1	Type	Integrated with system			
2	Scan time	Not more than system scan time			
3	Resolution Required				
	Digital	1 msec	[X]	10 msec	[ ]
	Analog	250 msec	[X]	100 msec	[ ]
4	SOE PC	Required			
	Function of PC:				
		Event Data Collection			
		Alarm Data collection Diagnostics			
		History Data			
	SOE Printer	Required			
	Alarm Data Storage	Required			
	Storage Time	30 Days			
5	Interfacing with:				
	Control system	Yes			

Note:- Dedicated SOE workstation is not required. Engineering station shall have feature of SOE

ANNEXURE -5

Type of Signal	Inst to JB (1P,1T)		JB to CR (6P/12P/6T/8T/12T)		CR to MCC/MCC to CR (Multi-conductor cable)	
	Size *(mm2)	Type	* Size (mm2)	Type	Size (mm2)	Signal
AI	1.5	Signal	0.75	Signal	1.5	Signal
AO	1.5	Signal	0.75	Signal	1.5	Signal
DI	1.5	Signal	0.75	Signal	1.5	Signal
DO	1.5	Signal	0.75	Signal	1.5	Signal
RTD	1.5	Signal	0.75	Signal	1.5	Signal
TC	1.5	Signal	0.75	Signal	1.5	Signal
GD	1.5	Signal	1.5	Signal	-	-
SOV	2.5	Signal	2.5	Signal	-	-
POWER	2.5	Power	2.5	Power	2.5	Power
TC Extension cable	Special compensation cable between Element to transmitter					
RTD Extension cable	Triad cable between Element to transmitter of 1.5mm2					
Analysers	1.5	Signal	0.75	Signal or serial communication as the case may be.		

***Note :** Above size is minimum. Further cable size may be increase based on voltage drop calculation .

GENERAL SPECIFICATION

FOR

INSTRUMENT TUBE FITTINGS

1.0 GENERAL

1.1 Scope

1.1.1 This standard specification, together with the data sheets attached herewith, covers the requirements for the design, materials, inspection, testing and shipping of instrument tube fittings which includes the following type:

Stainless steel compression fittings (for stainless steel tube)

1.1.2 The related standards referred to herein and mentioned below shall be of the latest Editions prior to the date of the purchaser's enquiry: -

ANSIIASME American National Standards Institute/American Society of Mechanical Engineers

B 1.20.1 Pipe Threads General Purpose (Inch).

B 16.11 Forged Steel Fittings - Socket Welding and Threaded.

BS-4368 Carbon and Stainless Steel Compression Couplings for Tubes.

EN 10204 Inspection Documents For Metallic Products.

IS-319 Specification for free cutting Brass Bars, Rods and Sections.

ISA Instrumentation, Systems and Automation Society.

RP 42.1 Nomenclature for Instrument Tube Fittings.

1.1.3 In the event of any conflict between this standard specification, data sheets, statutory regulations, related standards, codes etc., the following order of priority shall govern:

a) Statutory Regulations

b) Data Sheets

c) Standard Specification

d) Codes and Standards

1.2 Bids

1.2.1 Vendor's quotation shall be strictly as per the bidding instructions to the vendor attached along with the material requisition.

1.2.2 Whenever a detailed technical offer is required, vendor's quotation shall include the Following;

a) Compliance to the specifications.

b) Whenever specifically indicated, detailed specification sheet for each item, which

shall provide the information regarding type, size, material of construction etc. of the items. The material specifications and units of measurement for various items in vendor's specification sheets shall be to the same standard as those indicated in purchaser's data sheet.

c) Deviations on technical requirements shall not be entertained. In case vendor has any valid technical reason to deviate, they must include a list of deviations item wise summing up all the deviation from the purchaser's data sheets and other technical specification along with technical reasons for each of these deviations.

d) Catalogues giving detailed technical specifications, model decoding details and other information for each type of instrument tube fitting covered in the bid.

1.2.3 All documentation submitted by vendor including their quotation, catalogues, drawings, Installation, operation and maintenance manuals etc , shall be in English language only.

2.0 DESIGN AND CONSTRUCTION

2.1 Stainless Steel Tube Fittings

2.1.1 Nomenclature of all tube fittings shall be as per ISA RP 42.1.

2.1.2 Fittings shall be of flare less compression type having four-piece (for double compression type) construction consisting of two ferrules, nut and body or three piece (compression type construction consisting of single ferrule, nut and body suitable for use on tubes of specified material for example stainless steel tubes conforming to ASTM A269 TP 316 with hardness in the range of HRB 70 to 79.

2.1.3 All parts of the tube fittings shall be of 316 Stainless Steel.

2.1.4 Hardness of the ferrules shall be in the range of HRB 85-90 so as to ensure a hardness difference of the order of 5 to 10 between tube and fittings for better sealing.

2.1.5 Nuts and ferrules of a particular size shall be interchangeable for each type.

2.1.6 Spanner hold shall be metric.

2.1.7 Threaded ends of fittings shall be NPT as per ANSI B 1.20.1.

2.1.8 Specific techniques like silver plating shall be used over threading in order to avoid jamming and galling.

2.1.9 Ferrule finish and fitting finish shall be such that there is no abrasion/galling when the nut is tightened.

2.1.10 All instrument tube fittings in oxygen and chlorine service shall be thoroughly degreased using reagents like trichloro-ethylene or carbon tetrachloride. End connection shall be plugged after degreasing process in order to avoid entrance of grease or oil particles.

2.2 Copper Tube Fittings (Not applicable for this Project)

2.2.1 Nomenclature of all tube fittings shall be as per ISA RP 42.1.

Fittings shall be of flare less compression type and of three-piece construction consisting of ferrule, nut and body Suitable for use on copper tubes conforming to ASTM B68 *1B68M,* hardness not exceeding HRB 50.

2.2.2 All parts shall be manufactured from brass as per IS 319 bar stock and nickel plated.

2.2.3 For better grip, vendor shall maintain hardness difference between tube and ferrule and indicate the same along with the offer.

2.2.4 Threaded ends of fittings shall be NPT as per ANSI B 1.20.1.

2.2.5 Spanner hold shall be metric.

3.0 NAMEPLATE

No separate nameplates are required on the fittings. However. manufacturer's name/trademark should be punched on a visible place on the body of each fitting for easy identification.

4.0 THIRD PARTY INSPECTION AND TESTING

4.1 Unless otherwise specified, purchaser reserves the right to test and inspect all items at vendor's works, inline with the inspection test plan for instrument tube fittings.

4.2 Vendor shall submit following test certificates and test reports for purchaser's review:

4.2.1 Type test reports for following tests in accordance with BS-4368·Part IV:

a) Hydrostatic proof pressure test.
b) Minimum hydrostatic burst pressure test.
c) Disassembly and reassembly test.
d) Minimum static gas pressure (vacuum) test.
e) Maximum static gas pressure test.
f) Hydraulic impulse and vibration test.

4.2.2 Material test certificates as per clause 3.1 B of EN 10204.

4.2.3 Routine test reports for following tests:

a) Hydrostatic Test
Instrument tube fittings shall be hydrostatically tested at ambient temperature at test pressures given in Annexure I of this specification. During and after the hydrostatic test, the tube fittings shall not show any leakage or rupture.

b) Pneumatic pressure test
The fittings shall be tested at 7 kg/c mg of dry air. There shall not be any visible leakage when immersed in water or coated with a leak detection solution.

c) Disassembly and reassembly test.

d) Hardness verification:
Hardness test shall be carried out on each rod used for machining ferrules. Vendor shall ensure that after machining, the finished ferrules shall meet the required hardness given in the specification.

d) Dimensional test report

4.3 Third Party Witness Inspection

4.3.1 All fittings shall be offered for pre-dispatch inspection for the following as a minimum:

a) Physical dimensional verification and workmanship on representative samples.
b) Hydrostatic and pneumatic tests as per clause 4.2.3 of this specification on representative samples.
c) Hardness verification as per clause 4.2.3 of this specification.
d) Disassembly and reassembly test on representative samples.
e) Review of all certificates and test reports as indicated in clause 4.2 of this specification.

4.3.2 In the event when no witness inspection is carried out by purchaser, vendor shall any way complete the tests and test reports for the same shall be submitted to purchaser for scrutiny.

5.0 SHIPPING

5.1 All threads/ends shall be protected with plastic caps to prevent damage/entry of foreign matter.

5.2 All the fittings in oxygen and chlorine service shall be separately packed along with a certificate indicating 'SUITABLE FOR OXYGEN/CHLORINE SERVICE', as applicable.

6.0 REJECTION

6.1 Vendor shall prepare their offer strictly as per clause 1.2 of this specification and shall attach only those documents, which are specifically indicated in the material requisition.

6.2 Any offer not conforming to the above requirements, shall be summarily rejected.

Annexure- 1

Sr. No.	Size of Tube Fittings	Material	Line Pressure No. Class	Hydrostatic Test Pressure
1	¼”and ½”	Stainless steel	<600#	153 Kg/cm2 g
2	¼” and ½”	Stainless steel	>=900# to <=1500#	383 Kg/cm2 g
3	¼” and 3/8”	Brass		80Kg/cm2 g

GENERAL SPECIFICATION

FOR

INSTRUMENT TUBING

ABBRIVATIONS:

ID	Inner Diameter
OD	Outer Diameter
PVC	Polyvinyl Chloride

CONTENTS

1.0 GENERAL

1.1 Scope

1.1.1 This standard specification, together with the data sheets attached herewith, covers the requirements for the design, materials, inspection, testing and shipping of Instrument Tubing which includes the following types: -

Stainless steel tubes

1.1.2 The related standards referred to herein and mentioned below shall be of the latest edition prior to the date of purchaser's enquiry;

ASTM American Society for Testing and Materials.

A 269 Standard Specification for Seamless and Welded, Austenitic Stainless Steel Tubing for General Services.

A632 Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing (Small Diameter) for General Services.

B 251 Specification for general requirements for wrought seamless copper and copper alloy tube.

B 251M Specification for general requirements for wrought seamless copper and copper alloy tube (Metric)

B 68 Specification for seamless copper tube, bright annealed.

B 68 M Specification for seamless copper tube, bright annealed. (Metric)

E 243 Standard Practice for Electromagnetic (Eddy - Current) Examination of Copper and Copper - Alloy Tubes

EN 10204 Inspection Documents for Metallic Products

1.1.3 In the event of any conflict between this standard specification, job specification/data sheets, statutory regulations, related standards, codes etc. the following order of priority shall govern:

a) Statutory regulations
b) Job specification
c) Standard specification
d) Codes and standards,

1.2 Bids

1.2.1 Vendor's quotation shall be strictly as per the bidding instructions to vendor attached with the material requisition.

1.2.2 Whenever a detailed technical offer is required, vendor's quotation shall include the following;

a) Compliance to the specifications.

b) Whenever the requirement of a detailed specification sheet, is specifically indicated, the specification sheet shall provide information regarding size, length, construction, materials etc. of the Items. The material specifications and units of measurement for various items in vendor's specification sheets shall be to the same standards as those indicated in purchaser's data sheet.

c) Overall dimensions in mm/inch as per purchaser's specification.

d) Deviations on technical requirements shall not be entertained. In case vendor has any valid technical reason to deviate, thc)! must include a list of deviations item wise. summing up all the deviations from the purchaser's data sheet and other technical specification along with the technical reasons for each of these deviations.

e) Catalogues giving detailed technical specifications; model decoding details and other related information for each item covered in the bid,

1.2.3 All documentation submitted by the vendor including their quotation, catalogues, drawings, installation and maintenance manuals shall be in English language only.

1.3 Drawings and Data

1.3.1 Detailed drawings, data, catalogues and manuals required from the vendor are indicated by the purchaser in vendor data requirement sheets. The required number of reproducible, prints and soft copies shall be dispatched to the address mentioned adhering to the time limits indicated.

1.3.2 Final documentation consisting of design data by the vendor or after placement of purchase order shall include the following as a minimum;

a) Specification sheet for each type of tube.

b) Copy of test certificates of all tests indicated in clause 4.0 of this specification.

2.0 DESIGN AND CONSTRUCTION

2.1 Stainless Steel Tubes

2.1.1 The tubes shall be 316 Stainless Steel fully annealed, and seamless and hot extrusion.

2.1.2 The hardness of the tubes shall be limited to HRB 70-79. Equivalent hardness as

Rockwell superficial scale (30T/15T) or Vicker's hardness scale shall also be acceptable.

2.1.3 Tubes shall have good surface finish and shall be free from scratches burrs etc. and suitable for bending.

2.1.4 Maximum working pressure shall be as per Annexure - I attached with this specification.

2.1.5 Tubes shall preferably be supplied in length of 5 to 6 metres without welding in between. Tube length less than 5 meters shall be rejected.

2.1.6 All tubes in oxygen and chlorine service shall be thoroughly degreased using reagents like trichloro-ethylene or carbon tetrachloride and tube ends shall be plugged after degreasing process in order to avoid entrance of grease or oil particles.

2.1.7 Stainless Steel Seamless Instrumentation Tubes should be Cold Finished and Bright Annealedas per ASTM A 213 /A 269 / EN 10216-5.

2.1.8 Hot Extruded Mother Pipes must be used for manufacturing Seamless Tubes. It is not acceptable to use Hot Pierced Mother Pipes. It should be followed by Cold Pilgering Process to ensure good quality tubes from Hot Extruded Mother Pipes

2.1.9 With C <0.025% improves Corrosion resistance &Weldability with Special Chemistry

2.1.10 Nickel – 13% Minimum and Molybdenum – 2.50% Minimum

2.1.11 Hardness Controlled to < 80 HRB (It ensures easy Bending &Swaging)

2.1.12 Dual Certified Grades – 316 / 316L

2.1.13 IGC Practice as per ASTM A 262 Practice E

2.1.14 Complies to NACE MR 0175

2.1.15 100% Eddy Current Testing of Tubes as per ASTM A1016

2.1.16 Hydro Testing on Request

2.1.17 End Capped

2.1.18 Wooden Box Packing

2.1.19 Surface Finish Ra < 1.0 Microns on OD and 1.8 Microns on the ID Unpolished surface

2.2 Copper Tubes (Not applicable for this project)

2.2.1 Copper Tubes (PVC Jacketed)

a) The tube shall be soft annealed copper with 6mm OD and a wall thickness of 1.0mm as per ASTM B 68M copper No. C 12200.

b) The tube shall be jacketed with black PVC. The jacket thickness shall be 1.6mm. The PVC jacket shall confirm to ASTM D-I047.

c) The tube ends shall be plugged prior to transportation.

d) The tube shall be continuous length without any brazing in between.

e) The length of single tube shall preferably be100 metres. However any tube length less than 70 meters shall be rejected unless specifically required otherwise in job specification.

f) The dimensional tolerances shall be as per ASTM B 251M.

2.2.2 Bare Copper Tubes (For Steam Tracing)

a) The tube shall be soft annealed copper with 3/8" (10mm) OD with wall thickness of 0.049" or 6mm OD with wall thickness of 1.Omm as per ASTM B6&.copper No.C12200.

b) The tube ends shall be plugged prior to transportation.

c) The tube shall be continuous length without any brazing in between.

d) The length of single tube shall preferably be 100 metres. However any tube length less than 70 meters shall be rejected unless specifically required otherwise in job specification.

e) The dimensional tolerances shall be as per ASTM B 251.

f) Maximum working pressure shall be 53.0 kg/crrr'g at 38°C unless specified otherwise.

3.0 NAME PLATE

3.1 The following information shall he marked on the stainless steel tubes:

a) Name of manufacturer

b) Type and material grade of tube

c) Tube outer diameter and wall thickness.

4.0 INSPECTION AND TESTING

4.1 Unless otherwise specified, purchaser reserves the right to test and inspect all the items at vendor's works, in line with the inspection test plan for instrument tubing.

4.2 Vendor shall submit following test certificates and test reports for purchasers review:

a) Material test certificates as per clause 3.1B of EN 10204.

b) Hydrostatic test for stainless steel tube and bare copper tubes as per clause 4.3 of this specification.

c) Pneumatic test for PVC jacketed copper tubes as per clause 4.4 of this specification.

d) Hardness / tension test for stainless steel tubes as per clause 4.5 of this specification.

e) Ball test for copper tubes as per clause 4.6 of this specification.

I) Eddy current examination of copper tubes as per ASTM E-243

g) Dimensional test report.

4.3 Hydrostatic test

4.3.1 Stainless steel and bare copper tube shall be hydrostatically tested at ambient temperature at test pressures given in Annexure - 1 attached with this specification. During and after the hydraulic test, the tubes shall not show any leaks or rupture.

4.4 Pneumatic test

PVC jacketed copper tubes shall be tested at 7.0 kg/crrr'g of dry air. During and after the test, tubes shall not show any leak or rupture.

4.5 Hardness/Tension Test

All mother tubes shall be hardness tested for each heat prior to drawing for proper quality control. The hardness of the drawn tubes shall be checked by Rockwell Hardness Test.
Following shall apply;

a) For tubing less than 0.6Sin (1.6Smm) in wall thickness, Rockwell superficial hardness test on 30T / 1ST scale or Vicker's scale shall be equivalent to HRB 70 - 79.

b) Hardness test is not required for tubes smal1er than 1/4in (6.4mm) inside diameter or tubes having a wall thickness thinner than 0.020in (O.Slmm). These tubes shall be tension tested in accordance with ASTM A632.

4.6 Ball Test

4.6.1 Ball test shall be carried on all copper tubes to ensure clear opening of the tube. The OD of the ball shall be minimum 1.0 mm for 6.0mm 00 tube and 2.0 mm for 3/8" (10mm) OD tube.

4.7 'Witness Inspection

4.7.1 All tubes shall be offered for pre-dispatch inspection for the following, as a minimum;

a) Physical dimensional verification and workmanship.

b) Hardness / tension test for stainless steel tubes.

c) Hydrostatic and pneumatic tests on representative samples.

d) Ball test on copper tubes on representative samples.

c) Eddy current examination of copper tubes on representative samples.

f) Review of all certificates and test reports as indicated in c1ause4.2 of this specification.

4.7.2 In the event that the witness inspection is not carried out by purchaser, vendor shall anyway complete the tests and test reports for the same shall be submitted to purchaser for scrutiny.

5.0 SHIPPING

5.1 The tube shall be plugged at both ends to prevent entry of foreign matter.
5.2 The tubes shall be packed carefully so as to avoid damage during transport.

5.3 All tubes III oxygen and chlorine service shall be separately packed along with a certificate indicating 'SUITABLE FOR OXYGEN! CHLORINE SERVICE', as applicable.

6.0 REJECTION

6.1 Vendor shall prepare their offer strictly as per clause 1.2 of this specification and shall attach only those documents and information which is specifically indicated in the material requisition.

6.2 Any offer not conforming to above requirements, shall summarily be rejected.

ANNEXURE - 1 : MAXIMUM WORKING PRESSURE AND HYDROSTATIC TEST PRESSURES FOR INSTRUMENT TUBING

Sr. No.	Size of Tube (OD)	Material	Line Pressure Class	Thickness	Maximum Working Pressure	Hydrostatic Test Pressure
1.	½" (12 mm)	Stainless Steel	≤ 600 #	0.049" (1.2 mm)	102 Kg/cm2g	153 kg/cm2g
2.	½" (12 mm)	Stainless Steel	≥ 900 # to ≤ 1500 #	0.065" (1.65 mm)	253 Kg/cm2g	383 kg/cm2g
3.	¼" (6 mm)	Stainless Steel	≤ 600 #	1.00 mm	102 Kg/cm2g	153 kg/cm2g
4.	¼" (6 mm)	Stainless Steel	≥ 900 # to ≤ 1500 #	0.065" (1.65 mm)	253 Kg/cm2g	383 kg/cm2g
5.	¾" (10 mm)	Copper	-	0.049"	53 Kg/cm2g	80 kg/cm2g
6.	¼" (6 mm)	Copper	-	1.00 mm	53 Kg/cm2g	80 kg/cm2g

GENERAL SPECIFICATION

FOR

INSTRUMENT VALVES AND MANIFOLDS

Abbreviations

CWP	Cold Working Pressure
NPT	National Pipe Thread
PTFE	Poly Tetra Fluoro Ethylene

CONTENTS

1.0 General

This standard specification shall be used for Instrument Valves and Manifolds.

2.0 DESIGN AND CONSTRUCTION

2.0.1 The finishing and tolerances of parts like stem, piston, stem threading etc. of the offered Valves and manifolds shall be properly machined to avoid problems like galling.

2.0.2 The hand wheel material for all valves and manifolds shall be zinc/nickel plated carbon steel. Any other material, if provided as per standard vendor design, shall also be acceptable.

2.1 Instrument Valves (Miniature)

2.1.1 The instrument valves shall be of globe pattern needle valves forged bar stock with inside screwed bonnet, with back-seated blowout proof system.

2.1.2 Body material shall be 316L Stainless Steel unless otherwise specified.

2.1.3 The minimum cold working pressure (CWP) rating of the valve shall be as per Annexure 1 of this specification, unless otherwise specified.

2.1.4 The end connection shall be *1/2" NPTF* to ANSI B1.20.1, unless otherwise specified.

2.1.5 Flow direction shall be marked on the body.

2.1.6 The valve dimensions shall be as follows:
a) End to end dimensions 76mm (approximately).
b) Height in fully open condition - 135mm maximum.
These dimensions are indicative only.

2.2 Valve Manifolds

2.2.1 3-Valve and 5-Valve manifolds:

2.2.1.1 3-Valve manifold

a) 3-Valve manifold shall be designed for direct coupling to differential pressure Transmitters having 2 bolt flanges with 54mm (2-118") centre-to-centre connections and 41.3mm (1-5/8") bolt-to-bolt distance.

b) 3-Valve manifold shall contain two main line block valves and an equalizing by pass valve. The valves shall be needle type. They shall use self-aligning 316LStainless Steel ball seats, unless otherwise specified.

2.2.1.2 5-Valve manifold

a) 5-Valve manifold shall be designed for direct coupling to differential pressure Transmitters having 2 bolt flanges with 54mm (2-1/8") centre-to-centre connections and 41.3mm (1-5/8") bolt-to-bolt distance.

b) 5-Valve manifold shall contain two main line block valves and a combination Double block and bleed for the bypass line The valve shall of needle type or special ball With bleed hole.

2.2.2 The flanges shall be integral part of manifold block.

2.2.3 The material of construction shall be 316L Stainless Steel, unless otherwise specified.

2.2.4 The minimum cold working pressure (CWP) rating of manifolds shall be as per Annexure 1 of this specification, unless otherwise specified.

2.2.5 The process connection shall be 1/2"NPTF to ANSI B 1.20.1.

2.2.6 Wherever the manifolds are specified for stanchion mounting, these shall be supplied along with mounting accessories. The bolts and nuts MOC shall be ASTM A 193 Gr B7 and ASTM A194 Gr. 2H. Other accessories shall be zinc plated.

2.2.2 3 way 2 valve manifolds for pressure gauges

2.2.2.1 The manifold shall be designed for use with pressure gauges with block and bleed valves. The manifold body shall be either straight or angle type as specified in the data sheet.

2.2.2.2 The valve shall be a needle type.

2.2.2.3 The body material shall be 316L Stainless Steel, unless otherwise-specified.

2.2.2.4 The minimum cold working pressure rating of the manifold shall be as per Annexure 1 of this specification, unless otherwise specified.

2.2.2.5 The manifold shall have the following connections:

a) The inlet connection shall be %" plain ends with a minimum of 100mm nipple Extension suitable for socket weld or butt weld as per B16.11/ B16.9 as Specified in the job specifications

b) The gauge connection shall be with union nut and tail piece threaded to ½" NPTF.

c) The drain connection shall be ½" NPTF.

2.3 Instrument Air Valves

2.3.1 Instrument Air Isolation Valves (Miniature)

2.3.1.1 The valves shall be full-bore ball type with forged body.

2.3.1.2 Body material shall be 304 Stainless Steel

2.3.1.3 The minimum cold working pressure rating of instrument air isolation valves shall be as Per Annexure 1 of this specification, unless specified otherwise.

2.3.1.4 The end connection shall be1/4" NPTF to ANSI B 1.20.1, unless otherwise specified.

2.3.1.5 End to end dimensions shall be as per ASME B16.10.2000 (latest edition)

2.3.2 Instrument Air Needle Valves (Miniature)

2.3.2.1 The instrument valves shall be globe pattern-needle valves forged/bar stock with inside Screwed bonnet.

2.3.2.2 Body material shall be 304 Stainless Steel.

2.3.2.3 The minimum cold working pressure of Instrument Air Needle valves shall be per Annexure I of this specification. Unless otherwise specified.

2.3.2.4 The end connection shall be 1/4" NPTF to ANSI B1.20.1, unless otherwise specified.

2.3.2.5 Flow direction shall be marked on the body.

2.3.3 All instrument valves in oxygen and chloride service shall be thoroughly degreased using reagents like trichloroethylene or carbon tetrachloride. End connection shall be plugged after degreasing process in order to avoid entrance of grease or oil particles.

3.0 NAME PLATE

Following information shall be punched on the body of each of these items;

a) Material of construction to the same standards as in purchaser's data sheets.
b) Cold working pressure of each item to the same standards as in purchaser's data sheets.
c) Manufacturer's identification and model number.
d) Flow direction (if applicable)
e) Material of construction.

4.0 INSPECTION AND TESTING

4.1 Unless otherwise specified, purchaser reserves the right to test and inspect all the items at vendor's works, in line with the inspection test plan for instrument valve and manifolds.

4.2 Vendor shall submit following test certificates and test reports for purchaser's review:
a) Material test certificates as per clause 3.1B of EN 10204 for body and bonnet and as per clause 2.2 for other parts.
b) Dimensional test report.
c) Pressure test report as per clause 4.3 of this specification.
d) Hydrostatic proof and burst tests as per MSS-SP-99 for each design and size of valve.

4.3 Pressure Test Requirements

4.3.1 Each valve and manifold shall be subjected to hydrostatic pressure test at ambient temperature for both seat and shell leakage at test pressures given in Annexure-I of this specification. During and after the hydrostatic test there shall not be any visible leakage.

4.3.2 Pneumatic Test

Each valve and manifold shall be subjected to pneumatic test for both shell and seat leakage at 7.0 kg/cm-g with testing medium as air at ambient temperature. There shall not be any visible leakage when immersed in water or coated with a leak detection solution.

4.4 Witness Inspection

4.4.1 All valves and manifolds shall be offered for pre-dispatch inspection for following, as a Minimum:

a) Physical dimensional verification and workmanship.
b) Pressure test as per clause 4.3 of this specification on representative samples.
c) Review of all certificates and test reports as indicated in clause4.2 of this specification.

4.4.2 In the event, when witness inspection is not carried out by purchaser, the tests shall anyway be completed by the vendor and documents for the same shall be submitted to purchaser for scrutiny.

5.0 SHIPPING

5.1 The threads/ends shall be protected with plastic caps to prevent damage/entry of foreign matter.

5.2 All instrument valves and manifolds in oxygen and chloride service shall be separately packed along with a certificated indicating 'CERTIFED FOR OXYGEN/CHLORINE SERVICE' as applicable

6.0 REJECTION

6.1 Vendor shall prepare their offer strictly as per this specification and shall attach only those documents and information, which is specifically- indicated in the material requisition.

6.2 Any offer not conforming to above requirements, shall be summarily rejected.

Annexure-I

HYDROSTATIC TEST PRESSURES FOR INSTRUMENT VALVES AND MANIFOLDS

Sr. No.	Item	Line Pressure Class	Minimum Cold working pressure(CWP)	Hydrostatic Test Pressure For	
				Seat leakage Test	Shell Leakage Test
1	Instrument valve (Miniature)	≤ 600#	102 kg/cm^2 g	112 kg/cm^2 g	153 kg/cm^2 g
		≥900# to ≤1500#	253 kg/ cm^2 g	278 kg/cm^2 g	383 kg/cm^2 g
2	Instrument valve (Manifolds)	≤ 600#	102 kg/cm^2 g	112 kg/cm^2 g	153 kg/cm^2 g
		≥900# to ≤1500#	253 kg/ cm^2 g	278 kg/cm^2 g	383 kg/cm^2 g
3	Instrument Air Isolation Valve		27 kg/cm^2 g	30 kg/cm^2 g	41 kg/cm^2 g
4	Instrument Air Needle Valves		27 kg/cm^2 g	30 kg/cm^2 g	41 kg/cm^2 g

GENERAL SPECIFICATION

FOR

JUNCTION BOXES AND CABLE GLANDS

CONTENTS

1.0 GENERAL

1.1 Scope

1.1.1 This standard specification, together with the data sheets attached herewith, covers the requirements for design, materials, nameplate marking, testing and shipping of junction boxes and cable glands which include the following types:

a) Electrical junction boxes
b) Pneumatic junction boxes
c) Cable glands (whenever specified)

1.1.2 The related standards referred to herein and mentioned below shall be of the latest editions prior to the purchaser's enquiry;

ANSI/ASME	American National Standards Institute *I* American Society.of Mechanical Engineers.
B 1.20.1	Pipe Threads, General Purpose (Inch).
EN 10204	Inspection Documents for Metallic Products
IEC-60079	Electrical Apparatus for Explosive Gas Atmosphere
IEC-60529	Degrees of Protection Provided by Enclosures. (IP Code)
IS-5	Colours for ready mixed paints and enamels.
IS-13947	Specification for Low Voltage Switchgear and Control gear.
IS-2148	Electrical Apparatus for Explosive Gas Atmospheres – Increased safety Enclosures ‘e'.

1.1.3 In the event of any conflict between this specification, data sheets, related standards, codes etc., the following order of priority shall govern:

a) Statutory Regulations
b) Data Sheets
c) Standard Specification
d) Codes and Standards

1.2 Bids

1.2.1 Vendor's quotation shall be strictly as per the bidding instructions to vendor attached along with the material requisition.

1.2.2 Deviation on technical requirements shall not be entertained.

1.2.3 Whenever a detailed technical offer is required, vendor's quotation shall include the following;

a) Compliance to the specifications.

b) Whenever the requirement of a detailed specification sheet for each item is specifically indicated, the specification sheet shall provide information regarding type, construction material. Size and number of cable entries etc. The material specifications and unit of

measurement for various parts in vendor's specification sheets shall be to the same standards as those indicated In purchaser's data sheets.

c) Drawing for each type of junction box with dimensional details (in millimetres) showing the terminal, entries arrangement, mounting details etc.

d) Proven references for each offered model in line with clause 1.2.4 of this specification whenever specifically indicated in purchaser's specification.

e) Copy of certificate for approval of increased safety junction boxes, adapter, plug and cable glands from local statutory authority as applicable such as Chief Controller of Explosive (CCE), Nagpur or Director General Mines Safety in India along with:

i) Test certificate from recognised testing house like CMRI/ERTL etc. as per relevant Indian Standard for all Indian manufactured items or items requiring DGMS approval.

ii) Certificate of conformity from agencies like LICE, BASEEI:.A, PTB, CSA, UL etc. for compliance to ATEX or any recognised standard for items manufactured outside India.

f) Catalogues in English giving detailed technical specifications, model decoding details and other related information for each type of junction box and cable gland covered in the bid.

1.2.4 All items, as offered, shall be field proven and should have been operating satisfactorily individually for a period of minimum 4000 hours on the bid due date in the process conditions similar to those as specified in the purchaser's data sheet. Items with proto-type design or items not meeting provenness criteria specified above shall not be offered.

1.2.5 All documentation submitted by the vendor including their drawings, installation manual etc shall be in English language only.

1.3 Drawings and Data

1.3.1 Detailed drawings, data, catalogues and manuals required from the vendor are indicated by the purchaser in vendor data requirement sheets. The required number of reproducible, prints and soft copies, shall be sent to the address mentioned, adhering to the time limits indicated.

1.3.2 Final documentation consisting of design data and installation manual submitted by the vendor after placement of purchase order shall include the following, as a minimum;

a) Specification sheet for each junction box and its accessories like cable glands etc.

b) Certified drawing sheets for each junction box and its accessories, which shall provide dimensional details, internal constructional details (general arrangement details) and material of construction.

c) Copy of type test certificates.

d) Copy of test certificates for all the tests indicated in clause 4.0 of this specification.

e) Installation procedure for junction boxes and its accessories

2.0 DESIGN AND CONSTRUCTION

2.1 Junction Boxes

2.1.1 Junction boxes shall be either of the following type as specified in data sheets.

a) Weather proof junction boxes.
b) Weather proof and increased safety junction boxes.

No other type of junction boxes shall be offered ,*/* supplied unless specifically indicated otherwise.

2.1.2 Unless otherwise specified, the enclosure shall conform to the following standards:

Weatherproof housing : IP 65 to IEC-60529/IS-13947

Housing : EEx (e) as per IEC-60079/IS-2148.

2.1.3 Number of entries and their location shall be as per data sheets. Junction boxes with top entries shall not be offered. The size of cable entries shall be as per the cable sizes indicated in the data sheet.

2.1.4 Multi-pair junction boxes shall be provided with telephone sockets and plugs for connection of hand-powered telephone set.

2.1.5 Electrical Junction Boxes

a) The material of construction of electrical junction boxes shall be SS316L of minimum 2 mm thick.

a) b) Weather proof junction box shall have hinged type door with Silicon/EPDM or better gasket, which shall be fixed to the box by plated countersunk screws. JB's should be covered with Aluminum tapes at its periphery to prevent water ingress after final commissioning.

c) Increased safety junction box shall have detachable cover, which shall be fixed to the box by means of cadmium plated triangular head/hexagonal head screws.

d) Increased safety junction boxes for signal, alarm and control shall have the following warning engraved/integrally cast on the cover; "Isolate power supply elsewhere before opening"

e) Power junction boxes (junction boxes for power supply cable / distribution) shall have either the warning cast or shall have warning plate with following marking;

"Isolate power supply elsewhere before opening".

Unless otherwise indicated in the job specification, power junction boxes shall be suitable for incoming armoured power cable up to 150 sq.mm conductor size.

f) Terminals shall be spring loaded, vibration proof, clip-on type, mounted on nickel plated steel rails complete with end cover and clamps for each row.

g) All terminals used In signal, alarm and control junction boxes shall be suitable for accepting minimum 2.5sq.mm copper conductor, in general.

h) Terminal used in power junction boxes / power supply distribution box shall be suitable for accepting conductor size of 4 Sq. mm to up to 120 sq. mm. Exact requirement shall be specified in job specification. Higher size of terminals shall be provided when indicated. Bus bar terminals shall be provided for conductor size 50 sq.mm and above. Suitable size of lugs shall be provided to suit conductor size specified.

i) Each junction shall have minimum of 30% spare terminal of those actually required to be utilised. Unless higher number of terminal are specified in the purchaser's data sheet, the number of terminals for various types of junction boxes shall be as follows;

24 Nos for 6 pair junction box.
48 Nos. for 12 pair junction box
36 Nos for 6 triad junction box.
48 Nos. for 8 triad junction box.

j) Terminals shall be identified as per the type of input signal indicated in data sheets e.g all terminals for intrinsically safe inputs shall be blue while others shall be grey in colour.

k) Junction boxes shall be provided with external earthing lugs.

l) Sizing shall be done with due consideration for accessibility and maintenance in accordance with the following guidelines;

i) 50 to 60 mm gap between terminals and sides of box parallel to terminal strip for up to 50 terminals and additional 25 mm for each additional 25 terminals.

ii) 100 to 120 mm between two terminal strips for upto 50 terminals and additional 25 mm for each additional 25 terminals.

iii) Bottom/top of terminal shall not be less than 100 mm from bottom / top of the junction box.

2.1.6 Pneumatic Junction Boxes

a) Pneumatic junction boxes shall be made of 3 mm thick hot rolled steel, They shall have necessary Silicon/EPDM or better gasket between door and body. Door shall be flush with the box and shall be hinged type and provided with wing nuts.

b) Single tube entries shall be suitable for 6 mm 0.0 copper tube with bulk head fittings. Multi tube bundle entry shall be suitable for the data furnished in data sheets.

2.1.7 Painting (if applicable)

a) Surface shall be prepared for painting. It shall be smooth and devoid of rust and scale.

b) Two coats or lead-free base primer and two final coats of lead free epoxy based paint shall be applied both for interior and exterior surfaces.

c) The colour shall be as specified in data sheets. However, following philosophy shall be

followed, in general:

(i) Light blue for all intrinsically safe junction boxes.

(ii) Light grey for all others

2.2 Cable glands, Plugs and Reducers/Adaptors

2.2.1 Cable glands shall be supplied by vendor whenever specified.

2.2.2 Cable glands shall be double compression type for use with armoured cables.

2.2.3 The cable glands shall be of SS316, as a minimum.

2.2.4 The cable glands shall be weatherproof. Whenever specified they shall also be increased safety and certificate for the specified electrical area classification specified in the data sheets.

2.2.5 Cable glands shall be supplied to suit the cable dimensions indicated along with tolerances in data sheets. Various components like rubber ring, metallic ring, metallic cone and the outer / inner nuts etc. shall be capable of adjusting to the indicated tolerances of cable dimensions.

2.2.6 Reducers / adapters shall be supplied as per details indicated in data sheets. They shall be SS316 as a minimum. These shall also be weatherproof and *I* or increased safety wherever specified and certified for the electrical area classification specified in the data sheets.

2.2.7 Plugs shall be provided as specified elsewhere.

2.2.8 Plugs shall be certified increased safety when used with increased safety junction boxes.

3.0 NAMEPLATE

3.1 Each junction box shall have an anodised aluminium nameplate permanently fixed to it at a visible place furnishing the following information;

a) Tag number as per purchaser's data sheet.
b) Manufacturer's serial number and model number.

c) Manufacturer's name *i* trade mark.

d) Stamp of certifying agency with certificate number.

e) Electrical area classification.

4.0 INSPECTION AND TESTING

4.1 Unless otherwise specified, purchaser reserves the right to test and inspect all the items at the vendor's works in line with inspection test plan for junction boxes and cable glands.

4.2 Vendor shall submit following test certificates and test reports for purchaser's review:

a) Material test certificates as per clause 2.2 of EN 10204

b) Pressure test on castings for £1ameproofjunction boxes.

c) Dimensional test report.

d) High voltage and insulation resistance test report.

e) Air leak test report on pneumatic junction boxes.

f) Certificate from statutory body for suitability to install in specified hazardous area.

4.3 Witness Inspection

4.3.1 All Junction boxes, cable glands and other accessories shall be offered for pre-dispatch inspection for the following. as a minimum:

a) Physical dimensional verification and workmanship on representative samples.

b) High voltage and Insulation resistance test on representative samples.

c) Air leak test report on representative samples of pneumatic junction boxes.

d) Review of all certificates and test reports as indicated in clause 4.2 of this specification.

4.3.2 In the event when witness inspection is not carried out by purchaser, the tests shall anyway be completed by the vendor and documents for the same shall be submitted for scrutiny of purchaser.

5.0 SHIPPING

5.1 All threaded openings shall he suitably protected to prevent entry of foreign material.

5.2 All threaded components shall be protected with plastic caps to prevent damage of threads.

6.0 REJECTION

6.1 Vendor shall prepare their offer strictly as per clause 1.2 of this specification and shall attach only those documents, which are specifically indicated in the material requisition.

6.2 Any offer not conforming to above requirements, shall be-summarily rejected.

GENERAL SPECIFICATION

FOR

PROGRAMMABLE LOGIC CONTOROLLER (PLC)

0	05.12.2016	05.12.2016	**For Tender**	**Ritu Agarwal**	**Sanjay Kr Tripathi**	**Sanjay Kr Tripathi**
REV	**REV DATE**	**EFF DATE**	**PURPOSE**	**PREPD**	**REVWD**	**APPD**

AC	:	Alternating Current
API	:	American Petroleum Institute
BIS	:	Bureau of Indian Standards
CCOE	:	Chief Controller of Explosives
CPU	:	Central Processing System
DC	:	Direct Current
DCS	:	Distributed Control System
DGMS	:	Director General of Mines Safety
DMR	:	Dual Modular Redundant
DVD	:	Digital Versatile Disc
EMI	:	Electromagnetic Interference
ERTL	:	Electronic Regional Testing Laboratory
ESD	:	Emergency Shutdown System
FAT	:	Factory Acceptance Test
FMEDA	:	Failure Modes, Effects and Diagnostic Analysis
HART	:	Highway Addressable Remote Transducer
HW	:	Hardware
HWC	:	Hardwired Console
I/O	:	Input / Output
IEC	:	International Electrotechnical Commission
IEEE	:	Institute of Electrical and Electronic Engineers
IS	:	Indian Standards
ISA	:	International Society of Automation
ISO	:	International Organization for Standardization
LAN	:	Local Area Network
LCD	:	Liquid Crystal Display
LCIE	:	Laboratorie Central Industries Electriques
LED	:	Light Emitting Diode
MTBF	:	Mean Time Between Failure
MTTR	:	Mean Time to Repair
OPC	:	OLE for Process Control(Open Platform Communication)
P&ID	:	Piping and Instrumentation Diagram
PC	:	Personal Computer
PESO	:	Petroleum and Explosives Safety Organisation
PID	:	Proportional, Integral and Derivative
PLC	:	Programmable Logic Controller
PTB	:	Physlkalisch Technische Bundersanstalt
QMR	:	Quadruple Modular Redundant
RFI	:	Radio Frequency Interference
SAT	:	Site Acceptance Test
SER	:	Sequence of Event Recorder
SIL	:	Safety Integrity Level
SIS	:	Safety Instrumented System
TCP / IP	:	Transmission Control Protocol /Internet Protocol
TFT	:	Thin Film Transistor
TMR	:	Triple Modular Redundant
TUV	:	Technische Uberwachungsvereine

UHF	:	Ultra High Frequency
UL	:	Underwriter's Laboratories
UPS	:	Uninterrupted Power Supply
VDU	:	Video Display Unit
VHF	:	Very High Frequency

Triple Modular redundant (TMR), Quadruple Modular Redundant (QMR)configuration, Flexible Modular Redundant (FMR) configuration, Virtual Modular Redundant (VMR)

1.0 GENERAL

1.1 Scope

1.1.1 This specification, together with the Material Requisition defines the minimum functional requirements for the design, hardware, software and firmware specifications, nameplate marking, testing and shipping of Programmable Logic Controllers (PLC) designed for reliable effective and optimum control and monitoring of a process plant .

1.1.2 The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the purchaser's enquiry:

APIRP 552	Transmission Systems
EEMUA 191	Alarm System -A Guide to Design, Management and Procurement
EN 10204	Metallic Products -Types of Inspection Documents
EN 50039	Electrical Apparatus for Potentially Explosive Atmospheres: Intrinsically Safe Electrical System 'I'
IEC 60079	Electrical Apparatus for Explosive Gas Atmosphere
IEC 60529	Degree of Protection Provided by Enclosures
IEC-60584	Thermocouple Part 2: Tolerances
IEC 60617	Graphical Symbols for Diagram
IEC-60751	Industrial Platinum Resistance Thermometers and Platinum Temperature Sensors
IEC 61000-4-3	Electromagnetic Compatibility (EMC) -Testing and Measurement Techniques - Radiated, Radio Frequency, Electromagnetic Field Immunity
IEC-61000-4-4	Electromagnetic Compatibility (EMC) -Testing and Measurement Techniques - Electrical Fast Transients / Bust Immunity Test
IEC-61000-4-5	Electromagnetic Compatibility (EMC) -Testing and Measurement Techniques – Surge Immunity Test
IEC-61000-6-2	Electromagnetic Compatibility (EMC) -Generic Standards -Susceptibility - Industrial
IEC 61508	Functional Safety of Electrical/Electronic / Programmable Electronic Safety-related Systems
IEC 61131	Programmable Logic Controllers
IEC 61511	Functional Safety -Safety Instrumented Systems for the Process Industry Sector

IEEE 802.3	Telecommunication and Information Exchange between Systems -Local and Metropolitan Area Networks -Specific Requirements -Part 3: Carrier Sense Multiple Access with Collisions Detection (CSMA / CD) Access Method and Physical Layer Specifications
IS 2148	Flameproof Enclosures of Electrical Apparatus
IS-3043	Code of Practice for Earthing
IS 13947	Specifications for Low Voltage Switchgears and Control Gears
ISA 5.1	Instrumentation Symbols and Identification
ISA 5.2	Binary Logic Diagrams for Process Operations
ISA 5.3	Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic and Computer System.
ISA 5.4	Instrument Loop Diagrams
ISA 5.5	Graphic Symbols for Process Displays
ISA 18.1	Annunciator Sequences and Specifications
ISA 71.01	Environmental Conditions for Process Management and Control Systems: Temperature and Humidity
ISA 71.04	Environmental Conditions for Process Measurement and control Systems: Airborne Contaminants
ANSI/ISA	Security Technologies for Industrial Automation and Control Systems TR 99.00.01 Manufacturing and Control System
ISO 216	Writing Paper and Certain Classes of Printer matter-Trimmed Sizes-A & B Series
ISO 9241-5	Workstation Layout and Postural Requirements
ISO 9241-7	Display Requirements with Reflections

1.1.3 In the event of any conflict between this specification, data sheets, statutory regulations, related standards, codes etc., the following order of priority shall govern:

a) Design Philosophy / Statutory regulations

b) Data Sheets

c) Standard Specifications

d) Codes and Standards

1.1.4 In addition to meeting purchaser's specifications in totality, vendor's extent of responsibility shall also include the following:

a) Purchaser's data sheets specify the minimum acceptable functional requirements for the programmable logic controllers. It shall be vendor's responsibility to select proper hardware, software and firmware to meet the specified functional requirements.

b) Purchaser's data sheets specify the scan time / cycle time / response time and loading requirements. Vendor shall be responsible for sizing and selecting their standard product i.e. hardware, software and firmware to meet the requirements specified in the purchaser's data sheets.

c) Selection of proper and adequate hardware, software and firmware to meet system requirements specified in the purchaser's specifications, keeping the integrity of functional blocks specified in the configuration 'diagram attached with the material requisition.

d) Adequacy of Bill of Material selected to meet purchaser's requirements. Vendor to note that bill of material shall not be verified by the purchaser during evaluation stage. Any hardware, software and firmware required to meet the purchaser's specified requirements shall be provided by the vendor without any implication.

e) Providing adequate mandatory spares including consumable spares as specified in the purchaser's specifications. Vendor shall be responsible to meet mandatory spare requirements specified by the purchaser.

1.2 Bids

1.2.1 Vendor's quotation shall be strictly as per the bidding instructions to vendor attached with the material requisition. Vendor's quotation shall enumerate and include the detailed specification of each subsystem and each module of programmable logic controller, detailed system configuration, hardware and software capabilities, programming aids, display facilities and other relevant information.

1.2.2 Whenever a detailed technical offer is required, vendor's quotation shall include the following:

a) Compliance to the specifications.

b) Detailed specification sheets for each sub-system. The specification sheet shall provide information regarding hardware specifications, software specifications, redundancy requirements, capacity, power consumption etc. of the programmable logic controllers and its accessories. The material specifications and unit of measurement for various items in vendor's specification sheets shall be to the same standards as those indicated in purchaser's data sheets.

c) System security features and design details.

d) Proven references for each offered model in line with clause 1.2.4 of this specification whenever specifically indicated in the purchaser's specifications.

e) A copy of approval for flameproof enclosure, intrinsic safety etc whenever specified, from local statutory authority, as applicable, like Petroleum and

Explosive Safety Organization (PESO) / Chief Controller of Explosives (CCOE), Nagpur or Director General of Mines Safety (DGMS) in India along with:

i) Test certificate from recognized house CIMFR (Central Institute of Mines & Fuel Research) / ERTL (Electronics Research and Test Laboratory) etc. for specified protection class as per relevant Indian Standard for all Indian manufactured equipments or for equipments requiring DGMS approval.

ii) Certificate of conformity from agencies like LCIE, Baseefa, PTB, CSA, UL etc., for compliance to ATEX or other recognized standards for all equipments manufactured outside India.

f) Deviations on technical requirements shall not be entertained. In case vendor has any valid technical reason to deviate from the specified requirement, they must include a list of deviations item wise, summing up all the deviations from the purchaser's data sheets and other technical specification along with the technical reasons for each of these deviations.

g) Catalogues giving detailed technical specifications, model decoding details and other related information for each item / sub-system covered in the bid.

1.2.3 Vendor shall offer only their standard proven product i.e. system hardware, system software and firmware, which shall be configured to meet the functional requirements specified in the material requisition. Moreover, the equipment being offered / supplied shall be of latest proven version available in the current manufacturing range and meeting the requirements specified in clause 1.2.4 of this standard specification.

1.2.4 The system hardware, software and firmware as offered, shall be field proven and should have been completed trouble free satisfactory operation for a period of minimum 4000 hours on the bid due date in the similar application with equal or higher than the proposed system size with respect to number of inputs and outputs specified in the purchaser's data sheet. Items with prototype design or items not meeting proneness criteria specified above shall not be offered or supplied.

1.2.5 The detailed scope of work, specific job requirements, exclusions, deviations, additions etc. shall be indicated in the job specifications which shall be part of material requisition.

1.2.6 Whenever specified, vendor shall furnish tested values of failure rates, probability of failure on demand and test intervals for safety integrity level analysis.

1.2.7 All documentation submitted by the vendor including their quotation, catalogues, drawings, installation, operation and maintenance manuals shall be in English language only.

1.2.8 Vendor shall also quote for the following:

a) Two year's operational spares for each sub-system and their accessories which shall include the following as a minimum:

i) All type of electronic modules e.g. I/O modules, processor modules, communication modules, memory modules, disc controller module, power

supply modules etc.

ii) All type of auxiliary items e.g. barriers / isolators, hardwired instruments, annunciator modules, receiver switches, trip amplifiers, temperature element converters etc.

iii) Switches, lamps, fuses, connectors, terminals, pre-fabricated cables, circuit breakers, relays etc.

iv) Video display units, keyboards, disc drives, PC's, network items (e.g. switches, hubs etc.) etc. \

b) Any special tools and test equipments needed for the maintenance of PLCs and other items being offered by vendor. Vendor must confirm in their offer if no special tools or test equipments are needed for maintenance other than those specifically indicated in purchaser's data sheet.

1.3 Drawing and Data

1.3.1 Detailed drawings, data, catalogues and manuals required from thy vendor are indicated by the purchaser in vendor data requirement sheets. The required number of prints and soft copies shall be dispatched to the address mentioned, adhering to the time limits indicated.

1.3.2 Final documentation consisting of design manuals, installation manual, operation and maintenance manual etc., submitted by the vendor after placement of purchase order shall include the following, as a minimum:

a) Specification sheet for each sub-system, auxiliary instrument and bought out item.

b) Certified drawings for complete system including the following:

i) GA drawings for panels, cabinets, marshalling racks, hardwired consoles, operator console, programming terminal etc with complete dimensional details, internal construction and weight in kilograms.

ii) Control room layouts e.g. console room, rack room and engineering room layout with all dimensions in millimetres.

iii) Channel base frame drawing for console room, rack room and engineering room.

iv) Input / output assignment.

v) Logic / Ladder diagrams.

vi) Loop wiring diagram.

vii) Power supply distribution diagram.

viii) Memory loading calculations/Scan time calculation.

ix) Protocol/Pin Details.

x) Dynamic graphic diagrams.

xi) System grounding drawing.

c) Design manuals and functional design specifications which shall include hardware design manual, software design manual and special software specifications.

d) Copy of type test certificates.

e) Copy of test certificates for all tests indicated in this specification.

f) Installation manual containing installation procedure for programmable logic controllers and other items covered in the material requisition.

g) Power-on, start-up and internal testing procedures.

h) Software debugging and system configuration procedures.

i) Calibration and maintenance manual containing maintenance procedures including replacement of parts, application modification etc.

j) Any other drawings and documents specifically indicated in job vendor data requirement enclosed with the material requisition.

All system manuals and documentation shall be supplied in hard dover loose ring folders in 'A4' size as per ISO 216 i.e. of size 210mm x 297mm. All drawings and sketches shall be in multiple of'A4' size like 'A3' (297mm x 420mm) or 'A2' type (420mm x 594mm) etc. but folded to 'A4' size.

2.0 DEFINITIONS

The various terms used in this specification are defined as follows:

2.1 Programmable Logic Controller

The class of control systems which can be programmed to execute plant shutdown and / or interlock / sequence logics to the specified safety integrity levels.

2.2 Accessible

A system feature that is viewable by and interactive with the operator and allows the operator to perform user permissible control action e.g. set point change, auto-manual transfers or on-off actions.

2.3 Assignable

A system feature that permits an operator to direct a signal from one device to another without the need for change in wiring, either by means of switches or via other data entry devices like keyboard commands to the system.

2.4 Configurable

The capability to select and connect standard hardware modules to create a system or the capability to change functionality or sizing of software functions by changing parameters without having to modify or regenerate software.

2.5 I/O

Input / Output with respect to process / operator

2.6 PLC Console (Operator)

PLC console (Operator) is the operator's main plant interface device through which operator can view, monitor and control the plant and can give instructions to peripherals to execute commands, and shall have protective access to configure and maintain the system.

2.7 **PLC Console (Programming Terminal)**

PLC console (Programming Terminal) shall be the engineer's main interface device through which engineer can configure / program and maintain the system, and shall have protective access to monitor and control the plant, give instructions to peripherals to execute commands.

2.8 Local Level

All those sub-systems;' which directly interface with field devices shall be referred to as local level.

2.9 Central Level

Operator Console and Programming Terminal, which present data acquired from local level devices shall be referred as Central Level.

2.10 Database

Database shall be defined as the information stored temporarily or permanently in the system which can be accessed by various programs to meet all its functional requirements.

2.11 Loop Integrity

A system shall be said to have loop integrity if the failure of one component in the system/ sub-system does not affect more than one loop.

2.12 System Loading

System loading for a sub-system is defined as the percentage of time a sub-system spends in carrying out various activities referred to the use of memory, CPU time and communication capacity in the worst case of high sub-system operation out of the designed / designated cycle time of the sub-system.

2.13 Redundancy

A system component shall be termed as redundant if it takes over automatically the operation in the event of the failure of the main component without causing any interruption in the system and upsetting the process. The repaired or replaced device shall be brought in-line only through operator action without upsetting system operation.

2.14 Switchover Time

Time required for a back up instrument / system to come on-line automatically in case of the failure of the main instrument / system.

2.15 Processor Cycle Time (tpc)

Processor cycle time is the measure of the processing speed of a processor. Processor cycle time for a sub-system ofthe programmable logic controller shall be defined as follows:

Processor cycle time for programmable logic controller shall be defined as the total time taken by the processor to read input supplied by input module, execute all computations (analog as well as logic as configured) and write the outputs for the output module.

2.16 Scan Time (ts)

Scan time of a logic loops is the end-to-end response time of a sub-system and shall be defined as follows:

The scan time for a logic loop shall be defined as the total time taken by a sub-system e.g. programmable logic controller to read input from the input terminal, process input, execute logic, updating logic output and write output at the output terminal for all the logics configured within the subsystem.

2.17 User's Memory

Free memory space available after utilization of memory required for system operation, configuration and implementation of application and other system related functions for implementation of user defined specific programs such as plant calculations, process optimization or MIS (like free formatting of certain logs). The programs shall either be written in high level language or system specific language.

2.18 Event

An event shall be defined as any action taken by the operator via operator keyboard or switches on hardwired console like change of set point, change of control mode, start/stop of motor, open/close of shut down valves, alarm acknowledge etc.

2.19 Sequence of Event (SOE)

Arranging events in the sequence of their occurrence in time with a specified time resolution by a program is defined as sequence of event.

2.20 Sequence of Event Recorder (SER)

System or sub-system which presents and / or records the events in the sequence of their

occurrence in time with a specified time resolution utilizing its hardware and software capabilities is termed as sequence of event recorder.

2.21 Real Time Trend

Real time trend shall be defined as a continuously progressing graphical record showing updated parameter with most recent value and a past record of minimum of 10 minutes without pressing any additional key for moving backward in time.

2.22 Plant Information Network

High-level communication network which serves various users within a plant and transfer information for the purpose of unit / plant monitoring. This network is different than control network and is generally realised using open communication protocol network e.g. OPC etc.

2.23 Tag

A Tag is a collection of attributes that specify either a control loop or a process variable, or a measured input, or a calculated value, or some combination of these, and all associated control and output algorithms. Each tag is unique.

3.0 SPARES PHILOSOPHY

3.1 The system including sequence of event recorder, hardwired instruments etc. shall meet the following spare philosophy. This philosophy shall also be applicable for items like barriers, relays, terminals, lamps, push buttons etc.

3.1.1 Mandatory Spares

Vendor shall include following mandatory spares in their scope of supply:

3.1.1.1 Installed Engineering Spares

Installed engineering spares shall be provided in each sub-system for each type of module to enhance the specified" system functional requirements by 20%. The basis of offering installed engineering spares shall include:

a) For a system with conventional and / or smart analog input / output, discrete (contact) input / output, 20% spare input / output of each type shall be considered for calculating I/O modules and all other related accessories.

b) For all serial input / outputs to the system, 20% spare serial\I/O ports ofeach type of serial input / output shall be provided.

c) 20% spare accessories like relays, switches, lamps, fuses, circuit breakers, barriers, isolators, terminals etc.

d) The engineering spares shall be wired up to the field cable interface and shall be in ready-to-operate condition when field cable is connected to spare assigned terminals.

e) Spare pairs of the incoming cables shall be terminated on spare terminals in the marshalling / barrier cabinets as applicable.

f) The system shall be fully engineered considering 20% installed engineering spares including processor loading.

3.1.1.2 Spare Space Requirement

In addition to installed engineering spares specified in Clause 3.1.1.1 of this specification, the system shall be provided with following spare space:

a) I/O racks of programmable logic controller shall have 10% usable spare space for installing additional I/O cards of each type in future. However internal wiring for the same shall be connected up to the I/O terminals.

b) Processor system of programmable logic controller shall have capability to execute additional 20% logics.

c) Each operator console shall contain 20% usable spare group and related display capability in addition to as specified in para 3.1.1.1 of this specification.

d) The system shall have capability to extend its historical trending, logging and user's memory by 20% to meet future expansion with/without adding additional memory modules.

e) The communication sub-system shall have sufficient capacity to handle additional data contributed by addition of 20% I/O over and above installed engineering spares.

f) Usable spare space in panels and cabinets to install 10% spare hardwired items like relays, switches, lamps, fuses, circuit breakers, barriers, isolators, terminals, panel mounted instrument etc. in future.

3.1.1.3 Spare Memory Requirement

a) The system shall be provided with a minimum of 40% spare memory capacity, as required for application program and data base to meet specified functional requirements.

b) It shall be possible to extend the memory by at least 20% over and above the actual requirement at a later date.

3.1.1.4 Spare Software Capability

a) Sufficient additional software capacity shall be available in the system to take care of spares requirement as specified in para 3.1.1.1 and 3.1.1.2 of this specification to meet all functional requirements as per para 4.0 of this specification.

b) Unless specifically indicated otherwise, the offered system shall have software licenses to cover all the tag numbers indicated in the material requisition, including installed engineering spares and spare space indicated in clause 3.1.1.1 and

3.1.1.2 of this specification.

3.1.1.5 Predefined Mandatory Spares

a) Mandatory spares shall be ware-house spares and shall be supplied as loose items.

b) Mandatory spare module of 5% or one module of each type, whichever is higher, must be supplied for each type of modules being used excluding modules used in consoles, servers, Personal Computers.

c) For items like, Video Display Units, keyboards, disc drives, network components, hardwired instruments like barriers, lamps, fuses and circuit breakers, complete item limited to 5% or minimum one of each type shall be supplied' as predefined mandatory spare. But this shall not include hardware like hard discs, terminals.

3.1.1.6 Consumable Spares

Any paper, ribbon, printer heads, toner and ink required for printers, video copier or any other consumable item shall be supplied along with system required for minimum of six months duration after system acceptance.

3.1.1.7 Commissioning Spares

Unless otherwise specified, vendor shall be responsible to supply all spares which are found necessary to replace failed modules, failed sub-systems, or corrupted / faulty softwares while performing pre-commissioning and commissioning activities.

3.1.2 Two Years Operational Spares

Two years operational spares shall be as per Clause 1.2.8(a) of this specification and shall be quoted separately.

4.0 DESIGN AND CONSTRUCTION

4.1 Design Requirements

4.1.1 Programmable logic controller shall be microprocessor based system which shall be used to execute all the process and safety shut-down logic of the plant. When specified, it shall also execute plant interlock logics and sequence operation. Programmable logic controller shall be an independent unit and shall not depend on any of its functionality on any other system including Distributed Control System.

4.1.2 The system shall be of modular construction and expandable in future by adding additional modules which shall be easily accessible for maintenance and repair. The type of modules shall be kept to the minimum possible in order to have interchangeability and low inventory.

4.1.3 System Availability

a) The system shall be designed 'fault avoidant' as a minimum by selecting high grade components of proven quality and proper design of system electronics.

Redundancy shall be provided, as a minimum, as per this specification to improve system availability and reliability. Due considerations shall be given to the environmental conditions particularly for field mounted sub-system, if specified in job specifications, during system design.

b) The system shall have a high MTBF value and shall have well proven record of operating in hydrocarbon plants.

c) The system shall be designed with 99.995% or greater availability. The availability shall be defined as follows:

$$\text{Availability} = \frac{\text{Mean Time Between Failure (MTBF)}}{\text{MTBF + Mean time to repair (MTTR)}}$$

For the purpose of calculations, consider mean time to repairs as four (4) hours unless the manufacturer recommends higher value for MTTR. It is therefore necessary that:

i) Vendor covers all necessary spare parts in 2 years recommended operational spares which shall be necessary to meet specified MTTR time.

ii) Vendor provides adequate training to owner's personnel and cover all necessary maintenance related topics in their training programmes to ensure specified MTTR time.

4.1.4 Operating Environmental Conditions

4.1.4.1 Environmentally Controlled Location Installation

a) All subsystem of Programmable Logic Controllers located in Control Room, Local Control Room or in Satellite Rack Room shall be able to operate satisfactorily from 15°C to 30°C and 20% to 80% non condensing humidity.

b) In addition to above, all such sub-systems shall also be able to operate satisfactorily in case of air conditioning failure with ambient temperature of 50°C and 90% no condensing humidity until the system safe operating limits are exceeded. The minimum period of continuous operation in such condition shall be 48 hours at least once in a month without any damage or degradation of system performance. Vendor, therefore, shall provide continuous temperature monitoring for each enclosed cabinet housing items / equipments generating heat, such as system cabinets, barrier cabinets, relay cabinets etc and also provide alarm for operator alert in case the safe operating temperature limits are exceeded.

c) Chemical filters have been provided in the incoming air conditioning air to limit the concentration of contaminants below following limits:

Contaminants (Corrosive Gases)	Concentration
SOx	< 0.01 ppm by volume

NOx	< 0.05 ppm by volume
H2S	< 0.003 ppm by volume
Cb	< 0.001 ppm by volume
NH3	< 0.5 ppm by volume
SPM	< 200 ugm/m3
RSPM	< 100 ugm/m3

All sub-systems and system components shall be suitable for operating continuously in the above mentioned corrosive environments

4.1.4.2 Outdoor Installations

a) Sub-systems or system components which are installed outdoor shall be suitable to continuously operate at ambient temperature and humidity specified under ambient conditions. The heat generation effect of current carrying for the electronic modules shall also be considered. For this purpose the system shall be\rated for minimum 5 deg C more than the maximum ambient temperature specified. In case the system is not suitable for the above conditions, necessary cooling arrangement shall be provided.

b) Unless otherwise specified, all PLC sub-systems or system components installed outdoor shall have corrosive environmental protection coating meeting the environmental classification class G3 as per ISA-S71.04.

4.1.5 Transient, Static and EMI / RFI Protection

4.1.5.1 The system shall be internally protected against system errors and hardware damage resulting from:

a) Electrical transients on power wiring.

b) Electrical transients on signal wiring.

c) Connecting and disconnecting devices or removing or inserting printed circuit boards in the Programmable Logic Controller (PLC).

4.1.5.2 All sub-systems and system components shall be capable of accepting various signal inputs for its direct use while preventing noise errors due to electromagnetic interference (EMI) or radio frequency interference (RFI) including nearby radio stations, hand held two way radios, solenoids, relays or contactors carrying heavy currents as per levels of Environmental electromagnetic phenomenon defined in IEC-61000-6-2. The system shall have total noise immunity from UHF / VHF radio communication equipments, (RFI) and (EMI) noise generating equipments as per IEC-61000-4.

4.1.5.3 For interplant, inter unit and other system cables routed in the field, the level of surge

immunity required for equipment signal ports shall be increased to level 4 as defined in IEC-61000-4-5 and the system shall operate according to performance criterion B as defined in IEC-61000-6-2.

4.1.6 On-line Replacement

4.1.6.1 On-line replacement of any module of programmable logic controller shall be possible in such a way that removal and addition of the module shall be possible and safe without de-energising the system. Furthermore, there shall not be any interruption of the system while replacing a faulty module wherever redundant modules are provided.

4.1.6.2 Apart from system modules, power supply units shall be replaceable on-line without disrupting the process and without affecting the system redundancies. It shall be possible to hot swap any faulty system module without degrading the system safety or operation or freezing the output status. The switchover to the healthy module shall be bumpless. The swapped module shall take over the function of the failed module without any manual programming.

4.1.7 Electrical Isolation

Galvanic or optical isolation shall be provided for all field signals. The isolation levels shall be as follows:

Analog I/O channel to system ground 1500V AC

Discrete I/O channel to system ground 500V AC

External isolator shall be provided, if necessary to meet the above.

Isolation shall also be provided between Engineering / operator cbnsole/PLC programming terminal and related sub-systems connected to it if there is any possibility of high voltage being transmitted to the sub-systems.

4.1.8 Design Requirements of Equipments in Hazardous Area

4.1.8.1 Unless specifically indicated, the field devices are beyond the scope of this specification. However vendor shall be fully responsible for integrating these devices with their system.

4.1.8.2 General requirements

a) Unless otherwise specified, all instruments in hazardous area shall be intrinsically safe type. Other concepts shall be used when specified.

b) For conventional instrumentation, entity concept shall be used for selecting proper barriers / isolators.

4.1.9 Repeat Signals

4.1.9.1 Unless otherwise specified in the job specifications, following philosophy shall be followed for repeat signals:

a) Whenever repeat contact outputs are required as per job specifications following philosophy shall be followed:

i) For intrinsically safe input contacts, isolating barrier with dual contact output shall be utilized.

ii) For all other contact inputs, repeat contact shall be provided using electro-magnetic relays.

4.1.10 The system shall be designed fault tolerant and shall utilize high quality components of proven quality. Any single system fault shall not degrade the system safety or functionality or affect operation. The system shall have certified Safety Integrity Level as per IEC61508/ 61511 as applicable and specified in job specification. Unless otherwise specified, it shall meet the availability requirement specified in Clause 4.1.3 ofthis specification.

4.1.11 Unless otherwise specified, the scan time of programmable controller shall be of the order of 250 milliseconds for PLCs. Scan time for a PLC shall be as defined under para 2.16 of this specification.

4.1.12 Operation of the PLC shall be completely unaffected by a momentary power loss of the order of 20 milliseconds.

1.1.13 The system shall be programmed in principle as per the logic diagrams furnished during detailed engineering. Vendor shall prepare their own Logic/Ladder diagrams depending upon the capability of the programmable logic controller offered by them. Owner / Consultant reserve the right to revise or review the logic diagrams even after acceptance of any offer. The programming language of offered PLC shall be as per IEC 61131.

1.1.14 Whenever the requirement of SIL is specified for the PLC, it shall meet the requirements of SIL level specified and shall be certified by an independent body (e.g. TUV) for complying requirements of IEC-61508 / 61511 as specified.

1.1.15 The system shall have extensive set of self diagnostics hardware and software for easy and fast maintenance of PLC. Routine checks should run automatically at frequent intervals for identifying any fault in software or hardware. Diagnostics shall be required at local as well as console level. \

1.1.16 Safety barriers shall be provided by the vendor for intrinsically safe input/output circuits wherever specified. In such cases, the system shall be designed intrinsically safe based on entity concept. The barriers shall be certified by a statutory authority like Baseefa, LCIE, CSA, UL, PTB, CIMFR etc., for the use in the area classification as specified elsewhere in the job specifications. The proper selection of the safety barriers shall be the vendor's total responsibility. In case of smart transmitter, the entity parameters of the hand held terminals shall also be considered while selecting proper barriers.

1.1.17 Unless otherwise specified all intrinsically safe barriers shall be 3 port isolating type only providing isolation between;

i) Input and output (non-hazardous to hazardous side of barriers)

ii) Power supply and input

iii) Power supply and output

The minimum isolation level shall be 250V.

4.2 System Configuration

4.2.1 General

a) PLC system configuration / architecture shall be as specified in the job specification. For emergency shutdown system application the system configuration shall be TMR or QMR or DMR or VMR as per the job specification and shall be certified by independent agency e.g. TUV.

b) Regardless of the action feature selected (except for single architecture), the failure of single component shall not result in a failure of correctly executed safety function.

c) In general, the PLC system shall comprise of various sub-systems as described in the subsequent clauses of 4.2.

4.2.2 Input/ Output Subsystem

4.2.2.1 Each I/O module shall have its own processor. I/O modules configured m redundant configuration, shall have their processors properly synchronised.

4.2.2.2 Unless otherwise specified, system shall accept analog 4 -20mA inputs and contact inputs. The maximum number of Input/Output per I/O module shall be limited as per the following table.

Sl No.	Type of Configuration	Maximum No. I/O s
1	Single I/O system	8
2	Dual I/O system	16
3	Triple Modular Redundant system (TMR)	32
4	Quadruple Modular redundant System (QMR), Flexible Modular Redundant (FMR) configuration, Virtual Modular Redundant (VMR)	16

4.2.2.3 Each I/O shall be galvanically isolated from external control circuit by suitable means. The minimum isolation level between I/O and logic circuit shall be 1000 volts DC.

4.2.2.4 Each I/O shall be protected against the reversal of polarity of the power voltage to I/O.

4.2.2.5 Each input shall be provided with filters to filter out any noise in the input line and contact bouncing noise, as applicable.

2.2.2.6 All the inputs / outputs shall be double ended i.e. two wires per input / output and not with common return for all inputs.

4.2.2.7 The interrogation voltage to the inputs and power supply for 2-wire instruments shall be powered from separate redundant power supply / supplies and shall not be a part of PLC, unless otherwise specified. This power supply shall be supplied at one point and shall be distributed by the vendor.

4.2.2.8

a) Each module shall have a LED per channel to indicate the status of each input output.

b) When specified, input module shall be capable of monitoring the input contacts for any wire open fault and short circuit.

4.2.2.9 Analog Input Module

a) Input module shall be able to accept 4~20 rnA DC input from smart transmitters (e.g. 4 -20mA HART).

b) The module shall have 12 bit Analog to Digital resolution accuracy of ±0.2S% of full scale over the entire range, unless otherwise specified.

4.2.2.10

a) Output contacts from the PLC shall be potential free dry contacts with contact rating as per para 4.2.2.10 b) of this specification. Vendor must provide arc suppression device for each output contact.

b) The output contact rating shall be as follows:

SL.No.	APPLICABLE FOR	VOLTAGE RATING	CURRENT RATING
1	All output cards driving solenoid valve and alarm annunciator system unless otherwise specified Category -I Category -II	 **110 V DC** **24VDC**	 0.5 A 2A
2	All motors/pumps/compressor output cards unless otherwise specified. Category –I Category -II	 **240 V AC** **220 V DC**	 5.0A 0.2 A

c) The category of contacts shall be specified in the material requisition. Each output shall be short circuit proof and protected by fuse. Visual indication of fuse blown must be provided for each module.

d) When specified contact output module shall have monitored\ output features like wire open and short circuit.

4.2.2.11 Where inputs or outputs have multiple field devices for the same measurement or device, the corresponding inputs / outputs shall be configured in separate I/O modules.

4.2.2.12 Where single input signal is available for QMR or TMR or FMR or VMR configuration, inputs shall be multiplied to feed inputs to each input modules / channels.

4.2.2.13 PLC shall be provided with Auto I/O testing facility as a standard diagnostics features. PLCs which do not have auto I/O testing facility, manual testing facility shall be provided to detect any system fault. For manual testing, manual switches shall be provided to bypass each input at a time and its effect on the output shall be monitored.

4.2.3 Processor System

4.2.3.1 The processor shall have capability to implement all the control functions required to implement the logic scheme as logic/ladder diagram.

4.2.3.2 The size of the memory shall be sufficient for storage of the program instructions required by the logic schemes and other functional requirements. Offer shall indicate the amount of memory capacity occupied by the actual program and spare capacity available for future program modifications or additions.

4.2.3.3 Memory shall be non-volatile. However in case volatile memory is provided, battery backup shall be provided with a minimum of 3 months lifetime to keep the program storage intact. A battery drain indication shall be provided at least one week before the battery gets drained.

4.2.3.4 Watchdog timer shall be a software device. The healthiness of processors shall be continuously monitored by watchdog timer. Any hardware or software problem in the processor system, which shall include, CPU, memory, power supply, communication interface etc. shall cause the watch dog timer to report processor failure.

4.2.3.5 Wherever dual redundant processor is specified, redundancy shall be provided in such a way that in case of failure of the main processor, the standby shall take over automatically. The changeover shall be bump less. Redundancy shall be provided for complete processor system including processor, power supply and communication sub system.

4.2.3.6 In case of triple modular redundant system all the three processors shall execute the same instructions/program and check their results and vote to correct any faulty result. The faulty processor diagnostic shall be made available.

4.2.3.7 In case of QMR system, individual processor shall execute the same instructions/ programs and check their results within same CPU module and majority vote to correct any faulty result. The faulty processor diagnostic shall be made available.

4.2.3.8 Failure of a single processor in dual redundant, triple redundant system and two processors in QMR system shall not affect the system. In case of failure of complete processor system

i.e. both processors in case of dual configuration, two or more in case of triple redundant

system and more thah two in case of QMR system, outputs shall take failsafe state automatically unless otherwise specified in the data sheets.

4.2.3.10 It shall be possible to generate the first out alarm contact by the PLC in case where a group of parameters are likely to trip a system.

4.2.4 PLC Console (Programming Terminal)

4.2.4.10 The PLC console (Programming Terminal) shall be used for programming, program storing, fault diagnostics and alarm monitoring. Whenever specified, it shall also be possible to use this console for plant operation. The functionality to operate as engineering / programming terminal or operator terminal or both shall be as specified in the job specification.

4.2.4.2 It shall consist of at least one coloured 22" LED monitor with TFT technology and one programming / operating keyboard, mouse and printer unless specified otherwise.

4.2.4.3 PLC console when used for plant operation shall also meet the functional requirements as per clause 4.2.5 of this specification

4.2.4.4 The keyboard shall preferably be touch sensitive sealed type, easy to operate with each key clearly identified.

4.2.4.5 All illegal entries shall be rejected by the terminal and shall be identified by warning signal on VDU.

4.2.4.6 Manual forcing of any input or output contact connected to PLC shall be possible from keyboard. Forced functions shall have an associated audit trail.

4.2.4.7 It shall be possible to modify, add or delete the application program on line without affecting the outputs.

4.2.4.8 PLC Console shall display logic and/or ladder diagram indicating power flow and shall show description and status of each contact. It shall also be possible to display process alarms and diagnostic messages as and when they appear. Further it shall also be able to display I/O map in a user defined format.

4.2.4.9 I t shall be possible to print out the ladder/logic diagram on the dedicated PLC printer. The printer in addition shall also print out:

a) The diagnostic messages as and when generated and diagnostic reports, when called for.

b) Process alarms connected to the programmable logic controller as and when they appear and alarm report whenever initiated. The choice of printing alarms on this printer shall be operator selectable from a key lock / password protected switch on PLC console.

c) The I/O maps showing status of all inputs and corresponding outputs in a user defined format.

4.2.4.10 The PLC console shall be provided with self diagnostics feature which shall display error

messages and initiate an audible alarm if the fault is detected. Wherever specified, a potential free contact for diagnostic group alarm shall be provided which shall be connected to the hardwired alarm 'annunciator system.

4.2.4.11 The system shall be able to identify the failure at least up to the module level including I/O system and redundant processor and report print out.

4.2.5 PLC Console (Operator)

4.2.5.1 Where dedicated PLC operator console is specified, it shall be used for operation of plant, fault diagnostics, alarm monitoring and report generation.

4.2.5.2 It shall consist of colored 22" LED monitor with TFT technology, operator keyboard and printer unless specified otherwise.

4.2.5.3 At least two number cursor control devices shall be provided in addition to keyboard which may include touch screen, mouse, track ball etc.

4.2.5.4 PLC operator console shall have complete graphic capability and shall be able to display process dynamic graphics, overview and group view displays. It shall be possible to operate the plant i.e. start and stop of rotating machinery, opening and closing of valves, Pill function etc. from dynamic graphics and group displays available on PLC operator console.

4.2.5.5 It shall be possible to monitor, historise and print out all process alarms, diagnostic alarms and alarm reports.

4.2.5.6 Unless otherwise specified, the time stamping of all alarms shall be as per PLC processor time stamping.

4.2.5.7 The system shall be able to store and display stored data wherever required. The minimum storage capacity shall be for 30 days at 1 minute sample rate for all the inputs specified, diagnostic alarms, process and first out alarms, manipulation data etc.

4.2.5.8 The system shall be able to generate shiftly, hourly, daily, weekly and monthly reports. The log format shall be furnished during detailed engineering.

4.2.5.9 The system shall be supplied with first out alarm generation capability. The resolution of alarm shall be as per processor cycle time, as a minimum.

4.2.6 Communication Subsystem

4.2.6.1 The PLC communication subsystem shall be a digital communication bus that provides a high speed data transfer rapidly and reliably between the processor, I/O sub-system, PLC console and other devices connected in the PLC system.

4.2.6.2 Redundancy in PLC communication subsystem shall be provided as follows unless otherwise specified:

a) For single architecture, the communication subsystem between PLC processor and I/O subsystem shall be single unless otherwise specified. This shall include single communication bus and single interfaces/buffers.

b) For dual I/O configuration, each I/O sub set shall have separate communication interface and bus for connecting to PLC processors.

c) For the triple redundant system, each processor shall have a separate set of PLC communication subsystem.

d) For the QMR systems each I/O subset shall have separate communication interface and bus for connecting to respective CPU module.

e) The communication subsystem between processor subsystem and PLC console shall be dual redundant, consisting of two separate communication interfaces and two buses, each one configured in redundant mode, unless this is only used as programming aid.

4.2.6.3 In case of redundant PLC communication sub system, on the failure of the active device, the redundant device shall take over automatically without interrupting the system operation. Information about the failed device shall be displayed at local as well as on PLC console. It shall be possible to manually switch over the communication from main bus / device to redundant bus / device without interrupting any system function.

4.2.6.4 The mechanism used by the system for error checks and control shall be transparent to the application information / program. Error checking shall be done on all data transfers by suitable codes.

4.2.6.5 In general, PLC shall provide data m a well established protocol format preferably MODBUS protocol.

4.2.7 System Power Supplies

4.2.7.1 Unless specified otherwise, the programmable logic controller shall operate on uninterrupted power supply (UPS). However the system shall be capable of operating satisfactorily at the following power supply specifications:

Voltage	220 V ±10%
Frequency	50 Hz±3 Hz
Harmonic contents less than	5%
Power interruption	10 millisec

4.2.7.2 The power supply system shall be supplied with dual PLC feeders each capable of handling 100% of the total power supply load requirements. In case of failure of one feeder, redundant feeder shall supply the total load.

4.2.7.3 Each I/O rack shall be provided with separate power supply unless otherwise specified in job specifications. Each power supply shall be sized to take full load of the I/O rack/signal conditioning panel. Each rack shall be provided with dual redundant power supply.

4.2.7.4 Processor subsystem shall be provided with separate power supply, as a minimum, unless otherwise specified in job specification. Failure of one power supply shall not affect the

system operation/processor switchover in case of dual processor system. Wherever triple redundant system is specified each processor shall preferably be provided with a separate power supply. Also separate power supply must be provided for each multiplied process I/O channel.

4.2.8 Self Diagnostics

4.2.8.1 The system shall have an extensive set of self diagnostic routines which shall be able to identify all permanent and transient system faults / failures at least up to module level including redundant components and power supplies through detailed VDU displays and report print out.

4.2.8.2 At the local level, failure of a module in any subsystem shall be identified by an individual LED.

4.2.8.3 Diagnostic software shall have the capability to provide information about the failed module/system either in the form of a system configuration display or provide information in the form of a "statement".

4.2.8.4 Self diagnostic software shall have capability to detect faults which make the system permanently close/open in the I/O modules or I/O signal conditioning modules (in case of triple redundant system, whenever specified in the job specifications, this may be achieved by automatically running the testing software at cyclic intervals), The automatic cyclic testing feature shall also be provided for dual I/O configuration and dual I/O signal conditioning for triple redundant system. The testing software cycle time may be considered once in 30 minutes however this shall be field adjustable by engineer. However, system performance shall not be degraded whenever testing feature is specified.

4.2.8.5 System for the following functionalities shall be supplied when specified:

a) Long storage historisation

b) Log report generation

c) First out alarm generation

4.2.8.6 System diagnostics shall be capable of identifying, locating and reporting the following faults, as a minimum:

a) Processor fault

b) Communication fault

c) I/O module fault

d) Power supply fault

e) Over temperature monitoring

f) Permanently close / open (stuck on or off) fault

g) Memory fault

h) Signal redundancy fault

Any other additional diagnostic alarm if available as a standard shall also be provided by vendor.

4.2.8.7 Testing software shall be capable of detecting faults in case of normally closed system as well as in normally open system.

4.2.8.8 Feedback must be provided in case of triple redundant system and QMR system from the output voter system to detect any latest faults of the system in addition to other diagnostic software.

4.2.9 System Software

4.2.9.1 The system software shall include all programs for the PLC and PLC console which are required to perform all the PLC functions including communication and self-diagnostics. Whenever PLC is specified for shutdown application, the system shall be designed and engineered in full compliance with the requirement of IEC-61511. Whenever different functional logics are combined within a common PLC, the safety related I/O's of each functionality shall be kept segregated within the system.

4.2.9.2 Logic program shall also be recorded on the external most reliable electronic media like DVD which shall be delivered in triplicate together with the system.

4.2.9.3 The PLC programming language for implementation of logic operations shall be based on the following representations:

a) Logic diagrams -Binary logic symbols such as AND, OR, NOT Gates, Timers and Flip-Flops.

b) Ladder diagram -Series / parallel connection of relay contacts.

c) Combination of (a) & (b) above.

4.2.9.4 Diagnostic package and its related equipment and software shall be supplied. A list of additional diagnostic packages available and the packages provided, including the description and capabilities, shall be provided with separate quote, wherever asked.

4.2.9.5 It shall be possible to print out the ladder/logic diagram on a dedicated printer. The printer shall also print out all diagnostic reports. Vendor must supply the off line software package to enable the owner to modify/add/delete any part of program and for documentation.

4.2.9.6 Software for the generation of various displays including dynamic graphics wherever specified to be provided as per given below:

4.2.9.6.1 It shall be possible to display dynamic graphic of plant on the operator console VDU screens. Graphic displays shall be field configurable only through PLC Console (Programming terminal) with standard / user defined graphic symbols. Dynamic graphic displays of different sections of the plant shall be displayed on different pages.

4.2.9.6.2 The system shall have graphic symbol library as per ISA-5.! and 5.3. In addition standard industrial symbols like distillation columns, heat exchangers, pumps, compressors, tanks etc. shall also provided as a standard.

4.2.9.6.3 Graphic displays shall be interactive type through which it shall be possible to control the process. It shall also be possible to send motor start/stop and shutdown valve open/close commands, as specified in job specifications, from this display

4.2.9.6.4 It shall be possible to view the process variable and alarm points and view and change set point value, manipulated variable, controller mode etc. from the graphic display. Also rotating machinery (i.e. compressor / pump) status and valve status shall be displayed on the graphic display with different colours

4.2.9.6.5 Various colours used in the generation of graphics like colour of the process lines, utility lines, Instrument signal lines and event modifier conditions shall be finalised during detailed engineering. The colours used to identify event modified conditions shall generally be as follows unless otherwise indicated during detailed engineering

Red -	All points alarm
Blue-	Valve open, pump running
Green -	Valve closed, pump stopped
Flashing green -	Shut down valve transition state

4.2.9.6.6 It shall be possible to go from any graphic page to related graphic pages or any group view or alarm summary in single key stroke using soft key function.

4.2.9.7 The software for printing alarms, system as well as process, and events on the PLC printer must be provided. All alarms must be printed as and when they appear.

4.2.9.8 Software package for displaying I/O map showing status of inputs and corresponding output providing tag numbers as per logic diagram shall be offered. The I/O map format shall be user definable.

4.2.10 Power Supply Distribution

4.2.10.1 All type of power supplies shall be made available at one point. Further distribution of power supply shall be in vendor's scope.

4.2.10.2 In general, all output contacts and solenoids shall be powered with 1l0V±10% DC/ 24V±10% DC power supply. However, the actual interrogation voltages shall be as per job specifications and logic diagrams.

4.2.10.3 The distribution network for interrogation voltage shall be designed such that a single fault in any branch shall not cause trip of the logic other than where the fault has occurred.

4.2.10.4 Sequential starting of various load centers shall be provided whenever specified.

4.2.10.5 Power distribution network must use bus bars of adequate capacity with DPDT (Double Pole Double Throw) switches and HRC (High Rupture Capacity) fuses in each branch network. Vendor may select circuit breaker if short circuit characteristics do not match the HRC fuse.

4.2.10.6 All cubicles lighting shall be on 240 V, 50 Hz AC normal power supply.

4.2.11 PLC System Cabinets

4.2.11.1 All PLC system cabinets shall be completely wired with all modules in place. Inside cabinet wiring shall preferably be done using ribbon type pre-fabricated cables.

4.2.11.2 All the cabinets shall be free standing, enclosed type and shall be designed for bottom entry of cables. Cabinet structure shall be sound and rigid. Cabinet shall be provided with removable lifting lugs to permit lifting of the cabinets.

4.2.11.3 Cabinet shall be fabricated from cold rolled steel sheet of minimum 2 mm thickness suitably reinforced to prevent warping and buckling. Doors shall be fabricated from cold rolled steel sheet of minimum 1.6 mm thickness. Cabinets shall be thoroughly deburred and all sharp edges shall be grounded smooth after fabrication.

4.2.11.4 Cabinet finish shall include sand blasting, grinding, chemical cleaning, surface finishing by suitable filter and two coats of high grade lacquer with wet sanding between two coats. Two coats of paint in the cabinet colour shall be given for non-glossy high satin finish. Colour of the cabinets shall be as per job specification. Final coat shall be given after assembly at site when specified in the job specifications.

4.2.11.5 Each cabinet shall be maximum 2100 mm high (excluding 100 mm channel base), 800 mm wide and 800 mm deep, in general. Construction shall be modular preferably to accommodate 19" standard electrical racks. All cabinets shall be of same height.

4.2.11.6 Cabinets shall be equipped with front and rear access doors. Doors shall be equipped with lockable handles and concealed hinges with pull pins for easy door removal.

4.2.11.7 In order to effectively remove dissipated heat from the cabinets, ventilation fans along with vent louvers backed by wire fly screen shall be provided as required. Ventilation fans shall be provided in all cabinets where the temperature rise with all doors closed and all internal and external loads ertergised shall exceed 10° C above the ambient temperature. A temperature element (resistance temperature detector) shall be provided in each cubicle for temperature measurement. Ventilation fans shall be provided in dual configuration, as a mmimum.

Each fan shall have a separate dedicated assembly and shall be replaceable on-line without shutting down any equipment / panel/cabinet / console in part or in complete. \

Ventilation fan assembly shall operate at 240V AC power supply. Each fan shall have its own dedicated circuit breaker.

Each ventilation fan shall be fitted with a protection type finger guard. Whenever, the numbers of cabinets are compacted (supplied in mechanical joined conditions), each cabinet shall be provided with separate ventilation fan assembly.

The maximum noise level with all fans operating and cubicle doors open shall not exceed 85dBA.

Following signals and alarms shall be provided for each cabinet:

i) Fan failure alarm for each cubicle in PLC.

ii) Temperature indication of each cabinet or compacted combination, as applicable in PLC.

iii) A common alarm each for high temperature and fan-failure shall be made available.

4.2.11.8 Internal illumination shall be provided for cabinets to ensure proper illumination level of250 lux for performing maintenance activities. Illumination shall be provided for all cabinets by incandescent lamps, which shall be activated individually by door operated magnetic switches. The lamps shall activate when door is opened and deactivate when the door is closed. The magnetic switches selected shall have undergone life cycle cyclic test of at least 1000000 operations. A manual over-ride switch shall be provided inside the cabinet which shall keep the lamp deactivated even when the door is open.

4.2.11.9 Equipment within the cabinet shall be laid out in an accessible and logically segregated manner. Cable glands shall be provided and supplied by vendor for incoming and outgoing cables to prevent excessive stress on the individual terminals. All metal parts of the cabinet shall be electrically continuous and shall be provided with a common grounding lug.

4.2.12 Control Panels/ Hardwired Console

4.2.12.1 Control panels, if required, shall be non-graphic self supporting, free standing cubicle with back doors made up of sectional steel panels. Each section shall be maximum 2100 mm high, 1200 mm wide and 1000 mm deep and shall be mounted on 100 mm high channel base. Care shall be taken to ensure that the face of the panel is truly flat and smooth.

4.2.12.2 Panels / hardwired console shall be fabricated from 3.0 mm thick cold rolled steel sheet. Angle iron frame shall use a minimum section of 50x50x4mm angle.

4.2.12.3 Front of panel/console instrument nameplates shall be black laminated plastic with white core. Nameplate shall be provided on the rear of the panel also for each instrument.

4.2.12.4 Document pocket / wallet shall be provided on the inner side of front and rear doors of each cabinet and on the inner side of the door of each panel. Similar arrangement shall also be made on the inner side of doors of console.

4.2.13 Wiring Requirements'!

4.2.13.1 All wiring shall conform to API RP 552-Transmission Systems. Different signal level cables shall be routed with separation distances as recommended by this code.

4.2.13.2 All wiring inside racks, cabinets, and back of the panels shall be housed in covered, non-flammable plastic raceways arranged to permit easy assembly to various instruments for

maintenance, adjustments, repair and removal. \

4.2.13.3 All wiring in the raceways shall be properly clamped. All incoming cable and outgoing cables shall be terminated by vendor at marshalling rack. Total wiring cross-sectional area shall not exceed 50% of the raceway cross sectional area.

4.2.13.4 Separate wiring raceways shall be used for power supply wiring, DC and low level signal wiring, and intrinsically safe wifing. Parallel runs of AC and DC wiring closer than 300mm shall be avoided.

4.2.13.5 Vendor can alternately offer prefabricated cables for interconnection between different cabinets and panels.

4.2.13.6 Wire termination shall be done using self insulating crimping lugs. More than two wires shall not be terminated on one side of single terminal. The use of shorting links for looping shall be avoided.

4.2.13.7 Terminal housing shall be strictly sized with considerations for accessibility and maintenance. Minimum distance required between various components is listed below. These distances are clear distances and are excluding the width of the raceways or any other component / item mentioned herein. Following clearances should be considered:

a) Distance between terminal strip and side of the cabinet parallel to the strip, up to 50 terminals, shall be minimum 50 mm.

b) Distance between terminal strip and, top and bottom of the cabinet shall be minimum 75mm.

c) Distance between two adjacent terminal strips shall be minimum 100 mm.

d) Additional distance for each additional 25 terminals shall be minimum 25 mm.

e) Distance between cable gland plate and the bottom of the strip shall be minimum 300 mm.

4.2.13.8 All terminal/terminal blocks shall be DIN Rail mounted type and shall be easily removable. The size of the terminal blocks / terminals of different types shall be consistent and identical. All terminal blocks shall be mounted on suitable anodised metallic or plastic stand-off.

4.2.13.9 No splicing is allowed in between wire/ cable straight run.

4.2.13.10 Terminal strips shall be arranged group-wise for incoming and outgoing cables separately. Terminal blocks for intrinsically safe wiring shall be separate. 20% spare terminals shall be provided, as a minimum, preferably in each terminal strip. Terminals shall be suitable for wires up to 2.5 sq. mm base solid or stranded conductor in general. For power cables, higher size terminals shall be used.

4.2.13.11 Cabinet and rack layout shall be made considering proper accessibility and maintenance.

4.3 Earthing

4.3.1 All system equipments such as panels, marshalling cabinets, system cabinets and other powered equipments shall be provided with following type grounding system:

a) Protective Earth/ Electrical Earth

b) System Earth! Signal Earth

c) Safety Earth! Barrier Earth (when required)

Both system earth and safety earth shall be totally separate from protective earth.

4.3.2 Protective Earth / Electrical Earth

a) Each metallic enclosure / cabinet / panel/console etc. shall be provided with electrical earth lug, as a minimum.

b) Unless recommended otherwise by vendor, all earthing lugs of metallic equipments indicated in Clause 4.3.2 (a) above shall be connected individually to electrical protective earthing system bus-bar / earthing station using ,a maximum of 10sq mm solid copper conductor PVC insulated wires.

c) Where multiple cabinets are multiplexed together, earth looping with permanent shorting link cables shall be acceptable. Two earthing connection wires as indicated in Clause NoA.3.2 (b) above shall be used for connecting multiplexed cabinets to protective earth station / bus-bar.

4.3.3 System Earth

a) System earth shall be totally noise free dedicated earthing system and shall be fully isolated from electrical protective earth. This earth must be very high integrity system and shall be used to ground zero volt references and signal cable grounds.

b) System earth shall be less than one (l) ohm grounding system with its own dedicated earthing pits. These earth pits shall be away from any heavy noise plant equipment. Outside the control room building is the most appropriate location.

c) Wherever supply of earth pit is kept in vendor's scope in the Material Requisition, the earth pit design shall be as per IS-3043 code of practice for earthing. A minimum of four (4) number of earth pits shall be provided for grounding system integrity. In case number of pits required to meet 1 ohm resistance are more than (2), the number of earth pits shall be two times the actual number of pits required to meet resistance criteria. All these pits shall be securely connected with each other to form a one homogeneous system earth grid.

d) Each marshalling / system cabinet / panels etc shall be provided with system earth bus-bar which shall be insulated from the metallic body frame. This bus-bar shall be used to earth also signal zero volt references and signal cable screens.

Terminals used for termination of spare conductor pairs / cores of multi-pair signal/control cables shall be connected to system earth bus-bar. Shorting links shall be used for spare terminal looping.

e) System bus-bars in the multiplexed cabinets can be joined together by permanent shorting links. System bus-bars of other cabinets can also be connected together provided they are permanently joined using 35 sq mm stranded copper conductor cable.

4.3.4 Safety Earth / Zener Barrier Earth

a) Whenever Zener barriers are selected or used to meet intrinsically safe requirements, the earthing terni'inal of the zener barriers shall be connected to a separate earth bus bar.

b) This earth shall meet all the requirements specified in Clause 4.3.3 of this specification.

c) Safety earth bus bar shall be directly connected to earth pits using dual insulated cable. Cable conductor size shall be minimum 95 sq. mm (c~pper).

4.4 Interface with DCS

The PLC shall be required to be interfaced to the Distributed Control System bus whenever specified. A suitable interface shall be offered in order to achieve the following functions:

a) Display of all input points under alarm/first out alarm connected to PLC or generated by PLC, continuous indication for analog signal on the main DCS operator console.

b) Generate shutdown reports on the logging printer of Distributed Control system.

c) To receive certain operational commands from the operator console for the operation of certain output devices connected to PLC

d) To display diagnostic message of PLC.

In general, PLC shall provide data in a well established MODBUS protocol format.

The interface shall be dual redundant unless otherwise specified.

The speed of data transfer shall be such that any change in I/O which is to be updated on the operator console shall not exceed 3 second from the time event to update on the operator console screen considering one second standard update rate in DCS operator console.

4.5 Sequence of Event (SOE) Function Requirement

Sequence of Event, whenever specified, for analog and digital inputs shall be generated and

time stamped in PLC. The maximum resolution between two events shall not exceed specified PLC scan time unless specified otherwise. A separate SOE PC with 21" size TFT screen and printer shall be provided for PLC sub-system unless specified otherwise.

5.0 TESTING, INSTALLATION, COMMISSIONING AND ACCEPTANCE

5.1 General

5.1.1 This specification defines the basic guidelines to vendor for factory testing and acceptance, installation, commissioning and field acceptance of the complete PLC system. On the basis of this specification, vendor shall submit their own detailed testing, installation, commissioning and acceptance procedure. For hardware, the procedure shall include test name, purpose of test, test equipment / set up, definition of input, test procedure, results expected and acceptance criteria. Similarly for software, it shall include test name, details of the method, list of tests, sequence of execution, results expected and acceptance criteria.

5.1.2 The testing and acceptance of the system shall be carried out on the approved testing procedures and criteria based on this specification and vendor's standard testing requirements and procedures.

5.2 Factory Acceptance Tests (FAT)

5.2.1 Vendor shall test and demonstrate the functional integrity of the system hardware and software. No material or equipment shall be transported until all required tests are successfully completed and certified "Ready for Shipment" by the owner/consultant.

5.2.2 The purchaser reserves the right to be involved and satisfy himself at each and every stage of inspection. The purchaser shall be free to request any specific test on any equipment considered necessary by him although not listed in this specification, as a part of approval of factory testing procedure. The cost of performing all tests shall be borne by the vendor.

5.2.3 Vendor to note that acceptance of any equipment or the exemption of inspection or testing shall in no way absolve the vendor of the responsibility for delivering the equipment meeting all the requirements specified in Material Requisition.

5.2.4 It shall be vendor's responsibility to modify and/or replace any hardware and modify the software if the specified functions are not completely achieved satisfactorily during testing and factory acceptance.

5.2.5 Schedule of FAT shall be included in the Vendor's proposal.

5.2.6 Vendor shall not replace any system component/module/sub-system unless it is failed. A log of all failed components/modules in a sub-system shall be maintained which shall give description of the failed component/module, effect of failure on the sub-system, cause of failure and number of hours of operation before it failed. If malfunction of a component/ module in a sub-system repeats, the test shall terminate and vendor shall replace the faulty component/ module. Thereafter the test shall commence all over again. If even after this replacement, the sub-system fails to meet the requirements, vendor shall replace the full sub-system by the one meeting the requirements and the system shall be tested all over again. If a sub-system fails during the test, which is not repaired and made operational within four

hours of active repair time after the failure, the test shall be suspended and restarted all over again only after the vendor has replaced the device in the acceptable operation.

5.2.7 Testing and FAT shall be carried out in two phases. The minimum requirements for testing during these two phases shall be as follows:

5.2.7.1 Under the first phase, vendor shall perform tests at his works to ensure that all components function in accordance with the specification for each type of test. A test report shall be submitted for purchaser review within one week of completion of this test. Phase II testing (witness inspection) shall start only after this.

All subsystem shall undergo a minimum of 30 days burn in period. The burn-in time shall start after the sub-system is fully assembled and is powered up. It may include any such time for which the system has been kept powered on even for system generation and Phase I testing.

Following tests shall be performed by the vendor and reports shall be forwarded to purchaser:

a) Quality control test which shall be carried out to assure quality of all components and modules in accordance with vendor's quality control and assurance procedures.

b) System pre-test which shall be physical check of all modules, racks, cabinets etc.

c) System power-up test which shall test functionally all hardware and software. This shall include testing of redundancy, System performance on power supply variations, application software testing and system diagnostic verification.

5.2.7.2 The second phase of testing shall systematically, fully and functionally test all hardware and software in the pre~ence of purchaser representatives. All subsystems shall be interconnected to simulate, as close as possible, the total integrated system. Following minimum tests shall be carried out:

a) Visual and mechanical testing, which shall be carried out in principle to assure correct, proper, good and neat workmanship by the vendor This testing shall include dimensional verification, Layout verification as per approved GA drawings, Verification of Sheet thickness / Quality of painting (outer and inner) / N~meplates, identifiers and tag plates / Adherence to ferruling philosophy / Dressing of wires / prefabricated cables and clearances / Locks and handles as a minimum.

b) Verification of Bill of Material. The Bill of material verification shall include both hardware and software.

c) Functional testing:

This shall include the simulation of each input and output to verify proper system response. The testing as a minimum shall include:

i) Complete system configuration loading.

ii) Demonstration of all PLC system builder functions including addition/deletion of an input/output, addition/ deletion of a rung or an element in a rung, generation of dynamic graphics and other views, report generation etc.

iii) 100% checking of logics configured in the PLC by connecting switch/lamp at input/output, by simulating inputs and verifying outputs preferably using simulator, other related functions like forcing, first out shall also be verified.

iv) Checking of scan time. Scan time verification shall be carried out using high resolution storage oscilloscope during Factory Acceptance Test based on the specified requirements considering discrete input by given step change. The scan time values so observed shall be within 90% confidence level. Incase of analog inputs, input shall be ramp or minimal step, however such reading for analog inputs should be noted only for reference.

v) Checking of all PLC console displays, keyboard and touch-screen operation (wherever specified), printer/hard copier functions etc.

vi) System redundancy check including correct change over of the back-up unit in case of failure of main unit.

vii) System diagnostic checking for all subsystems on local level as well as on console, including checking of the testing software for I/O modules/signal conditioning modules, when specified.

viii) Checking of output status on processor failure.

ix) Checking of first-out alarm generation.

x) Simulation of power failure and system restart auto boot-up of system configuration and program after power restoration.

5.2.8 Vendor shall notify the purchaser at least three (3) weeks prior to factory acceptance test. In the event that representative arrives and the system is not ready for testing, vendor shall be liable for back charges for any extra time and expenses incurred.

5.3 Installation, Testing and Commissioning

5.3.1 Vendor shall offer the services of an installation team which would install the equipment in the control room, lay the interconnecting cables inside control room, check-out, test and commission the system.

All technical personnel assigned to the site by the vendor shall be fully conversant with the supplied system and software package, and shall have both hardware and software capability to bring the system on line quickly and efficiently with a minimum of interference with other concurrent construction and commissioning activities

5.3.2 Vendor's responsibility at site shall include all activities necessary to be performed to complete the job as per material requisition including:

a) Receipt of hardware/software and checking for completeness of supplies.

b) Installation of the system including for free supply equipment, if any.

c) Field cable termination and inter-cabinet cabling and termination.

d) Check out equipment installation.

e) Checking of interconnections, hardware and software configuration, overall system

f) Loop checking.

g) Field tests.

h) Commissioning and on-line debugging of the system.

i) Involvement during plant commissioning and performance of final acceptance test.

j) Co ordination for integration with DCS / other third party system.

5.3.3 Field Inspection

5.3.3.1 All equipments shall be inspected thoroughly by vendor after its receipt at site for completeness and proper functioning. Vendor must initiate the remedial action, in case unsatisfactory operation of any item is observed, with intimation to Engineer-in-charge.

5.3.3.2 Vendor must document all observations including details of any malfunction observed. Items/ equipments requiring total replacement must document the reasons for the same.

5.3.4 Loop Checking

5.3.4.1 Loop checking shall be carried out by vendor including checking the interconnections, configuration and overall system functioning.

5.3.4.2 Vendor's scope of work as a part of system installation and loop checking shall include termination of field cables in the control room, checking of interconnection between instrument/equipment, glanding, ferruling/tagging of interconnecting cables in control room, ferruling of field cables in control room and performing overall loop performance check.

5.3.4.4 The input signals shall be simulated by disconnecting/connecting the field wires for all field switches connected to 'PLC. All field transmitters connected to control room shall be loop checked at 0%, 50% & 100% of full scale (for both increasing and decreasing signals). Wherever receiver cards are used, the set point shall be generated by giving the input signal to receiver card. All outputs shall be checked in field, either for actual operation of solenoid valve or actual pick-up of electrical contractor for rotary equipments. Shutdown schemes shall be checked for proper functioning, configuration and actuation.

5.3.4.5 After loop checking is completed, vendor shall connect back any ~erminals and connections removed for loop checking.

5.4 System Acceptance

5.4.1 The owner shall provisionally takeover the system from vendor after System acceptance test. System acceptance test shall be started only after the satisfactory performance of loop checking and verification of all loop checking records by Engineer-in-charge.

5.4.2 The system acceptance test shall be carried out in the presence of owner's representative and Engineer-in-charge or his authorised representative. The tests carried out in System acceptance test shall be fully recorded and duly signed by all representatives participating in the System Acceptance Testing. .

5.4.3 Vendor shall carry out the following functional tests, as a part of system acceptance test, as a minimum.

a) Hardware verification as per final Bill of Material.

b) Visual and mechanical check-up for proper workmanship, identification, ferruling, nameplates etc.

c) System configuration as per approved configuration diagram.

d) Demonstration of all system function, display and diagnostics.

e) Checking of correct change-over of redundant devices.

f) Checking of various peripheral devices like printers and printing of all reports.

g) Complete checking of logic system, loading of user's program and checkout of results.

h) Checking of proper functioning of all disc drives, alarm summary, alarm history etc.

i) Proper information transfer on the information network by verifying system displays and printout.

5.5 Final Acceptance Test

The owner will take over the system from the vendor after the final acceptance test, which is defined as successful uninterrupted operation of the integrated system for three weeks. Vendor's personnel shall be present during the test. Any malfunctioning of the system components shall be replaced / repaired as required. Once the system failure is detected, the acceptance test shall start all over again from the beginning. The warranty period commences from the day owner takes over the system.

6.0 GENERAL REQUIREMENTS

6.1 Vendor shall comply fully with the general requirements of PLC system including logistic

support services, documentation, warranty, maintenance contract and shipping instructions.

Post Warranty Maintenance Contract

Vendor shall quote separately for post warranty maintenance contract after warranty period for five years for the complete system as per commercial terms and condition of the requisition and the type (i.e. comprehensive or non-comprehensive) of post warranty maintenance shall be as specified in job specification. The personnel deployed during post-warranty maintenance shall have thorough knowledge of the system and at least two years of experience on the maintenance of similar system. Any other conditions of contract required by vendor shall be explained in the offer.

7.0 SHIPPING

7.1 All the materials used for packing, wrapping, sealers, moisture resistant barriers and corrosion preventers shall be of recognised brands and shall conform to the best standards in the areas for the articles which are packed

7.2 Workmanship shall be in accordance with best commercial practices and requirements of applicable specification. There shall be no defects, imperfections or omissions which would tend to impair the protection offered by the package as a whole.

7.3 The packing shall be suitable for storing in tropicalised climate, the ambient conditions, being specified injob specifications.

7.4 Shipment shall be thoroughly checked for completeness before final packing and shipment. Vendor shall be responsible for any delay in installation or commissioning schedule because of incomplete supply of equipments.

INSPECTION AND

TEST REQUIREMENTS

FOR INSTRUMENTATION

CONTENT

ATTACHMENT

1. INSPECTION AND TESTS

1.1 General

1.1.1 All instruments and system-oriented items shall undergo factory testing and inspection by authorized Third party representatives / Owner and PMC unless specified otherwise.

1.1.2 Wherever inspection at manufacturer's shop is waived because of any reason, the sub vendor's own testing reports shall be verified before despatch. In no case items shall be released without proper inspection verification.

1.1.3 The inspection and testing shall be carried out as per related specifications, international codes and practices/standards, approved documents and/or any other documents attached along with specifically suggesting testing to be carried out at manufacturer' works.

1.1.4 Items, for which 'Witness Inspection' is specifically exempted, manufacturer shall forward the test certificates as desired for review. The material shall be despatched only after obtaining written despatch clearance.

1.1.5 No system or system oriented item shall be despatched without integrated factory testing witnessed by representatives of / Third party inspector / Owner /PMC. The testing procedures shall be detailed out, based on testing requirements indicated in individual system specifications and shall be approved by Owner/ PMC. It must certify that the system is actually ready before calling the Owner/PMC for FAT. Also all the necessary documents and literature are to be submitted before calling for FAT.

1.1.6 Testing and inspection for all items shall be carried out as per approved factory testing procedures.

1.1.7 Performance specifications must be detailed out on each time which shall be verified by third party agency / by Owner / PMC during factory testing.

1.1.8 Acceptable criteria for Radiography and other NDT requirements for the instruments / instrument castings shall be inline with those specified in 'Piping Specifications' have been attached elsewhere in this package.

1.1.9 IBR certifications shall be provided by in the appropriate format duly signed by IBR authority or their authorised agency.

1.1.10 Verification of setpoint of rupture disc shall be part of witness inspection. Testing shall be carried out on the rupture disc, which are part of the actual rupture disc batch of manufacturer. This shall be in addition to the 3 numbers of spare rupture discs already indicated in the requirements. The testing, in general, shall be as per ASME section VIII.

1.1.11 Inspection and test items, witness inspection items for each kind of instrument at FAT (Factory acceptance test) shall be as shown in Table A.

1.1.12 Inspection and acceptance standards

Inspection and acceptance standards shall be as follows.

1.2 Visual Inspection

1.2.1 Conformation items

1. Type and model
2. Tag no.
3. Rating
4. Range, Scale and symbol of unit
5. Set pressure and capacity of safety valves
6. Valve characteristics and CV value of control valves
7. Name of materials
8. Nameplate
9. Colour of painting
10. Die Marking (nominal size, material of flange and direction of flow)
11. Accessories
12. Quantity

1.2.2 Harmful defects

- Defect such as cracks, deformation and flaws shall not be found in the casting, forging and machined surface of the pressure rating part.
- Defect such as inside surface weld protrusion; lack of fusion and incomplete penetration shall not be found in welded places of pressure retaining part.

1.2.3 The instrument shall be in rugged design and assembly of all components within the enclosure fixed firmly to avoid loosening or falling-off of any parts.

1.2.4 Painting of instrument's surface shall be such that there is no defect or lack of uniformity.

1.3 Dimensional Inspection

[X] Main parts
[ ]
[ ]

Check and conform to the requirement of Purchaser's Spec, approved drawings or applicable code and standards.

1.4 Material Inspection

1.4.1 Mill test certificates

Manufacturer shall submit the mill test certificates for the following parts.

1. ANSI class 900 or above (ALL material used at the P.T. ratings)

2. The following parts made of steel for :
   - High temperature service (Alloy steel above C-Mo steel used at temperature of 400ºC or over)
   - Low temperature service (Iron and steel material of design temperature bellow minus 11ºC containing Al-killed steel)
   - Corrosion-resistant materials

I.	Temperature detective parts	: **[X]**	Flange and Thermowell
II.	Orifice assembly	: **[X]**	Flange
III.	Venturi tube, Flow nozzle and Low-loss tube	: **[X]**	Body
IV.	Positive displacement flow meter and	: **[X]**	Body, Strainer and

	Turbine meter		Straightner
V.	Area type flow meter	: **[X]**	Body and Flange
VI.	Displacement type liquid level meter	: **[X]**	Chamber and Flange
VII.	Glass Gauge	: **[X]**	Body and Flange
VIII.	Control valve	: **[X]**	Valve body, Bonnet, Plug, Seat and Vane
IX.	Safety valve	: **[X]**	Valve body, Nozzle and Disc
X.	Condensate pot	: **[X]**	Body
XI.	Gas eliminator	: **[X]**	Body

1.4.2 Material grade 316SS or 316L SS of stainless steel, Purchaser may require Vendor to carry out the qualitative analysis for molybdenum.

1.5 Non-Destructive Examination

1. Control valve and safety valve
   Following Par. 1.5.2 and 1.5.3

2. Other instruments
   Shall be carried out in accordance with manufacture's standards approved by Purchaser

1.5.1 Ultrasonic Examination

1. Forging material on Orifice flange and Flow nozzle
   [X] ANSI class 900 or above

1.5.2 Radiography Examination

[ ] The pressure retaining casting parts

1. Applicable material and quantity (refer table VI)
   - Welded parts : [ ] JIS Z 3104, Z 3106
     [X] ASME VIII Division 1 uw-51 "Radiographic & Radioscopic Examination of Welded Joints"

2. Acceptant standards and grade
   - Casting : [ ] JIS G 0581
     [X] ASTEM E 446-9 or 186-93

Table VI Radiography Examination

Materials			Quantity
Casting	class 1500 or over	C-steel	One out of total quantity of the same type, size and rating for pressure retaining critical parts(a)
	class 900 or over	C-Mo steel	
	class 600 or over	Cr-Mo steel Stainless steel	
	class 300 or over	Al-killed steel 2.5 Ni steel 3.5 Ni steel	
Pressure retaining welded parts	class 1500 or over	C-steel C-Mo steel	One spot on each welded parts per same material and same welder. All welded crossing parts
	class 300 or over	Cr-Mo steel Stainless steel	
	class 150 or over	Al-killed steel 2.5 Ni steel 3.5 Ni steel	

a. Following parts are Critical parts.
- Groove-welded parts of cast body
- Flange neck and valve seat's vicinity of cast body
- Other welded parts included in pressure retaining parts

Note: 1. In case of practical difficulty to perform Radiography Test, Manufacture shall notify Purchaser in advance, and for such case, magnetic particle or liquid penetrant examination may be used in accordance with Par. 1.5.3 with Purchaser's approval.

2. For the welded parts having nominal size of 1-1/2 in. or below, magnetic particle or liquid penetrant examination in Par. 1.5.3 may be used.

1.5.3 Magnetic Particle or Liquid Penetrant Examination

[X] For the pressure retaining parts

Table VII Magnetic particle / Liquid penetrant examination

Materials			Quantity
Casting	class 900 or over	C-steel	20% of total quantity of the same type, size and rating for pressure retaining critical parts (a)
	class 600 or over	Cr-Mo steel Cr-Mo steel Stainless steel	
	class 150 or over	Al-killed steel 2.5 Ni steel 3.5 Ni steel	
Pressure retaining welded parts (b)	class 150 or over	All materials	20% of total welded parts

a. Refer to Par. 1.5.2(1).
b. Including butt groove-welded parts at site.

1.6 Pressure Test

1.6.1 Control Valve

1. Body and Bonnets

[X] Hydrostatic test with Applicable codes and standards

2. Body of special type

[X] Hydrostatic test

Test pressure and Hold time

[X] 1.5 times of max. Operating pressure / min. 2 kgcm2g
[X] Minimum 5 minutes.

3. Permanent distortion or Leakage

[X] shall not be found

1.6.2 Safety Valve or Safety Relief Valve

1. Pressure retaining parts

[X] Hydrostatic test before assembling

i. Test pressure and Hold time

[ ] 1.5 times of Max. Operating pressure / min. 2 kgf/cm2g.
[X] 2.2 times of Max. Operating pressure.

[X] Minimum 5 minutes.

ii Distortion or leakage
[X] shall not be found

2. The out side parts of enclosed type
[X] Hydrostatic test after assembling

i. Test pressure and Hold time
[X] 1.5 times. Nominal pressure of flange
[ ] 2.2 times. Nominal pressure of flange
[X] Minimum 5 minutes.

ii. Defects
[X] Shall not be found

3. Special type valves

[X] Hydrostatic test with the manufacturer's standards approved by purchaser, where Par. 1.6.2(1) and (2) are not applicable

1.6.3 The pressure retaining parts of instrument

[X] Hydrostatic test or Pneumatic test as per applicable codes and standard

I Test pressure and Hold time
[X] 1.5 time of Max. Operating pressure / Min. 2 kg/cm2g
[X] Min. 5 minutes

ii Permanent distortion or Leakage
[X] Shall not be found

If the above mentioned test is technically difficult, the test shall be carried out in accordance with the manufacturer's standards approved by purchaser.

1.7 Pneumatic Test

1.7.1 The pneumatic test for instrument

I Test pressure & Hold time

[X] Max. Operating Pressure. (Design press.)
[X] Minimum 5 minutes

ii Permanent distortion or Leakage

[X] Shall not be found

1.8 Seat Leakage Test

1.8.1 Control Valve

Allowable leakage valve / (code):

[X] ANSI B16.104 (FCI 70-2)

Unless other wise specified, butterfly valves shall not require the seat leakage test.

1.8.2 Safety valve

Seat leakage test (closing property) as follows.

1. Safety valve for Steam

   i. Test pressure

      [X] 90% of set pressure

   ii. Leakage

      [X] Shall not be found

2. Safety valve for Gas

   i. Test pressure

      [X] 90% of set pressure

   ii. Allowable leakage value (Refer Table – VIII)

Table VIII - Allowable leakage value of Safety valve

Type	Orifice Area (mm)	Number of Bubbles (min)	Leakage Value (cm3/min)
General	16.0 and less 20.5 and over	40 20	11.80 5.90
Balance bellows	16.0 and less 20.5 and over	50 30	14.75 8.85

3. Relief safety valves, Vacuum breakers and atmospheric valve
   [X] Manufacture's standard (approved by Purchaser)

1.9 Performance Test

For each instruments, the performance test shall be carried out in accordance with procedure approved by Client / PMC.
Acceptance standard shall be in accordance with applicable codes & standard, All specification, and manufacture's standard shall be approved by Client / PMC.

1.10 Steam Test

Steam test shall be performed as follows:

[ ] Valves used for steam service Temperature of 450°C or more, and the body ratings of class 600 and above.

[ ] After attaining the steady surface temperature same as temperature of the service with the pressure of service condition.

In the case, when steam test has been performed and the report is submitted for the valve of same type, same bore size and material from the same lot, the steam test for the other valves may be omitted.

1. Leakage

   i. Body : [ ] Shall not be found
   ii. Seat : [ ] As per specified leakage value

2. Operation

   [ ] To be smooth

   After the steam test, the test of Par. 1.6 and Par. 1.8 shall be carried out.

1.11 Insulation Resistance Test

1. Power supply circuit & alarm circuit : 10M Ω or over (instrument panel: 3 MΩ or over/each panel)

2. Signal circuit : 5M Ω or more (instrument panel: 3 MΩ or More per panel)

The test shall be carried out in accordance with the applicable codes & Standards. Due to any technical constraint to measure, this test can be omitted

1.12 High-voltage Test

1. A-C power supply and alarm circuits

   i. Voltage level less than 250 V : **[X]** A-C 1500 V

   ii. Voltage level 250 V and above : **[X]** A-C 2E + 1000V

   'E' is the rated voltage.

2. D-C power supply circuits : **[X]** A-C 500V

   Test can be omitted in case of any technical constraint.

Table A : Table of Inspection and Test Items

Kind of Instrument	Inspection and Test Items										
	Visual insp.	Dimensional insp.	Material insp.	Non-destructive exam	Pressure test	Pneumatic test	Seat Leakage test	Performance test	Insulation resistance test	High voltage test	Steam test
1 Thermocouple	○ ●T	○●T	—	—	—	—	—	□●T	□●T	□●T	—
2 Resistance thermometer bulb	●T ○	●T ○	—	—	—	—	—	●T □	□●T	□●T	—
3 Compensating lead wire	○●T	○●T	—	—	—	—	—	□●T	□●T	□●T	—
4 Bimetallic thermometer	○●T	○●T	—	—	—	—	—	□●T	—	—	—
5 Gas or liquid-filled thermometer	○●T	○●T	—	—	—	—	—	●T □	—	—	—
6 Thermowell	○●T	○●T	○ □●T	○ □●T	○ □●T	—	—	—	—	—	—
7 Orifice plate	○●T	○ □●T	○●T	—	—	—	—	—	—	—	—
8 Orifice flange	○●T	○●T	○ □●T	○ □●T	—	—	—	—	—	—	—
9 Restriction orifice	○●T	○ □●T	○●T	—	—	—	—	—	—	—	—
10 Flow nozzle low-loss tube	○●T	○●T	○ □●T	○ □●T	○ □●T	—	—	—	—	—	—
11 Venturi tube	○●T	○●T	○ □●T	○ □●T	○ □●T	—	—	—	—	—	—
12 Positive displacement flow meter	●T ○	●T ○	●T ○ □	●T ○ □	●T ○ □	—	—	●S ○ □	●T ○ □	●T ○ □	—
13 Area type flow meter	○●T	○●T	○ □●T	○ □●T	○ □●T	—	—	○ □●T	○ □●T	○ □●T	—
14 Thermal mass flow meter	●T ○	●T ○	●T ○	—	●T ○ □	—	—	●S ○ □	●T ○ □	●T ○ □	—
15 Turbine meter	●T ○	●T ○	●T ○ □	●T ○ □	●T ○ □	—	—	●S ○ □	●T ○ □	●T ○ □	—
16 Differential pressure flow meter	●T ○	●T ○	—	—	●T ○ □	—	—	●T ○ □	●T ○ □	●T ○ □	—
17 Differential pressure transmitter	●T ○	●T ○	—	—	●T ○ □	—	—	●T ○ □	●T ○ □	●T ○ □	—
18 Magnetic flow meter	●T ○	●T ○	●T ○	●T ○ □	●T ○ □	—	—	●S ○ □	●T ○ □	●T ○ □	—
19 Bourdon gauge	○●T	○●T	—	—	○ □●T	—	—	○ □●T	—	—	—
20 Draft gauge	○●T	○●T	—	—	—	—	—	○ □●T	—	—	—
21 Differential pressure gauge	○●T	○●T	—	—	○ □●T	—	—	○ □●T	—	—	—
22 Pressure transmitter	○●T	○●T	—	—	○ □●T	—	—	○ □●T	○ □●T	○ □●T	—
23 Displacement type level indicator, controller	●T ○	●S ○ □	●T ○	●T ○	●S ○ □	—	—	●S ○ □	●S ○ □	●T ○ □	—
24 Chamber for displacement type level meter	○●T	○ □●T	○ □●T	○ □●T	○ □●T	—	—	—	—	—	—
25 Glass gauge	○●T	○	○	○	○ □	—	—	—	—	—	—

Kind of Instrument	Inspection and Test Items										
	Visual insp.	Dimensional insp.	Material insp.	Non-destructive exam	Pressure test	Pneumatic test	Seat Leakage test	Performance test	Insulation resistance test	High voltage test	Steam test
		☐●T	☐●T	☐●T							
26 Float type level meter,	●T ○	●S ○	●T ○ ☐	●T ○ ☐	●S ○ ☐	—	—	●S ○ ☐	●S ○ ☐	●T ○ ☐	—
27 Differential pressure type level meter	○●T	●T ○	●T ○	—	●T ○ ☐	—	—	●T ○ ☐	●T ○ ☐	●T ○ ☐	—
28 Purge type level meter	○●T	○●T	—	—	—	—	—	○ ☐●T	—	—	—
29 Capacitance type level meter	○●T	●T ○ ☐	●T ○	—	—	—	—	●T ○ ☐	●T ○ ☐	●T ○ ☐	—
30 Conductivity type level meter	○●T	●T ○	●T ○	—	—	—	—	●T ○ ☐	●T ○ ☐	●T ○ ☐	—
31 Conductivity type level meter	●T ○	●S ○	—	—	—	—	—	●S ○ ☐	●S ○ ☐	●T ○ ☐	—
32 Weight sounding type level meter	●T ○	●S ○	—	—	—	—	—	●S ○ ☐	●S ○ ☐	●T ○ ☐	—
33 Radiation type level meter	●T ○	●S ○	—	—	—	—	—	●S ○ ☐	●S ○ ☐	●T ○ ☐	—
34 Pneumatic type control valve	●T ○	●S ○	●T ○ ☐	○ ☐●T	●S ○ ☐	—	●S ○ ☐	●S ○ ☐	●T ○ ☐	●T ○ ☐	
35 Hydraulic type control valve	●T ○	●S ○	●T ○ ☐	●T ○ ☐	●S ○ ☐	—	●S ○ ☐	●S ○ ☐	●T ○ ☐	●T ○ ☐	
36 Motor-operated control valve	●T ○	●S ○	●T ○ ☐	●T ○ ☐	●S ○ ☐	—	●S ○ ☐	●S ○ ☐	●S ○ ☐	●S ○ ☐	
37 Self-acting control valve	○●T	○●T	○ ☐●T	○ ☐●T	○ ☐●T	—	—	○ ☐●T	—	—	—
38 Indicator	○●T	○●T	—	—	—	—	—	○ ☐●T	○ ☐●T	○ ☐●T	—
39 Recorder unit	○●T	○●T	—	—	—	—	—	○ ☐●T	○ ☐●T	○ ☐●T	—
40 Controller unit	○●T	○●T	—	—	—	—	—	○ ☐●T	○ ☐●T	○ ☐●T	—
41 Integrator unit	○●T	○●T	—	—	—	—	—	○ ☐●T	○ ☐●T	○ ☐●T	—
42 Alarm setting unit	○●T	○●T	—	—	—	—	—	○ ☐●T	○ ☐●T	○ ☐●T	—
43 Computing unit	○●T	○●T	—	—	—	—	—	○ ☐●T	○ ☐●T	○ ☐●T	—
44 Converter unit	○●T	○●T	—	—	—	—	—	○ ☐●T	○ ☐●T	○ ☐●T	—
45 Limiter unit	○●T	○●T	—	—	—	—	—	○ ☐●T	○ ☐●T	○ ☐●T	—
46 Power source unit	○●T	○●T	—	—	—	—	—	○ ☐●T	○ ☐●T	○ ☐●T	—
47 Instrument panel	●T ○	●S ○	—	—	●T ○ ☐	●S ○ ☐	—	●S ○ ☐	●T ○ ☐	●T ○ ☐	—
48 Instrument desk	●T ○	●S ○	—	—	—	—	—	●S ○ ☐	●T ○ ☐	●T ○ ☐	—
49 Gauge board	●T ○	●S ○	—	—	●T ○ ☐	●S ○ ☐	—	●S ○ ☐	●T ○ ☐	●T ○ ☐	—
50 Safety valve	●T	●S	●T	●T	●T	—	●S	●S	—	—	—

Kind of Instrument	Inspection and Test Items										
	Visual insp.	Dimensional insp.	Material insp.	Non-destructive exam	Pressure test	Pneumatic test	Seat Leakage test	Performance test	Insulation resistance test	High voltage test	Steam test
	○	○ ☐	○ ☐	○ ☐	○ ☐		○ ☐	○ ☐			
51 Pilot operated safety relief valve	●T ○	●S ○ ☐	●T ○ ☐	●T ○ ☐	●T ○ ☐	—	●S ○ ☐	●S ○ ☐	—	—	—
52 Vacuum breaker	●T ○	●S ○ ☐	●T ○ ☐	●T ○ ☐	●T ○ ☐	—	●S ○ ☐	●S ○ ☐	—	—	—
53 Atmospheric valve	●T ○	●S ○ ☐	●T ○ ☐	●T ○ ☐	●T ○ ☐	—	●S ○ ☐	●S ○ ☐	—	—	—
54 Gas chromato-graph	●T ○	●T ○	—	—	—	●T ○ ☐	—	●S ○ ☐	●S ○ ☐	●T ○ ☐	—
55 Mass spectro-meter	●T ○	●T ○	—	—	—	●T ○ ☐	—	●S ○ ☐	●S ○ ☐	●T ○ ☐	—
56 Infrared type gas analyzer	●T ○	●T ○	—	—	—	●T ○ ☐	—	●S ○ ☐	●S ○ ☐	●T ○ ☐	—
57 Magnetic type gas analyzer	●T ○	●T ○	—	—	—	●T ○ ☐		●S ○ ☐	●S ○ ☐	●T ○ ☐	—
58 Thermal conductivity type analyzer	●T ○	●T ○	—	—	—	●T ○ ☐	—	●S ○ ☐	●S ○ ☐	●T ○ ☐	—
59 Combustion type gas analyzer	●T ○	●T ○ ☐	—	—	—	●T ○ ☐	—	●S ○ ☐	●S ○ ☐	●T ○ ☐	—
60 Density type gas analyzer	●T ○	●T ○	—	—	—	—	—	●S ○ ☐	●S ○ ☐	●T ○ ☐	—
61 Photo-electric type analyzer	●T ○	●T ○	—	—	—	—	—	●T ○ ☐	●T ○ ☐	●T ○ ☐	—
62 Moisture analyzer	○●T	●T ○	—	—	—	—	—	●T ○ ☐	●T ○ ☐	●T ○ ☐	—
63 pH meter	○●T	○●T	—	—	—	—	—	○ ☐●T	○ ☐●T	○ ☐●T	—
64 Turbidity analyzer Water quality analyzer	●T ○	●T ○	—	—	●T ○ ☐	—	—	●T ○ ☐	●T ○ ☐	●T ○ ☐	—
65 Density meter	○●T	○●T	—	—	○ ☐●T	—	—	○ ☐●T	○ ☐●T	○ ☐●T	—
66 Electric conductivity meter	○●T	○●T	—	—	○ ☐●T	—	—	○ ☐●T	○ ☐●T	○ ☐●T	—
67 Flame detector	●T ○	●T ○	—	—	—	—	—	●S ○ ☐	●S ○ ☐	●T ○ ☐	—
68. Mass Flow meter	●T ○	●T ○	●T ○ ☐	●T ○ ☐	●T ○ ☐	—	—	●S ○ ☐	●T ○ ☐	●T ○ ☐	—
69. Vortex Flow Meter	●T ○	●T ○	●T ○ ☐	●T ○ ☐	●T ○ ☐	—	—	●S ○ ☐	●T ○ ☐	●T ○ ☐	—
70 Gas detector	●T ○	●T ○	—	—	—	—	—	●S ○ ☐	●S ○ ☐	●T ○ ☐	—

○ : Tested by Manufacturer.
● : Tested by manufacturer & witnessed by 3rd party inspector(TPI).
☐ : Manufacturer will submit Inspection & test records.
T : Total Inspection by TPI.
S : Sample inspection by TPI.(10% of total quantity of the same type & rating.

Notes: PMC/OWNER may witness any or all testing in stages during manufacturer or at final stage before shipment.

SECTION VI- 4.0

CONSTRUCTION/ERECTION, PRE-COMMISSIONING, COMMISSIONING AND START-UP

FOR

UREA HANDLING & BAGGING PACKAGE

[UREA (NEEM OIL COATED) HANDLING SYSTEM, BULK SILO AND BAGGING SYSTEM INCLUDING FILLED BAGS STACKING/ LOADING TO WAGON & TRUCK]

PLANT: **AMMONIA-UREA PLANT BASED ON COAL GASIFICATION**

PROJECT: **INTEGRATED COAL BASED FERTILISER COMPLEX AT TALCHER, ANGUL DISTRICT, ODISHA (INDIA)**

0	18.06.2021	Issued for enquiry	JKY	JKY	RRK
REV	REV ATE	PURPOSE	PREPD	REVWD	APPD

CONTENTS

LIST OF ANNEXURES

1 General scope of Work and services - Construction/Erection:

LSTK CONTRACTOR shall be responsible for construction and erection of the Plant/ Unit including but not limited to the following:

1.1 Construction and erection of Plant/Unit and perform all other activities required to be performed for implementation of the WORK.

1.2 Provide and supply in due course all construction Equipment and Materials, tools, and temporary facilities necessary for implementation of the WORK.

1.3 Establish and operate adequate material control system in site for receipt, unloading, inspection, maintenance, handling, storage and utilization to ensure all Equipment and Materials are preserved and available as necessary for completion of the Plant/Unit.

1.4 Provide and supply all staff, tradesmen and labours for implementation of the WORK.

1.5 Establishment of overall construction policy and procedures for the Plant/Unit.

1.6 Provision of overall management and control of construction phase of the Plant/Unit.

1.7 Ensuring that all parts of the Plant/Unit are constructed and tested strictly in accordance with the specifications and applicable codes and standards asked for in the project documents.

1.8 Ensuring that construction is accomplished in accordance with the schedules.

1.9 Provide transportation of all Equipment and Materials to be provided and supplied by LSTK CONTRACTOR under the CONTRACT either from inside or outside to Site.

1.10 Construct, operate and maintain all temporary facilities required for its personnel involved in the WORK.

1.11 Provide transportation in the area of the Site and between Site and temporary facilities for all its personnel involved in the implementation of the WORK, including field labour, administrative staff, etc.

1.12 Recruit field and organize, manage and supervise its Sub Contractors and field labour for the WORK.

1.13 Provide liaison with OWNER, Sub Contractors, Licensors and Vendors to ensure that the Plant/Unit is constructed in accordance with the respective standard and specifications, set forth in the CONTRACT.

1.14 Establish with OWNER adequate procedures, control and reporting systems to provide close control of the progress of the WORK.

1.15 Provision of labour and facilities for loading, unloading and transportation of the Equipment within the site area.

1.16 Provision of all other works and/or services required for completion of the WORK.

1.17 Execution of the whole civil, structural and building works of the Plant/Unit and/or utilities and off-site facilities.

1.18 Piping work on the Site, if applicable..

1.19 Erection and installation of EQUIPMENT and auxiliary facilities associated with the Plant/Unit.

1.20 Erection and field fabrication of structural steelwork, cladding ladders, handrails, stairs and platform of the Plant/Unit and/or utilities and off-site facilities.

1.21 Testing, Pre-commissioning & Commissioning of the Plant/Unit.

1.22 Carrying out Mechanical Completion.

1.23 Perform all material identification as per application codes and standards.

1.24 Provide drawings and documents as required.

1.25 Supply to OWNER complete test records within three (3) days after completion of actual testing.

2.0 General scope of WORK and Services- Pre-commissioning

LSTK CONTRACTOR shall be responsible for the pre-commissioning phase of the Plant.

LSTK CONTRACTOR shall provide at SITE an adequate number of qualified pre-commissioning engineers to direct and control pre-commissioning activities.

LSTK CONTRACTOR shall also ensure that all special tools and test equipment required for pre-commissioning are available at its own cost.

LSTK CONTRACTOR shall provide adequate construction labour, construction tools and equipment for pre-commissioning.

Pre-commissioning which shall be performed by LSTK CONTRACTOR shall include, but not limited to the following:

2.1 Checking, Testing, calibration simulation test and adjustment of instruments, equipment and systems including control valves and safety devices, and installation and checking of orifices plates and other sensor devices in so far as this can be done before actual operation of the item concerns of complete system and loops.

2.2 Function test and checking out of electrical systems including substations, transformers, cables and switchgear, checking of all interlocks and setting of all relays. This shall include drying out operations, filtering of oil if required.

2.3 For motor driven equipment, amperage checking of motors and removal of temporary safety screens.

2.4 Cleaning of screens and filters replacement and adjustment of packing and seals and tightening of flanges.

2.5 Any other activity required to complete the job in all respect as [per NIT.

3.0 Basic Plan for Temporary Services

Temporary Construction Facilities

The LSTK shall arrange following facilities at his own cost for Construction/Erection purpose. Demolition and cleaning of temporary facilities developed for construction purpose shall also be under LSTK Contractor's scope.

1. 1 No. 11 kV Feeder (rated for 2 MVA) at Existing Substation near 132 KV Switchyard shall be made available. Tapping of Construction Power (on chargeable basis) from this feeder (including supply & erection of all required materials like structural supports for cable tray, cable trays, power cables, control cables, protection & metering, cable termination etc. as well as underground cabling work) and further distribution shall be in LSTK Contractor's scope.
2. Construction Water (on chargeable basis) shall be made available
3. Construction sheds
4. Construction offices
5. Temporary Communication facilities
6. Office furniture
7. Labour colony during construction.

3.1 Sewage & Refuse Disposal

All temporary building like site office, canteen etc. shall be provided with individual septic tanks and soak pits for treatment and disposal of sanitary sewers. Construction site shall be provided with a network of temporary drain for disposal of rain water.

4.0 Mechanical Completion

Mechanical Completion means the time when all construction, erection & installation work per finally approved P&ID and pre-commissioning related to the Plant is completed in accordance with the Project drawings and specifications, and all mechanical and pressure tests, including but not limited to hydro-testing, non-operating adjustments, cold alignment checks, final cleanup, hot bolting, refractory drying, field calibration of safety valves, calibration of all instruments, instrument loop checking and testing, monitoring / control / safety systems checking and testing, and all pre-commissioning activities have been completed, all incoming & outgoing services and utilities have been connected to each unit of the PLANT, interconnections of process lines and interconnection are completed and the Plant/Unit is ready in every respect for commissioning and for the first introduction of feed materials.

When OWNER is satisfied that Mechanical Completion of the plant has been achieved, OWNER shall issue certificate of Mechanical Completion to LSTK CONTRACTOR in accordance with the CONTRACT.

In order to meet this, LSTK CONTRACTOR shall perform all necessary mechanical works, tests and checks.

5.0 COMMISSIONING

5.1 Schedule for Commissioning

LSTK CONTRACTOR shall prepare a schedule for commissioning and testing and initial operation in conjunction with OWNER. This shall be issued at least three months before commissioning of the first facility.

This schedule shall include all activities as detailed herein and any other special activities, which require to be performed during commissioning.

5.2 Commissioning

LSTK CONTRACTOR shall be responsible to perform commissioning of the Plants and to provide necessary facilities during commissioning of the Plant. LSTK CONTRACTOR shall provide commissioning engineers and supporting staff and adequate commissioning labour. LSTK Contractor shall associate OWNER's engineers and operating staff with the commissioning work.

6.0 START UP

LSTK CONTRACTOR shall be responsible to perform start-up of the Plant/Unit. LSTK CONTRACTOR shall provide necessary facilities and for Start Up of the PLANT.

NOTE:

Detail COTRACTOR'S scope of work in relation with the construction / erection, and pre-commissioning, commissioning and start-up from the point of scope of execution as well as performing way are described in detail in the following Sub-Annexes of Sections 7.0 as given below.

7.0 Sub-Annexure:

Annex 7 - 1 : LSTK Contractor's Work Definition

Annex 7 - 2 : Detail Technical Scope

Annex 7 - 3 : Quality Control Procedures and Inspection Requirement

Annex 7 - 4 : Schedule Progress Evaluation and Progress Reporting

Annex 7- 5 : General Notes

ANNEXURE-7-1

LSTK CONTRACTOR'S WORK DEFINITION

LSTK CONTRACTOR shall perform/provide the following activities but not limited to:

1. LSTK CONTRACTOR scope of work shall broadly consist of construction / erection, refurbishing, pre-commissioning, commissioning and Start Up of the Plant under the management of commissioning team it includes but not limited to civil works, fabrication & erection of structural steelwork, field assembly, mechanical erection and / or assembly and installation of all equipment and machinery, piping, electrical systems and network, instrumentation, insulation, painting, etc., except in so far as "Contract" otherwise provides, the provision of all temporary facilities, staff, tradesmen, labour, tools, tackle, construction equipment and materials, insurance, consumables and everything whether of temporary or permanent nature necessary and required in and for the work, so far as the necessity for providing the same is specified or reasonably inferred in or from the contract.

2. Perform all civil and building works as per Annex7 - 2A, titled civil and building works.

3. Perform all structural steel works as per Annex 7 - 2B, titled structural steelwork.

4. Perform all piping fabrication and erection works as per Annex7 - 2C, titled piping fabrication and erection work.

5. Perform all equipment erection works as per Annex 7 - 2D, titled equipment erection work.

6. Perform all electrical works as per Annex7 - 2E, titled electrical work.

7. Perform all instrumentation works as per Annex 7 - 2F, titled instrumentation works.

8. Perform all insulation works as per Annex 7 – 2G, titled insulation Specification/work**.**

9. Perform all painting works as per Annex 7 – 2H, titled painting Specification/work**.**

10. LSTK CONTRACTOR shall be responsible for providing services and materials for construction of all temporary facilities, which are essential for successful completion of construction and erection.

    The LSTK CONTRACTOR shall establish, operate and maintain all temporary facilities, such as, but not limits to:

a) Labour camp/officers camps

b) Fabrication shops/yard

c) Workshop for maintenance of construction/testing equipment.

d) Field drawing office

e) Temporary warehouses, including open storage yards.

f) Construction offices (including facilities for photocopying, drawing reproduction, etc.)

g) First aid along with ambulance

h) Lab facilities, including NDT, for testing calibration, etc.

i) All temporary or approach roads for carrying out the WORK including temporary approach roads for access to LSTK CONTRACTOR'S site office/workshop/camp, etc. ground preparation for heavy lifts including approaches to cranes for heavy lifts. OWNER does not take any responsibility for making temporary roads.

j) Canteen & catering facilities for all LSTK CONTRACTOR'S work force.

k) All drainage around the facilities created for his WORK, and sewage disposal arrangements for labour camps/officers camps, site offices, etc.

l) Necessary transport for movement of its personnel, construction Equipment and Materials, consumables, etc.

n) Watering of roads through water tankers for dust suppression.

o) All temporary lighting for working during night.

p) All temporary hutments, sanitary & potable water and domestic sewerage requirements of LSTK Contractor's work force.

10. Supply to OWNER complete survey report within three (3) working days after completion of any survey.

11. All excess soil shall be disposed of by LSTK CONTRACTOR outside the premises in a location designated by OWNER representative.

12. Perform all nondestructive, hydrostatic and pre commissioning testing if required.

13. Supply to OWNER complete test records within three (3) days after completion of actual

testing.

14. Perform all welding including radiography required.

15. Provide drawings and documents as required.

16. Provide mobilization and demobilization, temporary material and temporary facilities and utilities required executing work.

17. Perform all material identifications as per CONTRACT.

18. Perform all transportations as required.

19. Perform quality assurance, control and supply quality control documentation.

20. Perform all pre-commissioning activities as defined in the CONTRACT.

21. Provide and supply all procedures for execution of the work in accordance with drawings specifications, and applicable codes and standards.

22. Perform all other works and activities and supply all other materials which are required for completeness of the Work either mentioned in the CONTRACT or they are necessary for completeness of the work, in compliance with highest available standards and good quality.

ANNEXURE- 7- 2

DETAIL TECHNICAL SCOPE

See accompanying by discipline

Annexure-7 - 2A	Civil and Building work
Annexure-7 - 2B	Structural steel work
Annexure-7 - 2C	Pipe prefabrication and Erection
Annexure-7 - 2D	Equipment erection
Annexure-7 - 2E	Electrical work
Annexure-7 - 2F	Instrumentation work
Annexure-7- 2G	Insulation work
Annexure-7- 2H	Painting work (For detail refer **TS-2001**)

ANNEXURE- 7- 2A

CIVIL AND BUILDING WORK

1.0 **SURVEYING**

1.1 Base line and base elevation will be furnished to LSTK CONTRACTOR. LSTK CONTRACTOR will furnish all surveys from this base line and elevation.

1.2 OWNER shall have the authority at anytime to determine, in accordance with the drawings or written directives, the correctness on completeness of the lines in use by LSTK CONTRACTOR.

1.3 Any erroneous WORK shall be corrected to OWNER'S satisfaction at LSTK CONTRACTOR'S expense.

2.0 **SITE**

Finish grading elevation to be as shown on drawing.
LSTK CONTRACTOR'S access to the WORK areas shall be via existing roads.
Any other roads required by LSTK CONTRACTOR are to be developed by LSTK CONTRACTOR.

3.0 **EXCAVATION AND BACKFILL**

3.1 **Excavation**

- Provide all excavation by machine or by hand according to the specifications.

- Excavation is to be executed by LSTK CONTRACTOR in a manner that will provide adequate space for performance, inspection and timely completion of the WORK. Supply dewatering as required. The method of dewatering shall be subject to Approval by OWNER.

- Temporary water drainage routing requires prior Approval by OWNER.

3.2 **Backfill**

All backfills shall be according to the specifications.

All excavations shall be kept dry and workable prior to and during backfiring and compacting.

Material that LSTK CONTRACTOR excavates in the course of WORK and which can be used for backfill, must be approved by OWNER prior to use. All other backfill material as required in this scope of work, drawings and specifications, shall be supplied by LSTK CONTRACTOR.

Back filling shall be to ground level as shown on drawing. The placing of backfill may only

start after approval by OWNER.

LSTK CONTRACTOR will inform OWNER to arrange for the required proctor tests. Tests shall be done by OWNER on his account.

4.0 PILES AND CONCRETE FOUNDATIONS

4.1 Install Piles and major and minor concrete foundations in accordance with the specification and drawings.

4.2 Blinding to Underside Foundation Work

Prior to placing a blinding layer of concrete, LSTK CONTRACTOR shall supply, place, compact and prepare the surface of excavated area. After this LSTK CONTRACTOR shall supply a blinding layer of concrete. Blinding layer to be in accordance with specifications and / or drawings.

4.3 Reinforcement of Concrete

Cut and bend to bar bending schedules, all type of reinforcing bars.

Store and protect all reinforcing bars against corrosion and any other deleterious effects prior to placing.

Installation of reinforcement including installation of spacers, supports, tying, wire in accordance with the specifications and drawings.

4.4 Anchor Bolts

Install all anchor bolts, in accordance with the specifications and drawings.

The following WORK is included but not limited to LSTK CONTRACTOR'S scope for installation of anchor bolts:

- Deliver of all templates.
- Store and protect against corrosion and any other deleterious effects.
- Place anchor bolts accurately in formwork or by templates, if required, or in pockets.
- Clean and grease anchor bolts threads after Concrete pour and protect bolts after greasing with plastic covers.

4.5 Inserted and Embedded Item

Install all concrete inserts and embedded items, including but not limited to the following items in accordance with the specifications and to the detail drawings to be furnished by LSTK CONTRACTOR.

- Cement - In sockets.
- Cinch anchors.

- Steel sleeves, various size angle.
- Channel shapes with anchors. Curb angles and steel plates.
- Anchor rails.
- Pipe sleeves of heavy duty PVC pipe.

The WORK shall include but not limited to:

Store and protect against corrosion and damage place accurately in Formwork or by templates, if required, or by temporary bars for proper positioning.

4.6 The following WORK is included but not limited to LSTK CONTRACTOR'S scope for installation of major and minor foundations:

- All excavation, including sheet piling, if required, backfill, compacting and the transportation of surplus material, neatly stockpiled at a location, chosen by LSTK CONTRACTOR and approved by OWNER. The supply, installation and maintenance of a complete concrete batch plant, including concrete testing laboratory. Installation of selected backfill material, if required. Supply and delivery and installation of all formwork, assembly and disassembly of all reusable formwork, inclusive if any and all required supporting, bracing, pockets, cutouts, recesses, etc.

- Bending and installation of concrete reinforcement bars to the requirements and supply of items as defined in 4.3 above.

- Installation of all anchor bolts (including fabrication of templates), to the requirements and supply of items as defined in 4.4 above.

- Installation of embedded and inserted items, to the requirements and supply of items as defined in 4.5 above.

- Installation of construction and expansion joints where required.

- Mixing, delivery and pouring of concrete in accordance with specifications. Stripping of formwork and removal of all surplus material to LSTK CONTRACTOR'S yard or locations designated by OWNER.

- All temporary storage of formwork at SITE shall be of an orderly nature. In case storage does not comply with the above-mentioned rule, OWNER shall have the right to remove formwork from SITE within forty eight (48) hours after first warning and back charge LSTK CONTRACTOR for all related costs. OWNER shall not be held responsible for any of LSTK CONTRACTOR'S losses.

- The finishing of concrete, where required to a finish in compliance with the specifications.

A copy of all-concrete mix truck delivery slips if applicable.

Concrete composition analysis of the concrete batch plant.

All scaffolding required.

All required dewatering to keep the excavations / backfill dry for the WORK.

5.0 CONCRETE STRUCTURES AND ELEVATED SLABS

Install concrete structures, in accordance with the specifications and drawings.

6.0 The following work is included but not limited to LSTK CONTRACTOR'S scope for installation of concrete elevated slabs:

See 4.6; however with -following exceptions: No-excavation, no backfill and- no dewater

7.0 YARD PAVING AND FINAL SURFACING

7.1 Excavation

Setting out and grading by machine and/or by hand for yard paving to the shape and depth in accordance with the specifications and drawings.

Disposal of all excavated material and neatly stock piling to a location chosen by LSTK CONTRACTOR and approved by OWNER.

7.2 Concrete Yard Paving

- Mix and install concrete for heavy duty paving areas, in accordance with the specifications and drawings.

- Mix and install concrete for light and medium duty paving areas in accordance with the specifications and drawings.

- The following work is included but not limited to LSTK CONTRACTORS scope for installation of concrete yard paving: See 4.6 above

- Surface preparation, including the supply and placing of waterproof building paper or similar waterproof material, well lapped at joints, laid on top of the well compacted sand layer and before pouring concrete.

- Reinforcement for heavy duty paving at top and bottom face and for light duty paving at top face only, with square mesh fabric reinforcement including protection against corrosion, the cutting, the bending and placement.
- Mixing and pouring of concrete in accordance with specifications, sufficient vibrating. Stopping clear from bases, plinths and piers and forming around surface and lay to give levels and falls.

- Installation of construction / expansion joints.

7.3 **Unpaved Areas**

Install gravel, tiles or crushed stone on leveled unpaved areas, all in accordance with the specifications and drawings.

7.4 **Concrete Tiles for Walkways**

Install well compacted sub-base layer and install the tiles on the sub-base all in accordance with specifications and drawings.

8.0 **CONCRETE PIPE SLEEPERS**

Fabricate and install reinforced concrete sleepers for pipe, complete with foundations in accordance with the specifications and drawings.

9.0 **MANHOLES AND CATCH BASINS, TRENCHES**

9.1 Fabricate and install pre-cast or formed and poured in situ concrete manholes and catch basins and trenches in accordance with the specifications and drawings.

9.2 The following work is included but not limited to LSTK CONTRACTOR'S scope for installation of manholes and catch basins. All excavation including sheet piling of required, backfill, compacting and the transportation of surplus material, neatly stockpiled at a location, designated by LSTK CONTRACTOR and approved by OWNER.

For Poured in Site

- Delivery and installation of all formwork, inclusive if any and all required supporting, bracings, pockets, cutouts recesses etc.
- Bending and installation of concrete reinforcement bars to the requirements and supply of items as defined in 4.3 above.

- Fabrication and installation of embedded and inserted items, if any, to the requirements and supply of items as defined in 4.5 above.

- Mixing and pouring of concrete in accordance with specifications.

- Stripping of formwork and removal of all surplus material to LSTK CONTRACTOR'S yard or locations designated by OWNER.

- All required dewatering to keep the excavations *I* backfill dry for installation work.

- Install cast - iron manhole frames and solid cover and fabricate and install steelwork catch basin grating and frames in accordance with specifications.

10.0 **COLLECTION BASINS, PITS, SUMPS, RETAINING WALLS AND CULVERTS**

10.1 Fabricate and install concrete collecting basins in accordance with the specifications and drawings.

10.2 Fabricate and install concrete sumps and pits in accordance with the specifications and drawings.

10.3 Fabricate and install concrete walls around tanks and other retaining walls in accordance with the specifications and drawings.

10.4 Fabricate and install concrete pipe and bridge culverts including head walls in accordance with the specifications and drawings.

11.0 **DITCHES AND TRENCHES**

11.1 Fabricate and install earthen and concrete ditches and trenches including connection pipes and boxes in accordance with the specifications and drawings.

12.0 **STEEL SLIDING PLATES AND PTFE SLIDING PLATES**

12.1 **Steel Sliding Plates**

- Fabricate and install steel sliding plates in accordance with specifications and drawings.
- The following work is included, but not limited to LSTK CONTRACTOR'S scope for fabrication and installation of steel sliding plates
- Pick up materials, storage and protection against corrosion and any other deleterious effects.
- Fabricate, place in pockets, level and grout, protect against possible damage and corrosion.

12.2 **PTFE Sliding Plates**

- Install sliding plates, in accordance with the specification and drawings.

The following work is included but not limited to LSTK CONTRACTOR'S scope for installation of sliding plates pick up materials, transport, store and protect

- Place in pockets, level and grout, protect against possible damage.

13.0 **GROUTING**

13.1 Mix and install grouting in accordance with the specifications and drawings.

13.2 LSTK CONTRACTOR shall grout under all structural steel columns and under all equipments, as specified.

13.3 The following work is included but not limited to LSTK CONTRACTOR'S scope for installation of grouting:

- Prepare top surface of base and /or plinth, pockets, sleeves etc., prior to placing grout.
- Mix and install grout mortar in accordance with specifications.

- Grout mortar shall be used between steel base plate and concrete foundations.

- Mix and install non-shrink grout between reciprocating rotary equipment base frame including the filling of the equipment steel frame, if required, and concrete foundation in accordance with manufacturer specifications and project specifications.

13.4 Grouting of equipment shall proceed only when equipment setting has been accepted by OWNER.

14.0 ASPHALT PAVING

14.1 Mix and install asphalt paving over base courses installed by LSTK CONTRACTOR, in accordance with the specifications and drawings.

- Roads/ Driveways/ Parking areas/ Sidewalks/ Tank pads

14.2 The following work is included but not limited CONTRACOR'S scope for installation of asphalt paving to.

- Installation of all materials necessary to make a complete installation.

- Installation of sub-grade, sub-base and base courses all properly compacted.

- Delivery and installation of all formwork, inclusive if any and all required supporting, bracing, pockets, cutouts, recesses, etc.

- Installation of expansion joints where required and/or construction joints

- Stripping of formwork and removal of all surplus material to LSTK CONTRACTOR'S yard or locations designated by OWNER.

- Mixing, delivery, installation, spreading and compaction of asphalt paving mixture in accordance with specifications.

- Any and all measures for proper asphalt paving installation and curing.

15.0 ROAD REPAIR AND MAINTENANCE

15.1 Supply and deliver necessary materials, equipments and labour to repair and maintain all plant roads, as necessary.

- Repair work shall be in accordance with the specifications.

- LSTK CONTRACTOR shall be responsible for repair of roads, all on the indication of OWNER due to the damage to the roads, caused by LSTK CONTRACTOR’S activities and construction operations, or due to faulty construction by LSTK CONTRACTOR. LSTK CONTRACTOR is not entitled for compensation for such repair work.

16.0 REPAIR OF DYKES, SLOPES AND DITCHES

16.1 Supply and deliver necessary materials, equipment and labour to effect repairs on dykes, slopes and ditches as necessary.

- Repair WORK shall be in accordance with the specifications.

- LSTK CONTRACTOR shall be responsible for repair of dykes, slopes and ditches all on the indication of OWNER'S representative, due to damage to the dykes, slopes and ditches caused by LSTK CONTRACTOR'S activities and construction operations, or due to faulty construction by LSTK CONTRACTOR.

- LSTK CONTRACTOR is not entitled for compensation for such repair work.

17.0 UNDERGROUND SEWERS AND PIPING SYSTEMS

17.1 Install the underground piping systems, in accordance with the specifications and drawings.

17.2 The following work is included but not limited to LSTK CONTRACTOR'S scope for installation of underground piping systems.

- Excavation including sheet piling, if required, backfill, compacting and the transportation of surplus material, neatly stockpiled at a location designated by LSTK CONTRACTOR and approved by OWNER.
- Installation of sand backfill if required

- Receiving unload, inspect and transport LSTK CONTRACTOR'S supplied materials and store and protect.

- Installation of piping materials necessary for a complete installation.

- The installation of above ground fire hydrants, fire monitors and standpipe as well as the underground firewater system.

- The fabrication and installation of supports and thrust blocks for the piping as required.

- Surface preparations and installation of coating and wrapping of the underground piping, if required as per Technical specification Mentioned in **Annexure- 7- 2C**

- Installation of glass fiber reinforced epoxy piping in accordance with manufacturer’s instructions as well as the specifications.

- Hydrostatic pressure testing of the underground piping systems including test apparatus, test piping, test blinds, bolts and gaskets in accordance with the specifications.

17.3 **Hydro Testing of Sewers and Underground Lines**

- Tests all sewers and underground piping systems as per test instructions. Testing is to be witnessed and approved by OWNER. A test schedule by test system shall be prepared by LSTK CONTRACTOR. Testing and completion shall be in accordance with project system priorities.

- Piping systems shall be tested with suitable water.

- Develop test system procedures and follow priorities established by OWNER. LSTK CONTRACTOR shall prepare detailed schedules based on this data for submittal to OWNER for his approval.

- The water for testing purposes is to be provided by LSTK CONTRACTOR.

- Inexpensive temporary gaskets shall be used in place of permanent gaskets where test blinds are located for hydrostatic testing. On successful completion of a test, the permanent gasket shall be installed when the blinds are removed.

- After hydro testing, LSTK CONTRACTOR shall perform the following activities:

- Flushing
- Remove temporary blinds
- Install permanent gaskets.
- Flange connection bolts tightened.
- Coat and wrap welds.
- Holiday testing and coating repairs.
- Backfill and compaction.

18.0 **CIVIL PART FOR UNDERGROUND ELECTRICAL GROUNDING SYSTEM**

18.1 Excavation of the routing for the direct buried cables, for the road crossing and for the branch conduit and sleeves in accordance with layout and detail drawings.

18.2 Transport of the excavated soil, neatly stockpiled to location chosen by LSTK CONTRACTOR and approved by OWNER.

18.3 Installation of all protection conduits and installation materials in accordance with the specification, and design and detail drawings.

18.4 Transport of excavated soil and backfill including compacting of the round up to finished plant level.

19.0 **CIVIL PART FOR UNDERGROUND CABLE TRENCHES (AND CABLE) CIVIL PART**

19.1 Excavation of the routing for the concrete cable trenches for the direct buried cables, for the crossings and for the branch conduit and pipe sleeves by machine or by hand as dictated by local conditions.

19.2 Transport the excavated soil, properly stockpiled to a location off chosen by LSTK CONTRACTOR and approved by OWNER.

19.3 Installation of the concrete cable trenches in accordance with the specification and the design and detail drawings.

19.4 For scope of installation of concrete cable trenches see item 11.

19.5 Installation of the road culverts, protection sleeves and cable ducts at road crossing in accordance with layout and detail drawings. For scope of installation see item 10

19.6 Transport of the excavated soil and backfill of the surrounding area of the concrete trenches up to finished plant level.

19.7 Transport of the excavated soil and backfill of road crossing up to road including the supply and installation of the repair of the paving and / or asphalt road covering.

19.8 Transport and backfill of the trenches with a layer of clean sand, free from stones equalized up to the bottom level of the first (bottom) cable layer.

19.9 Transport and backfill of the layer of clean sand between cable. Layers and above top cable layer.

19.10 Transport of excavated soil and backfill including compacting of the ground up to the layer of concrete tiles or trench covers.

19.11 Installation of the cable protection covers and/or trench covers and /or cable routing colored marking tape.

19.12 Transport of the excavated soil and backfill including compacting of the ground above the layer of concrete tiles up to finished plant level.

19.13 Installation of the cable route designated, trench markers.

20.0 STORAGE TANK PADS AND DYKES

20.1 Install tank pads as specified and as quantified on the specifications and drawings.

20.2 Install tank dykes and ramps as specified and as quantified on the specifications and drawings.

20.3 Install impervious clay layer inside the dyked tankage areas in accordance with specifications and drawings.

21.0 PERMANENT PLANT FENCING

21.1 Install permanent plant fencing, including personnel gates and truck gates as located, specified and quantified in the specifications and drawings.

22.0 SCAFFOLDING

22.1 Supply and erect all scaffolding for WORK.

22.2 Scaffolding shall be supplied, erected and maintained in strict accordance with local and governmental regulations as well as OWNER'S safety requirements. If there are conflicts, the more stringent shall prevail.

LSTK CONTRACTOR shall dismantle all its scaffolding at the completion of its WORK.

23.0 TESTING

23.1 All necessary tests in order to control the quality of the field works shall be done and all such test certificates should be kept in record, such as but not limited to

- Soil compaction tests.
- Concrete testing
- Asphalt testing
- Reinforcing bars testing

23.2 If any test fails LSTK CONTRACTOR shall replace those items, which do not meet the requirements.

All costs for replacements shall be borne by LSTK CONTRACTOR.

24.0 WELDING PROCEDURES SPECIFICATIONS AND WELDING PROCEDURE QUALIFICATION RECORDS

24.1 Provide within two months before starting the construction execution, its welding procedures (for A.G, U.G piping and any structural steel) for comment and approval. Approval of welding procedures by OWNER is required before the start of welding.

24.2 Prior to start of filed welding LSTK CONTRACTOR shall submit one (1) copy of all welders' qualification paper and applicable welding procedures approved and stamped by regulating authorities to OWNER.

25.0 DRAWINGS AND DOCUMENTS

25.1 LSTK CONTRACTOR will carry out all construction activities directly from the AFC construction drawings and specifications.

25.2 LSTK CONTRACTOR shall submit reports of each test or inspection within three (3) days after actual test or inspection. Failure to comply with the above rule may result in OWNER arranging for additional tests or inspections. Costs of which will be back charged to LSTK CONTRACTOR.

25.3 LSTK CONTRACTOR shall submit material certificates and quality records of the materials, as specified in previous sections and the applicable engineering specifications and standards.

25.4 LSTK CONTRACTOR shall also furnish a concrete installation record within two (2) weeks after completion of the WORK indicating, date of installation and quantity of concrete of each foundations, floor slab, elevated slab, frames, columns, etc.

This concrete installation record shall also show a reference with the concrete compression test certificates of the respective concrete pours and the concrete delivery slip numbers.

Failure to comply with the above time may result in the preparation of the documents by OWNER in which case all related costs will be back charged to LSTK CONTRACTOR.

26.0 MISCELLANEOUS

26.1 LSTK CONTRACTOR shall be fully responsible for the correct and accurate setting out of all elevations, positions, dimensions, alignments, profiles. etc, of all parts of the WORK and for the provision of all necessary instruments, appliances and labour in connection therewith The checking of any such matter by OWNER shall not relieve LSTK CONTRACTOR of its responsibility for the correctness thereof.

26.2 If during the construction or maintenance of WORK, any error is discovered in WORK, LSTK CONTRACTOR shall at its own cost rectify such error to the satisfaction of OWNER. LSTK CONTRACTOR shall in such case take all necessary actions such as overtime, etc. in order not to endanger the agreed upon time schedule.

26.3 All dimensions shown on the plans and drawings are given in the SI system, unless otherwise stated.

26.4 All costs for setting out the earthwork and for assisting OWNER in checking the various points, lines, levels, profiles, etc. shall be deemed to be included in the price.

26.5 LSTK CONTRACTOR shall under no circumstances extend its operations outside the limits of the area appropriated for WORK. LSTK CONTRACTOR will ensure that its operations shall not interfere in any way with properties of others.

26.6 No excavation work shall be started before the exact positions of the WORK have been marked by means of stakes controlled and approved by OWNER.

26.7 OWNER shall notify LSTK CONTRACTOR of all known existing underground pipes, cables, drains, manholes, etc, in current use, together with the approximate locations and hazards involved and LSTK CONTRACTOR shall ensure that they will not be broken or damaged in any way by the execution of WORK. Hand labour shall be used for excavation within a horizontal distance of 1.5 meters from existing utilities.

26.8 Any damage as referred to above shall be reported by LSTK CONTRACTOR. LSTK CONTRACTOR shall repair the damage.

26.9 The discovery of any unregistered pipes, drains, cables, etc., shall be promptly reported to and deals with as directed by OWNER. Excavation, as required to determine the exact location of existing underground pipes, drains, cables etc. shall be considered as a part of WORK.

26.10 LSTK CONTRACTOR shall take precautions i.e. mats, lining with timber, etc. not to cause damage to permanent plant roads curbing and sidewalks with its construction equipment.

26.11 LSTK CONTRACTOR shall provide and be responsible for the construction of all temporary dewatering. Drainage, sheet piling, timbering etc. to ensure the stability of slopes, trenches, embankments, etc. during excavation work and that all areas are adequately drained to the satisfaction of OWNER.

26.12 LSTK CONTRACTOR is responsible for all soil slides that may occur during the execution of the WORK and for any detrimental effect of the same. LSTK CONTRACTOR shall as directed by OWNER either correct or repair the damage to the satisfaction of OWNER at its own expense or pay for the cost of repair by others of all damage caused to the WORK or adjacent property. No additional payments shall be made to LSTK CONTRACTOR to compensate the financial consequences of soil slides.

26.13 Collapse, cave-in, or movement of excavations, trenches, or the like shall be the responsibility of LSTK CONTRACTOR. LSTK CONTRACTOR acknowledges this responsibility and instructions of the OWNER.

26.14 Trenches, excavations, and the like shall be maintained in strict accordance with the requirements of the applicable national and local regulations.

26.15 LSTK CONTRACTOR shall be held entirely responsible for any effect or damage, which the execution of any of the earthwork may have upon, or which may be caused to any portion of WORK or any of the surrounding property.

26.16 Excavation will proceed until all unsuitable material is removed.

26.17 LSTK CONTRACTOR is responsible for the excavation required to installing bottom of footings at elevations as shown on drawings. The removal of a poor soil below the intended bottom of excavation is included in the CONTRACT. Any unnecessary over excavation will

be in LSTK CONTRACTOR'S account.

26.18 Backfill shall be to the elevation shown on the approved drawings or as directed in writing by OWNER.

26.19 Special care must be taken in compaction operations over underground pipelines.

26.20 LSTK CONTRACTOR shall furnish all field engineering, surveying, layout, and checking to properly install all foundations to meet all requirements of the drawings and specifications, on completion of each foundation LSTK CONTRACTOR shall mark all foundations with a clear center line, locating both North, South, East and West and a bench elevation mark. LSTK CONTRACTOR shall stencil or by other means, paint equipment and column designation and coordinates, to all foundations installed by LSTK CONTRACTOR. All markings shall be located above high point of paving. These markings shall be preserved for use by others.

26.21 LSTK CONTRACTOR shall design concrete mix specification and furnish by means of reports from OWNER'S laboratory, proof that the materials and mixes for concrete conform to the specifications and codes prior to pouring the first concrete on SITE. LSTK CONTRACTOR shall furnish all field labour to make concrete tests and fill cubes quality of concrete aggregates and mix design will be checked by OWNER'S laboratory regularly.

26.22 All aboveground concrete for supports for steel structures must be smooth finished, and exposed edges of concrete to have a chamfer.

The top of the foundations shall be poured so as to ensure true surfaces and designated slopes in all cases. LSTK CONTRACTOR is to avoid damage or movement of already installed reinforcement and/or other structures, formwork, etc., when pouring concrete.

26.23 All concrete pours for a given element must be monolithic, except where noted on the drawing or approved by OWNER.

25.24 If pouring cannot be finished within normal working hours, necessary actions shall be taken, sufficiently in advance for requesting permits for overtime. All pouring must be continued until the element is complete. OWNER shall be informed at least twenty-four (24) hours in advance.

26.25 Damaged formwork must be repaired in such a way as not to mark the concrete finish. All formwork must be braced adequately and be of a rigid construction. Gravel nests, surfaces crack, honeycombs, etc., and shall be repaired to the satisfaction of OWNER.

26.26 LSTK CONTRACTOR shall use immersion-vibrating equipment but it needs to be of a type approved by OWNER prior and also during use. Vibration of formwork and fresh concrete WORK is not allowed. OWNER will have the right to require replacement of inadequate during all phases of the WORK. A must condition shall be maintained after pouring as set forth in specifications. The WORK involved in this is to be included in the pricing.

26.27 OWNER reserve the rights to reject any WORK already poured which is not in accordance with drawing and specifications and of adequate quality.

Serious inclusions appearing in concrete shall be reason for the rejection of WORK and LSTK CONTRACTOR requested to repair or replace at his own expense.

26.28 All costs involved in demolition, removal and replacement of rejected WORKS shall be the responsibility of LSTK CONTRACTOR all materials, equipment or auxiliaries not accepted by OWNER shall be removed immediately from the OWNER'S property.

26.29 Ready - mixed concrete shall be delivered without segregation. The concrete batch plant has to be approved by OWNER. Small quantities of concrete may be made at SITE after approval of OWNER.

26.30 The pouring of any reinforced concrete may only start after having obtained Approval of OWNER.

26.31 LSTK CONTRACTOR shall provide, during the period of this CONTRACT, temporary drainage ditches in WORK so that water will not be pended and so that all areas are adequately drained to the satisfaction of OWNER.

26.32 LSTK CONTRACTOR shall provide, during the period of this WORK, systems for the dewatering of all its WORK areas as required to properly execute the WORK. All dewatering methods shall be subject to the approval of OWNER.

26.33 All excavated boulders will be removed from SITE by LSTK CONTRACTOR.

26.34 Manholes are to be marked with M.H. Number.

26.35 Underground service lines have to be marked at their installation limits to aboveground piping, indicating line size, and service and line number.

26.36 Prefabricated concrete -items are to - be marked with date of fabrication, size, Length, identification code and installation north arrow.

27.0 BUILDINGS

27.1 LSTK CONTRACTOR shall do the construction of the buildings, including all activities and installations as specified, in drawing and specifications including the fabrication of all items that are not standard hardware components.

28.0 Quality of all civil and building materials shall be approved by OWNER before usage in the PLANT.

ANNEXURE- 7-2B

STRUCTURAL STEELWORK

1. Delivery of all materials and fabricated structural steel to SITE, including all required transport, storage, intermediate storage, etc., including loading and unloading of materials.

2. LSTK CONTRACTOR will carry out all construction from the AFC construction / erection drawings and specifications.

3. LSTK CONTRACTOR shall be held entirely responsible for any effect or damage, which the erection of the structural steel may have upon, or which may be caused to any portion of WORK or any of the surrounding property.

4. **Erect Structural Steel-Structure Frames**

   This item covers all activities required to erect prefabricated structural steel framing for single and multilevel structures.

   It includes, but is not limited to, the following :

   - Provision of all tools, equipment and consumables used in the course of the work.
   - Shimming of foundations and joints.
   - Erecting.
   - Cutting, drilling, welding and bolting to achieve fitment.
   - Rectification required, if any.
   - Final levelling, aligning and bolting (including torquing).
   - Grouting of components and areas supplied unpainted or requiring finish coats, as per specifications.
   - Touch up painting of damaged areas.
   - Also included in this item are all clips plates, stiffeners, gussets, and connection material supplied loose for field installation.

5. **Fabricate and Erect Structural Steel-Structure**

This item covers all activities required to fabricate and erect structural steel framing for single and multilevel structures, from raw steel, if any, sections, plates, rounds, etc. It including, but is not limited to the following :

- Provision of all tools, equipment and consumables used in the course of the work.
- Preparation of detailed fabrication drawings and getting them approved from Owner.
- Shimming of foundations and joints.
- Measuring, cutting, bending, bolting and / or welding.
- Erecting.
- Cutting, drilling, welding and bolting to achieve fitment.
- Final levelling, aligning, bolting and /or welding (including torquing)
- Grouting of support piers.
- Painting as per specifications.

6. **Fabricate and Erect Ladder and Safety Cages**

This item covers all activities required to fabricate, assemble and erect ladders and safety cages in steel structures, from raw steel (unpainted) sections, plates rounds, etc.

It includes, but is not limited to, the following:

- Provision of all tools, equipment and consumables used in the course of the work.
- Preparation of detailed fabrication drawings and getting them approved from Owner.
- Measuring, cutting, bending, bolting and / or welding.
- Assembly and erecting including cutting, drilling, bolting, welding to achieve fitment.
- Cutting, drilling, welding and bolting to achieve fitment.
- Final Bolting and / or welding in position.
- Fabrication and installation of safety barrier rail and gate.
- Installation of raw bolts and forming of concrete pads, or connecting to a lower platform.
- Painting as per specifications.

7. **Fabricate and Erect Platform and Walkways**

This item covers all operations required to fabricate erect platforms and walkways on vessels, towers, structures, etc or on the ground from raw steel (unpainted) sections, plates, rounds, etc.

It includes, but is not limited to, the following :

- Provision of all tools, equipment and consumables used in the course of the work.
- Preparation of detailed fabrication drawings and getting them approved from Owner.
- Measuring, cutting, bending, bolting and / or welding.
- Erecting including any, cutting, drilling, welding for fitment.

- Final levelling, bolting and / or welding.
- Installing anchor bolts and grouting.
- Painting as per specifications.

Not including is the installation of flooring or the erection of handrail.

8. **Fabricate and Erect Welded Handrail**

This item covers all operations required to fabricate and erect double rail handrail and tope plate of all welded construction, from raw steel (unpainted) sections, plates rounds, etc.

It includes, but is not limited to, the following :

- Provision of all tools, equipment and consumables used in the course of the work.
- Preparation of detailed fabrication drawings and getting them approved from Owner.
- Fabrication including cutting, bending, welding, etc.
- Erecting of posts, top and middle rails toe plate including any cutting, trimming for figment and welding.
- Grinding smooth of all cut edges and welds.
- Painting as per specifications.

9. **Fabricate and Erect Galvanized Tubular Handrails**

This item covers all operations required to fabricate and erect double rail tubular galvanized hand railing including all standards, fittings, bends, etc., from raw steel (unpainted) sections, plates, tubes, etc.

It includes, but is not limited to, the following :

- Provision of all tools, equipment and consumables used in the course of the work.
- Fabrication including cutting, trimming edge stripping to required size & shape.
- Erecting into position.
- Bolting and/or welding.
- Trimming to suit platform structure and providing openings for pipe or cable, etc.
- Making good edges, and touch up painting including cold galvanizing of cut or welded parts.
- Painting of unpainted steel sections

10. **Fabricate and Install Floor Grating**

This item covers all activities required to fabricate and install galvanized floor grating from large sheets ready for cutting, trimming, etc., to platform shapes.

It includes, but is not limited to, the following :

- Provision of all tools, equipment and consumables used in the course of the work.
- Fabrication including cutting, trimming, edge stripping to required size & shape.
- Erecting into position.
- Bolting and/or welding.
- Trimming to suit platform structure and providing openings for pipe or cable, etc.
- Making good edges, and touch up painting including cold galvanizing of cut or welded parts.

11. **Fabricate and Install Chequer Plate Flooring**

This item covers all activities required to fabricate and erect chequer plate flooring, from sheets.

It includes, but is not limited to, the following :

- Provision of all tools, equipment and consumables used in the course of the work.
- Fabrication including cutting, trimming edge stripping to required size & shape.
- Erecting into position.
- Bolting and/or welding.
- Cutting to suit platform structure and providing opening for pipe or cable, <etc.

12. **Erect Davits**

This item covers all activities required to erect fabricated davits on exchangers, vessels or in structures.

It includes, but is not limited to, the following:

- Delivery of davits and all other materials.
- Provision of all tools, equipment and consumables used in the course of the work.
- Erecting up painting of damaged areas.

13. **Roof and Wall Sheeting**

This item covers all activities required to erect by bolting of roof and wall sheeting.
It includes, but is not limited to, the following :

- Provision of all tools, equipment and consumables used in the course of the work.

- Cutting and fitting of sheeting including all shrilling, trimming and notching to facilitate openings.

- All flashing of ridges, corners gables, door jambs, etc.

14. **Down pipes and Gutters**

This item covers all activities required to install metal downpipes and gutters.

It includes, but is not limited to, the following :

- Provision of all tools, equipment and consumables used in the course of the work.
- Erecting including fitting, trimming supporting and jointing.

15. **Roof or Ridge Ventilator**

This items covers all activities required for the erection of roof or ridge ventilators on a steel clouded building.

It includes, but is not limited to, the following :

- Provision of all tools, equipment and consumables used in the course of the work.
- Erecting on roof including any trimming or figment.

16. **Install Gantry Crane Rails**

This item covers all activities required to install rails.

It includes, but is not limited to, the following :

- Provision of all tools, equipment and consumables used in the course of the work.
- Erecting jointing levelling, aligning, and bolting or welding in passion.

17. **Install Gantry/Overhead Travelling Crane**

This item covers all activities required to erect and complete the installation of overhead cranes.

It includes, but is not limited to, the following :

- Provision of all tools, equipment and consumables used in the course of the work.
- Erecting into rails.
- Installing all controls, both mechanical and electrical.
- Testing and running of crane.

18. **Install Travelling Trolleys**

This item covers all activities required for the installation of beam mounted travelling trolley.

It includes, but is not limited to, the following :

- provision of all tools, equipment and consumables used in the course of the work.
- Erecting into position.
- All levelling and shimming of trolley beam as required.
- Marking of all beams and trolley with safe Working Load.
- All testing and running as required.

19. **Inspection and Testing**

- Inspection of steel structure shall be in accordance with the codes and standards.

- LSTK CONTRACTOR shall provide NDE services acceptable to OWNER. NDE inspection shall be carried out in accordance with standards, codes and specifications .

- LSTK CONTRACTOR shall be responsible for the repair of faulty welds and for all required extra radiography and inspection of the faulty welding work. In case of a faulty weld, 100% radiography on LSTK CONTRACTOR'S account can be done as per code.

ANNEXURE- 7– 2C

PIPE PREFABRICATION AND ERECTION

1.0 **PIPING**

1.1 **Magnitude of Piping**

LSTK CONTRACTOR shall prefabricate, install and test all piping as shown on the plan drawings and isometrics.

2.0 **PIPING FABRICATION AND ERECTION**

2.1 Piping systems and pipe supports shall be designed, fabricated, inspected, and tested in accordance with rules, codes, specifications and drawings.

2.2 Miscellaneous piping materials for vents, drains, instrument connections, etc. on equipment shall be installed using P & ID'S and equipment drawings.

2.3 The fabrication and erection of piping includes field welds. It is LSTK CONTRACTOR'S responsibility to choose the number and location of field welds to ensure efficient transportation and handling during erection. Furthermore LSTK CONTRACTOR shall locate the field welds in such a way that final adjustment for fit-up purposes will be possible.

For alloy piping that has to be stress relieved after welding the number of filed welds shall be kept to a bare minimum. LSTK CONTRACTOR shall thoroughly evaluate the need for each field weld in alloy piping he deems necessary.

2.4 LSTK CONTRACTOR will furnish OWNER with a marked up set of isometrics identifying all spool pieces, and weld numbers. All piping spools shall be clearly identified, per isometric by means of stainless steel tags affixed with wire.

2.5 LSTK CONTRACTOR shall erect all prefabricated and straight run piping as required by the drawings and specifications.

The erection and installation of the piping shall include but not be limited to the following

- Control valves.
- Safety valves
- Rapture disks.
- Level instrument and gauges.
- External level displacers.
- Special fittings.
- Breaching of vents, drains, instrument connections, etc.

- Rota meters.
- Orifice flanges.
- Orifice plates.
- In - line instruments.
- Steam tracing.
- Steam traps.
- Extension stems. Valve operators.
- Bellows, expansion joints and similar specialty items.
- Thermowells (flanged, screwed and weld Ins.).
- Sample coolers.
- Instrument connections (up to and including the first block valve).
- Spring hangers and spring supports.
- Installation of miscellaneous piping and instrumentation supplied by equipment vendor.
- Temporary piping for drying, flushing and hydrostatic testing if necessary.
- Connection of piping to equipment.
- Connection of aboveground piping to underground piping.
- Pipe supports.

This shall include any necessary work to the piping to correct equipment misalignment.

2.6 Fastening of floor supports on concrete will be done with expansion type foundation bolts, if no anchor bolts are provided.

2.7 **Wrapping & Coating**:- Surface preparations and installation of Wrapping & Coating of the underground piping with Cold tape (Materials for line coating and wrapping shall be of Tape coating system (Polyethylene backed tape with butyl rubber based adhesive system), if required

2.12.1 Protective coating shall consist of a coating system employing Primer, Inner Wrap and Outer Wrap.

2.12.2 The coating system shall be mechanically applied by an approved type of wrapping machine utilizing constant tension brakes except at tie-in welds, repair patches and at other locations where mechanical application is not practicable..

2.12.3 Coating and wrapping materials shall be handled, transported, stored and applied strictly in accordance with the manufacturer's instruction.

2.12.4 Wrapping Coating material is Cold tape type from **Polyken/Denso/Atla** shall be used.

2.13 **Flushing and Cleaning of Piping Systems**

i) Sections fabricated in LSTK CONTRACTOR'S workshop shall be fitted with plastic end caps to seal pipe ends, and jointing surfaces shall be suitably protected.

These caps shall not be removed until sections are in the course of erection after delivery at SITE and then shall be removed for refuse.

ii) During fabrication and erection the sections shall be inspected or internal cleanliness.

iii) The water which will be used for testing and flushing of the piping system shall be recollected per instruction given by OWNER.

v) Piping systems shall be flushed with suitable water as supplied by LSTK Contractor unless designated for nitrogen or air testing or otherwise specified by licensor. OWNER'S approval is required before start of flushing.

v) LSTK CONTRACTOR shall supply all equipment, pumps, gauges, etc. required for flushing and testing of the piping systems.

vi) For hydro testing and flushing the piping LSTK CONTRACTOR shall weld and caps and Install drain plugs, remove end caps after successful hydro test.

3.0 HYDRO TESTING

3.1 Inspection and hydro testing of the piping systems shall be in accordance with the drawings and specifications and in strict witness by OWNER representatives.

3.2 Atmospheric pressure systems shall be:

- Visually inspected that all joints are properly made.
- Filled with water for a 24 hours leakage test under atmospheric conditions.

If any leakage occurs in the system during testing, repairs must be made without extra costs to OWNER.

3.3 LSTK CONTRACTOR shall test all piping systems as per the project test diagrams. Testing is to be witnessed and approved by OWNER and where applicable by the appointed (independent inspection authority) filed inspector. A test schedule by test system shall be prepared by LSTK CONTRACTOR and shall be submitted to OWNER for Approval.

3.4 Testing and completion shall be in accordance with project system priorities.

3.5 All equipment, pumps, gauges, pressure recorders temporary piping and fittings, test gaskets and bolting, required for testing of the piping systems and part of LSTK CONTRACTOR'S supply. Before testing LSTK CONTRACTOR shall calibrate its testing equipment.

3.6 LSTK CONTRACTOR shall supply and install blind flanges when required to enable testing of the lines.

3.7 Inexpensive temporary gaskets supplied by LSTK CONTRACTOR, shall be used instead of permanent gaskets where test blinds are located for hydrostatic testing. On successful completion of a test the permanent gasket shall be installed when the blinds are removed.

3.8 Piping systems shall be tested with suitable water. Extreme care shall be taken that suitable water is used for stainless steel systems. For stainless steel the water must be approved by OWNER and shall have a content of chlorides ≤ 50 mg/L

3.9 The water for testing purposes will be furnished by LSTK CONTRACTOR.

3.10 LSTK CONTRACTOR is to perform the testing in a sequence so as to allow sufficient time for insulation and/or painting to complete within the time frame of the project schedule.

3.11 A formal system of documentation will be developed by LSTK CONTRACTOR and approved by OWNER for use by LSTK CONTRACTOR to certify this testing phase of the piping erection. This system will also include a section for supplying OWNER'S "But list" comments.

3.12 Erected piping shall be hydrostatically tested in test systems, but not through equipment, control valves etc. except where piping is welded to equipment.

3.13 LSTK CONTRACTOR remains responsible for ensuring that no item of equipment, or instrument, is damaged by the test pressure or the test fluid. Suitability of test fluid to be Approved prior to testing by the OWNER.

3.14 It is emphasized that the installation of temporary strainers prior to testing shall be part of WORK. OWNER shall be contacted concerning installation of temporary strainers.

3.15 When lines are pressure tested, valves at the end of the lines must be covered with a test blank for safety reasons. A record, preferably on the test diagrams, shall be kept by LSTK CONTRACTOR indicating which sections have been completed.

Note: Testing against closed valves in not allowed (spades to be used)

3.16 All material damaged during tests shall be replaced on LSTK CONTRACTOR'S account. All joints broken after testing for installation of strainers, orifice flanges, safety valves, etc. must be remade tightly; labour is for LSTK CONTRACTOR'S account.

3.17 After testing the piping systems, they shall be completely flushed and drained. OWNER will approve when a line is considered flushed and drained by LSTK CONTRACTOR.

3.18 When each section or circuit has been pressure tested and passed, a certificate prepared by LSTK CONTRACTOR on LSTK CONTRACTOR'S furnished forms showing details must be signed by LSTK CONTRACTOR and OWNER, when the test has been completed and the system drained, test blanks must be removed by LSTK CONTRACTOR.

3.19 The following activities by LSTK CONTRACTOR are included for the reinstatement of piping after hydro testing:

- LSTK CONTRACTOR installed temporary testing blinds to be pulled.

- Temporary spool pieces taken out.

- Gaskets renewed, temporary replaced with permanent.

- Flange connection bolts tightened.

- Post hydro punch list items corrected.

- Temporary strainers installed.

- Chemical cleaning performed.

- Supports and hangers checked if in final position.

- Rotating equipment cold alignment checked.

- Reinstallation of control and safety valves and in - line instruments which LSTK CONTRACTOR has removed for hydro-testing.

3.20 Nondestructive testing of welds and systems is to be performed in accordance with standards, codes and specifications prior to perform any hydro-test.

3.21 Wrapping Coating material for Under Ground piping is Cold tape type of Polyken or equivalent cold Tape to be used.

4.0 PIPING MATERIAL IDENTIFICATION AND PAINTING

4.1 All piping materials are supplied by LSTK CONTRACTOR and shall be properly stamped and color-coded to ensure that the correct materials are used as required by the drawings, specifications, codes and regulations.

4.2 All materials will be adequately marked as to its specifications. Should LSTK CONTRACTOR be required to cut same or otherwise render piece(s) to have no marking, LSTK CONTRACTOR'S transfer or replacement of proper identification marking to the pieces involved, must be done according to approved stamping method and to be counter stamped by LSTK CONTRACTOR. Paint alone is unacceptable.

4.3 The governing principle shall be that in the installed piping systems, all components can be identified and their origin and complete specifications can be determined. The method for identification and stamping or tagging of the various components of the system shall be worked out in coordination with OWNER and only be implemented after approval.

LSTK CONTRACTOR shall be held responsible for this requirement as a minimum, and any other requirements of local codes and regulations as to identification and documentation of materials.

4.4 Surface preparation and paint application of piping system by LSTK CONTRACTOR, shall be

per paint specification.

4.5 LSTK CONTRACTOR shall assure that no welds are covered by prime coats prior to acceptance of hydro test.

4.6 LSTK CONTRACTOR must ensure that all stamping such as code stamps, registration spool identification, charge numbers etc. shall be visible after paintwork.

5.0 **WELDING**

5.1 All welding shall be carried out according to codes and specifications.

5.2 Welder's qualification

5.2.1 All welders including those with valid qualifications will be required to submit a test conducted by OWNER prior to start of welding.

Welders that have a certificate which is still valid for the type of material and in accordance with ASME IX will not be tested by OWNER.

5.2.2 A current list of qualified welders must be maintained by LSTK CONTRACTOR and a copy furnished to OWNER each time a revision is made.

5.3 Welders' identification stamps shall be provided by LSTK CONTRACTOR. Each weld shall be clearly stamped with welders identification. All welding including tack welding shall be carried out by qualified welders. Unstamped welds shall be-removed and replaced at LSTK CONTRACTOR'S expense.

5.4 Job SITE fabrication shall be carried out under cover where possible.

5.5 Weld spatter shall be knocked off around all welds leaving a smooth clean surface.

5.6 Where openings for branches are cut in run of pipe, all material, which may drop inside the pipe, shall be completely removed before the branch line is welded in place.

6.7 The interior welds of orifice flanges shall be ground smooth.

5.8 **Electrodes, Rods, Wires and Fluxes**

Electrodes shall be stored in the makers' airtight containers until required for use. Electrode heaters shall be used on Job SITE, for low hydrogen types of electrodes.

Electrodes and filler wires to be used at site in this job shall be procured from the approved vendors only. Electrodes and filter wires shall be **D&H, Advani Orlikon or ESAB, Mailam and Bohler group make only**

5.9 **Open Air Welding**

Where welding in the open air is unavoidable, WORK must be discontinued where the quality

of the weld may be impaired by weather conditions. Including but not limited to airborne moisture, sand or high winds. After rain the metal surfaces shall be dried. For metal temperature below 5 ^{0}C joints to be preheated.

5.10 **Welding Procedure Qualification**

LSTK CONTRACTOR shall supply welding procedure specifications and qualification in accordance with the rules as set by OWNER.

5.11 Fees for inspection required for welding procedure and welders qualifications, supply of equipment required for the qualification test of welders and welding procedures are for account of LSTK CONTRACTOR.

5.12 **Inspection and Testing**

5.12.1 Inspection of welds shall be in accordance with the instructions of OWNER and/or the requirements of codes and standards.

5.12.2 LSTK CONTRACTOR shall be responsible for the repair of faulty welds and for all the required extra radiography and inspection of the faulty welding work. In case of a faulty weld, 100% radiography, on LSTK CONTRACTOR'S account, shall be done on the weld performed as per code.

OWNER shall have absolute discretion in the selection of the welds, which are to be radio graphed.

5.12.3 LSTK CONTRACTOR shall provide NDE service, acceptable to OWNER.

NDT inspection shall be carried out in accordance with codes for all lines as indicated in the piping specification. LSTK Contractor is responsible to complete the job in all respect.

ANNEXEURE- 7-2D

EQUIPMENT ERECTION

1.0 **SURVEYING**

1.1 Baseline and base elevation will be furnished to the LSTK CONTRACTOR. LSTK CONTRACTOR will furnish all surveying from this baseline and elevation.

1.2 OWNER shall have the authority at any time to determine in accordance with the drawings or written directives, the correctness or completeness of the lines in use by LSTK CONTRACTOR.

1.3 Any erroneous WORK shall be corrected to OWNER'S satisfaction at LSTK CONTRACTOR'S expense.

2.0 **RIGGING STUDIES AND PLANS**

2.1 LSTK CONTRACTOR shall supply rigging studies and plans as specified.

3.0 **EQUIPMENT HANDLING**

3.1 The handling of all equipment shall include, but not limited to the following activities by LSTK CONTRACTOR:

3.1.1 Submittal to OWNER of detailed rigging studies and plans for lifting, transporting and setting of equipment 4 weeks in advance of work for OWNER to review and approval. Complicated lifts shall be started in the morning and completed the same day.

The transportation plans are to include as a minimum:

Type of equipment to be used to transport each piece.

The planned route of the movement.

The estimated duration of the movement.

The obstructions to the route to be temporarily removed.

3.1.2 Receive, inspect, store, protect and perform preventative maintenance on all equipment in accordance with the specifications and drawings and/or equipment manufacturer's instructions.

3.1.3 Prepare foundations, pipe sleeves, paving, concrete structures and steel structures for setting equipment.

3.1.4 Transport form warehouse or point of unloading and install equipment on foundations, paving or structures.

3.1.5 Plumb level and align equipment with coordinates in accordance with the specifications and drawings.

3.1.5.1 **GENERAL**

All of the equipment must be plumbed, leveled and aligned with the coordinates specified on the drawings both in plan and elevation and to the tolerances called out in the specifications, specific manufacturer's instructions or recommended manufacture's practices.

- LSTK CONTRACTOR will be required to verify field conditions and will be responsible for final alignment of mechanical items for this project. LSTK CONTRACTOR will check the anchor bolt locations against the equipment. Any deviation must be reported to OWNER in writing.

- LSTK CONTRACTOR will be required to supply and install shims required for all equipment erection. All cinch anchors required for equipment and supports will be supplied and erected by LSTK CONTRACTOR.

  Prior to the placement of the equipment on a foundation, the surfaces of the foundation shall be cleaned of oil, grease, excess concrete and foreign matters by LSTK CONTRACTOR.

- Prior to setting the equipment on the foundations, the underside of the equipment base plate or supports will be cleaned free of oil, grease and other loose materials by LSTK CONTRACTOR.

- Anchor bolts shall be checked for damage to the thread and the threaded part shall be properly greased.

- Damaged anchor bolts must be replaced by LSTK CONTRACTOR and brought to the attention of OWNER.

- The openings between the anchor bolts and sleeves have to be cleaned of foreign materials to full depth of the opening by LSTK CONTRACTOR.

- All steel wear plates and guide keys shall be coated by CONTRACT with proper lubrication, prior to setting the equipment.

- Equipment shall be set true to line. at correct elevation and in proper orientation as shown and noted on the drawings.

- Maximum allowable setting tolerances shall be in accordance with manufacturer's requirements or with the specifications, whichever is more stringent.

- All equipment, unless otherwise specified, shall be leveled with shims at each anchor bolt (shim on both sides of each anchor bolt) and at intermediate points as required to prevent distortion of the equipment. Shims shall have square cut edges (not trimmed or sheared) and shall be of various thicknesses to minimize the number of shims required. Shims shall be supplied by LSTK CONTRACTOR.

- The equipment shall be set, leveled, aligned and inspected with precision tools (steel straight edge, graduated machinist levels, dial indicators, theodolites, water level instruments, turbine levels, etc.). Setting, leveling and alignment shall be according to manufacturer's recommended tolerances and specifications.

- There may be a number of items not installed by the manufacturer, i.e. seals, packing, lubricators, gauges, miscellaneous piping and tubing, thermometers, etc. that will come separately packed from the equipment itself that must be identified, stored, preferably inside in accordance with project criteria, and finally installed. LSTK CONTRACTOR is responsible for these activities.

- LSTK CONTRACTOR shall remove all temporary shipping supports or erection materials.

- For equipment with sliding type supports, LSTK CONTRACTOR will remove dirt, grease or other foreign matter and will coat with graphite grease supplied by LSTK CONTRACTOR on the support.

- The anchor bolt nuts will be placed so as not to restrict the longitudinal movement of the sliding end.

- All costs are included in the lump sum price.

4.0 MATERIAL HANDLING SYSTEM

4.1 ERECTION & COMMISSIONING

4.1.1 The complete material handling system including its all equipment shall erected at site and commissioned in accordance with the best engineering practice.

4.1.2 Packing, forwarding, transportation, unloading and storage at site, safety and protection of various components at site, insurance etc. shall be the responsibility of the LSTK Contractor / supplier.

4.1.3 All men, material and tools required shall be arranged by the LSTK Contractor at his own cost. The LSTK Contractor shall also arrange for the safe handling, storage, protection and security of his good at site.

4.1.4 The purchaser shall be responsible for supplying his part of material only as covered by the clause pertaining to the work to be excluded from LSTK Contractor's scope of supply.

4.1.5 After erection at site, the belt conveyors and related equipment shall be tested for satisfactory operation for mechanical completion.

4.2 MECHANICAL COMPLETION

4.2.1 Mechanical completion shall be considered as achieved when the system is mechanically complete along with the pre-commissioning activities and is ready for feeding. This shall include but not limited to the following:

1. The installation as per FINAL PROPOSAL is complete in all respects in accordance with the drawings, specifications including any approved changes thereto and in accordance with all applicable codes and laws.
2. The machinery, conveyors and all drives are aligned and run or cycled under no-load conditions.
3. The electrical system is installed and tested in accordance with applicable codes and specifications. All wiring is checked for correct hook-up. Motor rotation is checked and power system protective devices are set.
4. Painting is completed to the extent that the incomplete work does not prevent plant start-up and commissioning.
5. Successful completion of no-load test of all the equipment and the complete system.
6. Temporary construction facilities are removed to the extent necessary to permit the plant start-up and commissioning.

4.2.2 The OWNER shall inspect and certify that the LSTK Contractor executed the job in accordance with drawings and specifications.

4.2.3 When the complete belt conveyors and related equipment have been fully erected at site, LSTK CONTRACTOR shall request OWNER for his agreement to start the No-load Test Run. Owner shall, within 72 hours of receipt of such request, issue his agreement or advise LSTK Contractor in writing of any deficiencies noticed in the equipment.

4.2.4 Omissions / rectifications of minor items, if any, not affecting commissioning shall not withhold MECHANICAL COMPLETION as long as the LSTK Contractor agrees to supply / rectify the same within the specified period. The decision of the OWNER is final in this regard.

4.3 COMMISSIONING AND GUARANTEE TEST

4.3.1 After issue of Mechanical completion certificates by Owner, LSTK CONTRACTOR & OWNER shall mutually decide the date of commissioning of the equipment. From the

date of commissioning, the equipment shall be gradually brought up to full load or any other load at the discretion of OWNER, and thereafter the equipment shall be run for a minimum period of 5 days. OWNER shall have the right to reduce this period where deemed necessary because of OWNER's difficulties. During this period of 5 days of operation or the reduced period, the system shall run at an average of 90% of rated capacity. If the LSTK CONTRACTOR is not able to bring the load to 90% of the rated capacity as mentioned above within 2 (two) months, OWNER shall, without prejudice to any of his rights under the contract, has the right to take over the equipment and to proceed with modifications / rectifications / additions as he considers necessary at LSTK CONTRACTOR's cost and risk to achieve this sustained load run.

ANNEXURE- 7- 2E

ELECTRICAL WORK

1.0 **SCOPE: ELECTRICAL WORK COVERS**

1.1 Installation and erection of the following equipment (items) consists of the preparation for installation, connection, testing and pre-commissioning etc. as per specifications and as per drawings.

1.2 Provision of all tools, equipment and consumables used in the course of the work.

1.3 The installation of the following systems (items) shall consist of the connection, testing and pre-commissioning etc., so that the systems are ready for use as per specifications and as per drawings.

1.4 Transport, store and protect supplied materials to the construction location.

2.0 **ELECTRICAL ITEMS**

2.1 Generators / Motors

2.2 Control panels

2.3 Transformer

Note : Installation of all accessories, tanks, levelling and fixing in place are also considered.

2.4 **Switch Gears**

Note : Bolting together sections where supplied separately and installation of panels, levelling and fixing in place are also considered.

2.5 **Bus Ducting**

Note : Jointing and securing the associated switch boards / transformers are also considered.

2.6 Battery charger, battery sets and UPS unit.

2.7 Cables in trench / conduit / tray / Rack.

Note : Following items are also necessary .

a) Measuring and cutting of cable and protection of cut ends.
b) Identification of cables
c) Fixing of cable to tray / rack

2.8 Cable Glands

2.9 Cable terminations

2.10 Earthing cable in trench / conduit / tape on tray / Rack
2.11 Earth cable tape terminations

2.12 Lightening protection

2.13 Lighting/ fittings / supports

2.14 Earth Rod PRT and cover

2.15 Cable tiles

2.16 Trench marker posts

2.17 Air craft warning

2.18 Underground electrical grounding system

Note : All bellow items are also considered :

a) Pulling of grounding cable in trenches, through culverts, protection sleeves and cable ducts as per grounding cable supplier installation instruction, project specifications and layout and detail drawings.

b) Coil up and clearly designate the final destination of the cable ends, especially if cables have to be continued their routing underground or overhead via cable tray or otherwise to their final destination at a later date.

c) Install, including the provision of the required tools, the required through branch and end connections.

d) Installation of all grounding electrodes including inspection pits as per specification and the layout and detail drawings.

e) Return of the cable drums to the storage area including a clear make up of cable lengthleft on the reels of drums that are not empty.

f) Measure cable resistance for grounding continuity and grounding resistance of ground rods, record data and submit the rest result reports to OWNER prior to commissioning of the installation.

g) Check cables are in proper trenches and ground rods at their location.

h) Perform all test; witnessed by OWNER'S REPRESENTATIVES of the founding installation including the provision of all OWNER approved testing equipment and measuring devices.

2.19 Miscellaneous Electrical equipment

2.20 Earth resistance testing including earth resistance rods for grounding, continuity of grounding, installation resistance testing for electrical cables and HL-POT testing for electrical cables.

3.0 TESTING AND COMMISSIONING

Testing and commissioning consist of the complete testing prior to commissioning, including provision of required testing apparatus and testing documents as requested and as specified in the testing specifications.

- All test results shall be recorded on the test form and submitted to OWNER. Each test record shall include. date of test, ambient temperature, climatic conditions, instruments used with serial numbers, names of test personnel and witnesses, identifications of equipment, ground electrode or circuit tested.

- Testing shall be scheduled at least 24 hours in advance and OWNER is to be notified by LSTK CONTRACTOR. LSTK CONTRACTOR will notify all necessary interested parties including manufacturer's representatives.

  High potential tests shall not be repeated without authorization by OWNER.

4.0 DRAWINGS AND DOCUMENTS

4.1 LSTK CONTRACTOR will carry out all construction and any required erection activities directly from the AFC construction drawings and specifications.

4.2 LSTK CONTRACTOR shall promptly submit reports of each and every test or inspection.

4.3 For more details LSTK CONTRACTOR shall follow **Electrical design philosophy elsewhere mentioned in ITB.**

ANNEXURE- 7– 2F

INSTRUMENTATION WORK

1.0 **GENERAL**

1.1 Instrumentation symbols and identification of functions shall be based on the current edition of ISA S5.1.

1.2 Specifications for instruments and items of control equipment are shown on data sheets to be issued as they become available.

1.3 All materials and connections for control valves, relief valves, level controllers and similar equipment shall comply with applicable requirements for valves and fittings as noted in the piping specification.

1.4 LSTK CONTRACTOR shall install all shim plates, fixing material such as but not limited to anchors, red heads, etc.

1.5 LSTK CONTRACTOR shall install all instrument equipment tag plates.

2.0 **FIELD INSTRUMENT INSPECTION AND CALIBRATION AND INSTALLATION**

2.1.1 This item covers all activities and supply of all materials to import calibration of instruments. It includes, but is not limited to, the following :

2.1.1 Provision of all tools, equipment and consumables used in the course of the work.

- Calibration of instruments and provision of all necessary test equipment gauges, materials and ancillary items. All necessary testing instruments to be used must be certified by Govt. recognized testing laboratories.

- Check orifice plates and control valves.

- Protection of instruments to maintain cleanliness at all times.

- Mark instrument to indicate status of calibration.

- Return instruments, after calibration and checking to lay-down areas and / or stores including all packaging.

- Pressure and leak test including the provision of all necessary test equipment gauges materials and ancillary items.

Note : The calibration of all instruments within the packages is also the responsibility of LSTK Contractor.

2.1.2 LSTK CONTRACTOR shall install all instruments as listed in the instrument index and further per the relevant installation specifications, documents and drawings.

2.1.3 Field instrument installation includes, but is not limited to:

Mounting of instruments and related equipment, supports protection boxes, manifolds, junction boxes, nameplates, etc.
Installation of measuring elements (probes, sensors, detectors, etc) including their auxiliaries as required (thermowells, supports, valves, etc.) unless done by others

Installation of on-line instruments (by piping)

The following is a typical list of on-line instruments :

- Safety blow down valves.
- Control valves (all types)
- Motor - operated valves.
- Safety shut - down valves (including solenoid valves).
- Safety / relief valves.
- Pressure / vacuum relief valves.
- Self - regulating valves.
- Level gauges.
- Level displacer chambers.
- Orifice assemblies.
- Orifice plates.
- Venturies.
- Turbine meters, annubars, magnetic flow meter.
- Positive displacement meters.
- Variable area meters (rotameters)

- Stilling Wells.
- Thermowells and etc.

- Installation of process connections, impulse lines and capillaries.

- Installation of purge and flushing supply tubing, filter blocks and rotameters.

- Installation of air supply lines.

- Supply and installation of instrument nameplates for field instruments.

2.2 Cable, Supports and Fixing Wire pins, Conduit

LSTK CONTRACTOR shall use for cable installation for indoor and outdoor use the materials such as tubing, cable trays, etc. as called in the specifications.

2.2.1 Cable tray. ladder rack and tubing systems shall be installed to ensure electrical continuity throughout the run and such that water cannot collect or remain in any part of the system.

2.2.2 Pulling of the cables into the trenches, through culverts, protection sleeves and cable ducts as per cable supplier installation instructions and layout drawings, cable lists, trench sections and reel schedules.

2.2.3 Installation of the cable separation tiles, if specified.

2.2.4 Coil up and clearly designate the final destination of the cable ends, especially if cables have to be continued their routing underground or overhead via cable tray or otherwise to their final destination at a later date.

2.2.5 Installation of the sealing shrouds to avoid water ingress after cable cutting.

2.2.6 Installation of the cable markers stamped with cable number by LSTK CONTRACTOR as per cable list.

2.2.7 Installation of cable splicing if required.

2.2.8 Return of the cable drums to the storage area including clear markup of the cable length left on the reels of cable drums that are not empty.

2.2.9 Check if cables are spaced as specified.

2.2.10 Measure cable resistance and cable insulation, record data and submit the test result reports prior to commissioning of installation.

2.2.11 Check whether all cables are installed in the proper trenches.

2.2.12 Perform all tests, witnessed by OWNER of the underground cable installation including the provision of the OWNER'S approved testing equipment and measuring devices.

2.2.13 Record of actual installed cable lengths and location of cable splices.

2.2.14 Where cables required to be installed through or across the edges of tray or other metal work the edge of the lips shall be smoothed. painted and lined with a protective sleeving to avoid cable damage.

2.2.15 Supporting steelwork shall be fabricated and installed by LSTK CONTRACTOR. The material shall be primed in accordance with the painting specification by LSTK CONTRACTOR.

2.2.16 Storage and handling of cable before and during installation shall be carried out with due regard to manufacturer's recommendations. Cable drums shall be rotated only in the direction indicated by drum markings, and open ends of cables are to be effectively sealed immediately after cutting to prevent the ingress of moisture.

2.2.17 At all times, the utmost care shall be exercised to avoid damaging the protective sheathing to cable or of causing excessive bending or twisting which may result in damage to core insulation, sheaths armor and so on.

2.2.18 The bending radius of a cable either during or after installation shall not be less than manufacturer's recommended minimum.

2.2.19 Cables shall be run in continuous unbroken lengths and joints shall not be permitted unless specifically called for in the cable drum-cutting schedule.

2.2.20 Cables installed above ground shall be routed to avoid high-risk areas, e.g. high fire risk areas, and those areas where accidental leakage or spillage may occur and cause damage to cables and supports.

2.2.21 During installation, the ends of cables shall temporarily be protected using compound, tape, heat shrink seals or similar approved methods to avoid damage or entry or moisture until they are permanently terminated.

2.2.22 Pre-cast concrete members should not be drilled for any reason. Fixing shall always be by means of clamping brackets in the most efficient way and in consolation with OWNER.

2.2.23 Under no circumstances shall welding be carried out to any process plant equipment, vessels, pipelines, or structures or to any protected surface unless specifically indicated on the drawings and documentation and then in strict accordance with a procedure subject to Approval of OWNER.

2.2.24 Fixings to the above shall normally be made where brackets and so on, have already been provided or when agreed by the use of purpose built clamps.

2.2.25 On trays horizontal cable runs shall be fastened every 1200 mm, vertical cable runs every 600 mm.

2.2.26 **Grouping**

The cables employed to convey electricity shall be grouped according to the signal kinds. The main group kinds are but not limited to the followings

a) Intrinsically safe signals.
b) Signal cables not intrinsically safe.
c) Instruments power supply cables.
d) Coaxial cables or telephone cables used as serial data buses.

2.2.27 All cable trays, ladders, tubing and supports and fixing material for indoor and outdoor use shall be installed by LSTK CONTRACTOR.

2.2.28 All cables shall always be installed and connected in such a way that no forces can act on terminals. Further, all instrument and power supply cables inside and outside buildings shall be installed in accordance with both cable lists and drawings by LSTK CONTRACTOR.

Carbon steel coated cable stub ups shall be installed by LSTK CONTRACTOR for all cables from sand trenches to 500 mm above ground, in accordance with electrical connection detail drawings.

2.2.29 **Conduit system**

Single pair cables shall be used to connect field mounted instruments to local junction boxes. Single cables shall be armoured type laid in galvanized carbon steel / aluminium pipes with open ends or on closed cable trays. In order not to damage the cable, a plastic annular cap shall cover the pipe end.

Multipair cables shall be used to connect above said local junction boxes to the control room. Multipair cables shall be armoured type and shall run over head in closed cable trays / ladders supported on the pipe racks.

2.2.30 **Wire Pins**

All stranded cable conductors shall be fitted with crimped taper pins, amp (or equivalent) and all screens with lugs. Installation of all amp wire pins and screen lugs by LSTK CONTRACTOR.

Further, in general, all standby conductors shall be wired to terminals.

2.2.31 **Cable Marking**

All instrument cables, conductors and the instrument screen/earth wires shall be tagged on both sides in accordance with the instrument connection list for local and central control

room signals by LSTK CONTRACTOR.

2.2.32 **Cable Entry Sealing**

- **General**

  After installation of all cables and on direction of OWNER, LSTK CONTRACTOR shall seal off all cable entries and passages.

- **Outside walls**

  All cable entries in outside walls and below grade level shall be watertight sealed. Method of sealing shall be supplied by LSTK CONTRACTOR.

- **Separation walls**

  All cable entries in separation walls of buildings shall be sealed with a fire resistant sealing as described hereafter.

- **Control Room Floors**

  All cable and cabinet entries in floors shall be sealed with polyurethane foam.

- **Fire - resistant sealing**

  All fire resistant sealing shall be class H-30.
  Small openings in walls shall be sealed with CSD –F (or equal) in luminescent foam.

  Large openings in walls and between computer floor and cable basement shall be sealed by inserting CSD-F (or equal) in luminescent plates under between and above the cables. The remaining openings shall be sealed with CSD-F (or equal) in luminescent foam.

2.3 **Alarm Systems**

2.3.1 LSTK CONTRACTOR shall install the fire alarm including sensors, cabling, local panels, mimic panels and host system. In accordance with:

- Project engineering specification and codes and standards.

- Cabling between panel and detectors, alarms, switches etc. as described above.

- Installation of all junction / terminal boxes, cable terminations and connections, supporting brackets for cabling as described above.

2.3.2 All work related to the fire and gas system, including overall test / loop check as per specifications and drawings, among which the installation, placing and connection of all

cables of the fire and gas panel located in the control building and panel in the firehouse shall be done by LSTK CONTRACTOR.

2.4 **Analyzers Installation**

LSTK CONTRACTOR shall install all analyzers and sampling conditioning systems in the analyzer house as well as in the field consisting of, but not limited to:

- Installation of all vents and drains from analyzers.
- Installation of calibration gas bottles as well as regulators and connecting tubing, as required.

3.0 **LOCAL PANELS**

LSTK CONTRACTOR shall install local panels, consisting of, but not limited to:

a) Mounting, aligning and fixing to the foundation or steelwork. Uncoil, install and terminate underground cable ends. Install and terminate all aboveground cable to / from panels.

b) Install and connect air supply and air signal piping and tubing to 'from panels.

c) Install cabling and connect alarm horns.

d) Identification / tagging of all equipment, terminals, cables and tubing which is not installed by panel vendor. Tag plates to be installed by LSTK CONTRACTOR.

e) Installation of brackets / supports for cable, etc. and installation material as required to complete the installation.

4.0 **TERMINATION OF CONTROL CABLES FROM THE LV SWITCH ROOM**

The control cables running from the switch room shall be installed and connected in the marshaling cabinet by LSTK CONTRACTOR.

5.0 **CONTROL BUILDING INSTRUMENT INSTALLATION**

5.1 LSTK CONTRACTOR shall install all control building instrumentation in accordance with the relevant installation specifications and drawings.

6.0 **CABINETS AND CONSOLES**

6.1.1 LSTK CONTRACTOR shall install align and anchor all equipment cabinets and consoles in accordance with design drawings and seller's installation instructions.

6.1.2 The false floor shall be completely installed by LSTK CONTRACTOR.

All panels, cabinets, tables, boxes, computers etc. located on the instrument equipment layout shall be place and installed by LSTK CONTRACTOR.

6.1.3 Where cable passage is required according to installation drawings, LSTK CONTRACTOR to indicate locations of holes and passages.

6.1.4 FCS/ESD/PLC cabinets and data base unit:

These groups / cabinets shall be installed in place and bolted together by LSTK CONTRACTOR.

Internal wiring / cabling and / or connections between these groups of cabinets shall be done by LSTK CONTRACTOR in accordance with the instructions of the system vendor's representative.

6.1.5 **FCS Consoles**

The consoles shall be installed in place and bolted together by LSTK CONTRACTOR, including installation of special table with peripherals.

Internal wiring and cabling and/or connections between consoles shall be done by LSTK CONTRACTOR in accordance with the instructions of the system vendor's representative who will be present during these operations.

6.1.6 Communication racks with the same work description as specified elsewhere in Tender documents.

6.1.7 Main processor cabinets (data base units) with the same work description as as specified elsewhere in Tender documents.

6.1.8 **Marshaling Cabinets**

Cabinets shall be installed in place and bolted together by LSTK CONTRACTOR.

Cross wiring between these assembled sections shall be done by LSTK CONTRACTOR.

6.1.9 **Fire Panel Cabinets.**

6.2 **Handling and installation. Termination and Connection of Cabling**

Cables entering instrument room are installed under false floor. These cable shall be handled, cut to length, stripped and after installation of the cabinets be terminated and connected by LSTK CONTRACTOR.

LSTK CONTRACTOR shall leave slack in the cables and provide markings.

6.3 **Installation of System Cables**

LSTK CONTRACTOR shall install, plug in and support all system cables. Cable supporting rail in cabinets is installed by cabinet / console vendors, but in any case LSTK CONTRACTOR is responsible.

- System cable shall be installed by LSTK CONTRACTOR under false floor in auxiliary room. System cables are covered by instrument cable list.

6.4 **Conduits Cable Tray / Trucking. Support Frames and Brackets**

All cable trays, cable trucking, supports / brackets, etc. if required , shall be installed by LSTK CONTRACTOR. For cable tray installation see respective part.

6.5 **Auxiliary Cable Installation and Termination.**

LSTK CONTRACTOR shall install, terminate, support and connect all auxiliary cables.

Auxiliary cables are all cables covered by instrument cable list and instrument cable layout for control room.

LSTK CONTRACTOR shall open / remove and close parts of the false floor as required for cable installation.

6.6 **Communication Cables**

LSTK CONTRACTOR shall install and support communication cables. The connection of the cables in the consoles and cabinets shall be done by LSTK CONTRACTOR, under direct supervision of system vendor. LSTK CONTRACTOR shall open / remove and close parts of the false floor as required for cable installation. Communication cables are listed on instrument cable layout for control room and the system cable list.

6.7 **Power Supply Cabling**

LSTK CONTRACTOR shall install. terminate and connect all power supply cables between power distribution boards and cabinets, consoles, printers and other instrument equipment when listed on the power supply list

6.8 **Earthing System**

LSTK CONTRACTOR shall install and connect the insulated earthing cabling / wiring from the earth buses to the cabinets, consoles and all other instrument equipment.

All cabinets and consoles shall be fitted with earthing bus bars and earthing connection bolts

by the vendors and under supervision of LSTK CONTRACTOR.

LSTK CONTRACTOR shall install utility, shield and dedicated earth (clean earth) cabling and connections including tags at both ends.

LSTK CONTRACTOR shall check and test earthing system in accordance with relevant documents.

7.0 LIFTING

7.1 Major instrument equipment shall be rigged from points designated or suitable to accept rigging. When available, LSTK CONTRACTOR shall utilize lugs on equipment.

7.2 When establishing hoisting loads, riggings plans and crane capacities, LSTK CONTRACTOR shall adhere to the requirements and instructions as defined in the specifications and as instructed by OWNER.

8.0 TESTING AND PRECOMMISSIONING (FUNCTION TEST)

8.1 Testing and pre-commissioning consist of the complete testing and pre-commissioning prior to commissioning, including provision of required testing apparatus and testing documents, comprising, but not limited to:

8.1.1 Check for completion and conformance to specifications.

8.1.2 Check the accessibility of all instruments and components for field adjustments, routine maintenance and removal for overhaul, and relocate as necessary.

8.1.3 Perform pressure test on all air sub headers as required by the line specifications.

8.1.4 Clean all instrument air sub headers, transmission tubing and control tubing by blowing with dry, filtered air prior to connection of instrument components

8.1.5 Leak test pneumatic transmission and control tubing, using an approved method acceptable to OWNER

8.1.6 Perform hydrostatic or, where appropriate, pneumatic pressure tests on all instrument process piping, as required by the respective line specifications. Drain and below free of water, as necessary after test.

8.1.7 Check continuity and identification of transmission and control systems for each instrument to ensure proper hookup. Perform megger and continuity tests for instrument electrical wiring. Check correct source of power, polarity and earthing (take into account intrinsically safe technology of this procedure).

8.1.8 Check the bore of the orifice plates and flow direction during and after installation.

8.1.9 Check (on/off valve and) control valves for direction of flow and proper operation, e.g. travel, action with air failure, etc.

8.1.10 Calibrate all instruments (including the instruments in the fire and gas system) and synchronize transmitter and receiver readings for each instrument loop. Check the orifice plates and flow nozzles. Set air pressure regulators.

8.1.11 Install pressure and temperature gauges after line flushing.

8.2 Check fuses, perform voltage checks and energize all electrically powered instruments, alarm and shutdown system, etc. Maintain power supply.

8.3 Set pneumatic and electronic type switches and local control by simulation of input signals.

8.4 Check thermocouples and resistance thermometer circuits from element to measuring instrument by simulation.

8.5 Check and adjust calibration of all other field and panel mounted instruments.

8.6 Complete loop functional test of all instruments, including the instruments in all package units and in the fire and gas system. Functionally test complete control loops alarm and shutdown systems and partial process sequence, etc., to verify capability to measure, operate and stroke final control elements in the direction and manner required by the process application.
All test results shall be recorded and submitted to OWNER. Each test record shall include date of test, ambient temperature, climatic conditions, instruments used with serial numbers, names of test personnel and witnesses, identification of equipment, ground electrode or circuit tested.

Testing shall be scheduled at least 24 hours in advance and OWNER is to be notified by LSTK CONTRACTOR. LSTK CONTRACTOR shall advise OWNER prior to testing, of make, type and accuracy of test equipment used for above-mentioned items. All required test certificates should be of a recent date not exceeding 6 months.

9.0 PAINTING

Surface preparation and application of all required paint layers shall be executed in accordance with paint specifications and related standards.

10.0 WELDING

LSTK CONTRACTOR shall perform welding in accordance with the normal accepted industrial standards.

11.0 MECHANICAL COMPLETION

LSTK CONTRACTOR shall advise OWNER in writing when erection is completed.

Mechanical completion date shall be the date when the activities have been accomplished by LSTK CONTRACTOR as dictated by the construction schedule, which shall be submitted by LSTK CONTRACTOR and approved by OWNER on due time.

12.0 QUALITY ASSURANCE, QUALITY CONTROL, INSPECTION, CALIBRATION TEST AND MATERIAL CERTIFICATES

12.1 LSTK CONTRACTOR shall perform quality control, inspect, calibrate required testing, pre-commissioning and supply certificates.

12.2 LSTK CONTRACTOR shall submit reports of each and every test or inspection within three (3) days after actual test or inspection is made.

12.3 Calibration and Testing.

12.3.1 Calibration and testing to be executed by LSTK CONTRACTOR in accordance with respective specifications.

Local instruments such as transmitters, converters, receivers and so on, will be preset by bench testing by LSTK CONTRACTOR in accordance with the specifications before installation on the process, so that no new settings will be necessary for loop acceptance tests.

12.3.2 LSTK CONTRACTOR shall inspect all materials up on receipt for damage and completeness. In case of damage incomplete material, LSTK CONTRACTOR shall modify and immediately inform OWNER.

12.3.3 LSTK CONTRACTOR shall carry out all tests included in this paragraph shall fill out the installation checklists and shall submit all required test certificates and documentation as required.

12.3.4 All tools and test gear necessary to carry out described tests shall be provided by LSTK CONTRACTOR.

12.3.5 Inspection and testing shall be phased with construction and installation in such a manner as to involve the minimum necessary concentration of effort and manpower and the minimum loss of time in reaching the pre-commissioning stage.

12.3.6 All inspection and testing shall be witnessed and approved by OWNER / authorized representative.

12.3.7 LSTK CONTRACTOR shall be responsible for the complete loop continuity check of the field and control room installation, including the parts of the package units, which have been connected by others.

12.3.8 OWNER reserves the rights whenever distinguished package Plant(s)/Unit(s) vendor's representative to be present at site LSTK CONTRACTOR shall be responsible to arrange this WORK.

12.3.9 LSTK CONTRACTOR shall be responsible for the loop continuity checks from the marshaling cabinets or direct connected cabinet cables in the control room (termination point of underground multi core cable). The loop continuity checks shall be performed on a complete loop, including all parts of the loop as indicated on the instrument loop diagrams (ILD'S).

12.3.10 The communication equipment between field and control room building and/ or other buildings shall be the responsibility of LSTK CONTRACTOR.

12.3.11 Only complete loops shall be accepted, signed by OWNER after all calibration / function checks have been demonstrated successfully completed and recorded.

12.3.12 For all package units and systems supplied by LSTK CONTRACTOR, installed or partly installed and connected by LSTK CONTRACTOR.

LSTK CONTRACTOR shall perform a normal wiring and loop check of signals and supplies to and from these systems.

The following systems apply:

- Analyzer system
- Bentley Nevada system
- Flow metering system
- Fire, smoke and gas detection system
- Tank gauging
- FCS / ESD / PIC system, etc.

For more details LSTK CONTRACTOR shall follow **Electrical design philosophy elsewhere mentioned in ITB.**

13.0 **Miscellaneous**

LSTK CONTRACTOR shall remove all waste and debris from the SITE.

ANNEXURE- 7 - 2G

INSULATION WORK

1.0 GENERAL

1.1 SCOPE

This standard covers the requirement for supply and application of materials for thermal insulation of equipment, piping and other items.

1.2 REFERENCE STANDARDS

The design shall be in accordance with established codes, sound engineering practices and shall conform to the statutory regulations applicable to the country. The main codes, standards and statutory regulations considered as minimum requirements are as follows:- (Latest revision of these shall be followed)

IS 14164	Code of Practice for Industrial Application and finishing of thermal insulation material at temperature -80^{0}C and up to 750^{0}C.
IS 737	Wrought aluminimum and aluminium alloys, sheet, strip
IS 1254	Specification for corrugated aluminum sheet
IS 1322	Bitumen felts for waterproofing and damp proofing
IS 3069	Glossary of terms, symbols and units relating to thermal insulation materials.
IS 8183	Specifications for bonded mineral wool.
IS 9743	Thermal insulation finishing cements
IS 12436	Specification for Preformed Rigid Poly-urethane (PUF) and Poly-isocyanurate (PIR) Foams for Thermal Insulation
IS 13205	Code of practice for the application of polyurethane insulation by the in-situ pouring method.
ASTM C921	Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
ASTM C1029	Specification for Spray-Applied Rigid Cellular Polyurethane Thermal Insulation
ASTM C1696-16	Standard Guide for Industrial Thermal Insulation Systems
ASTM C411	Standard Test Method for Hot-Surface Performance of High - Temperature Thermal Insulation

ASTM C450	Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging
ASTM C871	Test Methods for Chemical Analysis of Thermal Insulation Materials for Leachable Chloride, Fluoride, Silicate, and Sodium Ions
ASTM C1338	Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
ASTM C1055	Guide for Heated System Surface Conditions that Produce Contact Burn Injuries
ASTM C1139	Specification for Fibrous Glass Thermal Insulation and Sound Absorbing Blanket and Board
ASTM D1622	Test Method for Apparent Density of Rigid Cellular Plastics
ASTM C680	Standard Practice for Heat Loss or Gain and Surface Temp.

1.3 **Deviations**:

Should unforeseen difficulties arise to comply with requirements of this standard.

Alternative material and application techniques superior to the requirements of this standard be submitted with complete details for approval of owner.

In case of any conflict / deviations amongst various documents, the order of precedence shall be as follows:

1. Statutory regulations.
2. Job specifications.
3. Engineering design basis.
4. Standard specification.

1.4 **LIMITATIONS**

Temperature Limits.

This standard deals with insulation applied externally on piping equipments etc. as per the table below:-

Maximum Operating Temperature	**Type of Insulation**
60^0C to 750^0C for C.S., A.S. & S.S.	HOT
- 180^0C to 20^0C	COLD

1.5 **THICKNESS DESIGN BASIS**

Thickness calculation method as per procedure given in ASTM C-680

1. **Hot Insulation**

Design Ambient Temperature	:	35ºC
Design Surface Temperature	:	45^0C
Permissible Heat Loss	:	100 kcal./m2 hr.
Permissible Wind Velocity Outside	:	1 m/sec
Permissible Wind Velocity Inside	:	0.25 m/sec

2. **Cold Insulation**

Design Ambient Temperature	:	35ºC
Design Surface Temperature	:	2 ºC below ambient/ 0.5 Deg C above the Dew Point
Permissible Heat Gain	:	10-12 kcal/m2 hr
Relative Humidity	:	85%
Permissible Wind Velocity Outside	:	1 m/sec.
Permissible Wind Velocity Inside	:	0.25 m/sec.

1.6 GENERAL REQUIREMENTS

1.6.1 Information to be supplied

- Material of construction / dimension of equipments / pipes required to be insulated.
- Temperature
- Location of equipment (Indoor/Outdoor/Elevn.)
- Requirement of removable box type insulation if any
- Special requirements if any regarding type of insulation material and other properties.
- These information shall be supplied in form of insulation schedule.
- Design calculations, drawings and insulation material schedule.
- Material Test certificate's.
- Insulation works execution schedule.
- Detailed procedure for all types of execution works.
- Bill of Quantities, Initial material take-off, final material take off and material requisition.
- QA/QC plan.

1.6.2 STORAGE OF MATERIAL

Insulation material shall at no time be stacked directly on the ground; instead it will be stored at a level higher than ground level. It should not only be covered by tarpaulin but other effective protections against weather are also to be provided. The contractor shall provide a properly covered storage to the satisfaction of engineer-in-charge (Refer IS: 10556).

1.6.3 HYDROSTATIC TEST FOR PIPES

Before taking up insulation job on piping or vessels it shall be ensured that hydrostatic test of the concerned equipment / piping is completed. Where it is felt necessary to take up the insulation job before such testing are performed all welded and mechanical joints shall be left un-insulated for a length of at least 150mm on either side of the joint.

1.6.4 PROTECTION OF INCOMPLETE JOBS

Any part of insulation job which is not provided with final weather proofing will be adequately protected by means of tarpaulins and other aids. After the day's work similar protection should be provided for the partially completed jobs to be continued the next day to avoid any absorption of rain / moisture during the night.

2.0 INSULATION SUPPORTS (CLEATS) TO BE PROVIDED BY EQUIPMENT SUPPLIER

Suitable supports (cleats) in the form of rings, lugs, studs or pins shall be provided on equipment by equipment supplier, however should any additional supports or anchorage be felt necessary for insulation works, the same shall be also considered in LTSK's scope, including all allied work necessary for the same. These will be installed by the contractor free of any extra cost. Owner shall be informed about the same in advance, so also design/drawings shall be updated accordingly.

3.0 MATERIAL REQUIREMENTS

3.1 INSULATION MATERIALS

3.1.1 General

Whenever reference to any Standard is made it is presumed that the latest revision as on date should be considered unless otherwise specified.

3.1.2 Specification and other requirements

Specification and other requirements will be as per below mentioned table:-

Hot Insulation:

For operating temperature Upto 400 deg.C,	Rockwool Mattress of density 120 kg/m3 conforming to IS:8183.
For operating temperature 401-450 deg.C,	Rockwool Mattress of density 150 kg/m3 conforming to IS:8183.
For operating temperature 451-500 deg.C,	1st layer insulation shall be 25mm Ceramic Fibre Blanket of density 128 kg/m3 conforming to IS :15402 and balance layers with Rockwool Mattress of density 150 kg/m3 conforming to IS:8183.
For operating temperature 501-550 deg.C	1st layer insulation shall be 50mm Ceramic Fibre Blanket of density 128 kg/m3 conforming to IS :15402 and balance layers with Rockwool Mattress of density 150 kg/m3 conforming to IS:8183.
For operating temperature 551-600 deg.C,	1st layer insulation shall be 75mm Ceramic Fibre Blanket of density 128 kg/m3 conforming to IS :15402 and balance layers with Rockwool Mattress of density 150 kg/m3 conforming to IS:8183.

Bands/Wires for securing insulation shall be of ASTM 8209 Alloy 3003 H16 or 18-737 designation 31000 (old NS3) condition H3 or 18/8 Stainless steel.

For securing cladding on insulation on piping, aluminium band 12mm (min) X 24 SWG thick shall be used. For securing cladding on insulation on equipment, aluminium band 20mm wide X 24 SWG shall be used.

Other insulating materials may be used provided they have the same or better properties and durability aspects.

Insulation thickness of insulating materials shall be based on design calculation of thermal conductivity, insulation class, etc. Same shall be submitted to the Owner with necessary design calculations, drawings, test certificates and durability parameters.

For Valves, Turbines & Compressors Insulation

Prefabricated factory made Ceramic Fibre pad to be used made out of Ceramic Fibre Blanket of density 128 kg/m3 encased in high temperature resistant cloth. The minimum thickness of the pad shall be –

1. 0 Deg.C to 300 Deg.C = 25mm
2. 301 Deg.C to 400 Deg.C = 50mm
3. 401 Deg.C to 500 Deg.C = 75mm

Removable insulation for flanges and valves, like tailor made jackets or pre formed insulation boxes, shall be suitable for quick removal and reinstallation. All tailor made jackets shall fit the actual valve/flange/equipment and secure adequate overlap to incoming insulated pipes.

Technical data sheet of the Ceramic Fibre Pad is as below:

A.	Purpose/Application This Engineering specification is for Fabric jacketed supercera ceramic Fibre insulated flexible reusable covers/pad for application on pipes: pipe fittings, valves, flanges etc vessels & equipments, tubes etc in hot services.				
01	Dimension (mm)	As per drawing/sketch provided by OEM.			
02	Thickness (mm)	25-100			
1. Specification of Protective jacketed material					
i	Vest Cover	Liner Fibre Glass Fabric			
ii	External Top Cover Fabric (for cold face)	Polymer Coated Fibre Glass fabric Temp. resistance 300 Deg. C, oil & water resistant			
iii	External Bottom Cover fabric (for hot face)	High silica cloth for Temp Resistance up to 900 Deg C			
2.	Specification of insulation Material	Ceramic Fibre Blanket (As per IS 15402)			
i	Classification Temperature	1260 degree Celsius			
ii	Thickness	25 – 100mm			
iii	Bulk Density	128kg/m3			
iv	Shot content on 70 mesh (%)	<30			
v	Tensile strength (KPa)	>40			
vi	Mean Fibre Dia (Micron)	2-4			
vii	Linear Shrinkage (%) At 1200 Deg. C for 24 Hrs	3.5			
viii	Thermal Conductivity (W/mK) Max.	1000C	2000C	3000C	5000C
		0.046	0.072	0.078	0.150
ix	Chemical composition	SiO2%		49-58	
		Al2O3%		41-48	
		ZrO2%		0-7	
		FeO3%		<0.1	
3	Hardware & Non Metal fastening				
i)	Buckle/Draw Stings	Stainless steel (min SS 316), High Temp Braided Chord of			

		fibre glass
ii)	Stic Pins	Stainless Steel (min SS 316), Pins to prevent the insulation from movement inside the cover
iii)	Stitching	Double sewn with Teflon coated Fibre glass wrapped stainless thread. The sewing thread shall not resolve or decompose in typical chemical plant environment.
iv)	Belting	High Temp Fabric same as used in hot face cover
4	Other Properties	
i	Fire Resistance (As per BS 476 Part-4)	Non-Combustible
ii	Chemical Stability/Resistance of Corrosion/water	Good
iv	Shock Resistance	Excellent

Rockwool Insulation shall be of water Repellent Grade and tested as per BS: 2972 for Water Absorption. Maximum water absorption is 0.5 kg/m2 in 48 hours duration.

Precautions must be implemented in the design and fabrication of the insulation jackets to avoid the insulation material from sagging causing reduction of the insulation properties of the jackets.

Cold Insulation:

Insulation material and specifications for cold insulation for operating temperatures up to (-) 180°C and dual temperature (cold/hot) service where, upper temperature limit is 125˚C shall be as given below for all sizes of piping/equipment:

- **Polyurethane Foam**

Preformed pipe section's and radial lags (for higher diameter pipe) of polyurethane foam of self-extinguishing type shall be in accordance with ASTM C591 TYPE-II Grade 2.The physical requirement of bulk density, chloride content, thermal conductivity and PH value of the material shall be as follows:

Temp. Limit Bulk density: Upto (-)180°C & 120°C (max) 35.0 to 39.9kg/m3
Chloride content : 20 ppm (max)
Thermal conductivity : 0.221 mw/cm˚C at mean temp. 10 deg C
PH Value : Neutral.
Closed cell content : 95% (min)

High density polyurethane foam block of bulk density more than 300 Kg/m3 shall be used for supports.

- **Polyurethane Foam Cast-in-Situ**

Cast-in-Situ Polyurethane Foam of density 42±2 kg/m3 conforming to IS: 13205 shall be used. High density polyurethane foam block of bulk density more than 300 Kg/m3 shall be used for supports.
Temp. Limit : Up to (-) 45^{o}C and 120^{o}C (max.)

- **Polyisocynaurate**

Temp. Limit : Up to (-) 180˚C and 125˚C (max.)

Other insulating materials may be used provided they have the same or better properties and durability aspects.

Insulation material specification/ thickness/application mentioned in this document are the minimum requirements. Insulation specification/ thickness/ application shall be based on design calculation of thermal conductivity, insulation class, relevant IS/ ASTM codes etc. Same shall be submitted to the Owner with necessary design calculations, drawings, test certificates and durability parameters. LSTK shall submit detailed material specifications, durability parameters assured, test certificates and application procedure to OWNER/ PMC approval.

3.2 AUXILIARY MATERIALS FOR CLADDING

a) **Aluminium Cladding**

- **Horizontal Vessels**

Aluminium sheet as per IS-737 (designation 31000, condition H3 for flat sheet & 31500/51300, H4 for corrugated sheets)) shall be used for cladding. Insulation on overall piping, vessel and equipment, cladding will be coated on the side in contact with insulation with 3 mil thick polysurlyn film.

Specifications for aluminium Cladding material shall be as follows:

Material	Reference Code / Standard	Thickness	Application
Aluminium sheet with applied moisture barrier of 3 mil thick Polysurlyn coating	IS : 737 / ASTM C-653	22 SWG (0.71mm)	For all piping, tanks, vessels, heat exchanger, flanges, valves, equipments etc. upto 24” outside dia
		20 SWG (0.91mm)	For piping, tanks, vessels, heat exchanger, flanges, valves etc. above 24” outside dia
Removable cover for flanges, valves etc. shall be made out of minimum 18 SWG thickness Aluminium Sheets.			

- Vertical Vessels

Cladding material for vessels with insulation O.D. 900 mm and less shall be same as for pipes. For vessels above 900 mm insulation O.D. 22 SWG corrugated aluminium sheet as per IS-1254 or ribbed aluminium sheet 32 mm x 5 mm deep corrugations may be used.

Aluminium Foil to protect stainless surfaces in Temperature below 0 deg c shall be 0.1 mm (42 SWG) thick per ASTM 8209 alloy 3003 H16 or IS-737 designation 31000 (0IdNS3) condition H3. For securing aluminium foil on stainless steel surface 24 SWG thick x 20mm wide aluminium bands shall be used.

b) **Screws**

Screws used with aluminium sheeting shall be of self tapping type, A No.8x12mm long cadmium plated / SS of high quality at intervals of 150mm.

c) **S-Clips**.
Aluminium, 20x1.5mm or 25mm wide stainless steel banding bent to form a shape of "S" provide a minimum lap of 50mm.

d) **Bands for securing cladding**.
Aluminium of dimensions 12mm width x 0.56 mm thick (24 SWG) for pipes. Stainless Steel bands Type 304, 0.4mm thick x 13mm wide for large dia pipes (above 24") and cylindrical equipment up to outside dia 900mm, 0.5mm thick x 19mm wide for cylindrical equipment above 900mm outside dia meter.

e) **Quick release clips for removable covers**.
Suitable quick release clips will be made as shown in fig. 7 from 20Cm width x 20 SWG aluminium sheet and some fig.7 from 20mm width x 20 SWG aluminium sheet and some suitable rectangular ring.

f) Sealant for cladding joints with Foster 95-44 /TIKI F9544.

g) The vapour barrier mastic shall be Foster 60-38/39 /TIKI M6038/39

h) Adhesive for cold insulation shall be Foster 81-33 /TIKI P8133

i) Vapour Stops at pipe support location shall be Foster 90-66 /TIKI F9066

j) **Rivets**: Aluminium 'POP' blind eye type / Stainless Steel 9.5mm long x 5mm dia meter.

k) Filler material shall be PUF dust or mineral wool mixed with specified adhesive shall be placed lightly so as to fill irregular voids and sealant shall be Foster Foam Seal Sealer 30-45. Glass cloth to be used for vapour barrier reinforcement shall be open weave 10 mesh having glass fibre thickness of 5 mils.

Galvanised steel sheets/ Annealed galvanised steel sheets/ Galvanised colour coated sheet are strictly **PROHIBITED** for use in cladding works. Other cladding materials (except G.I.) may be used provided they have the same or better properties and durability aspects, after prior approval from Owner/PMC.

Cladding material / auxiliary material specification/ thickness/ application mentioned in this document are the minimum requirements. Cladding material/ auxiliary material specification/ thickness/ application shall be based on design calculation of thermal conductivity, insulation class, corrosion aspects, durability, relevant IS/ ASTM codes, etc. Same shall be submitted to the Owner with necessary design calculations, drawings, test certificates and durability parameters.

LSTK shall submit material specifications, durability parameters assured, test certificates and application procedure to OWNER/PMC approval.

4.0 INSPECTION.

4.1 General

All insulation material shall be subject to inspection by owner before application. In case of doubt, Owner's representative will have the liberty to get the material tested by the contractor at any approved test laboratory. Any material not meeting specified requirement will be rejected and the rejected material shall have to be replaced by the contractor with material of specified type and quality. Insulation found to be improperly installed shall be removed and reinstalled properly by the contractor.

Contractor shall maintain detailed log of various insulation works and same shall be updated on daily basis. QA/QC checks of work done and materials shall be also registered in the daily logs. Owner will have the liberty to check the logs.

4.2 **Inspection**

Inspection of materials and / or installation by owner shall not relieve the contractor of his responsibility to ensure that finished insulation conform to specified requirements and is free from defects, contractor shall correct any defects due to poor workmanship. Contractor shall maintain test certificates and other relevant data from manufacturer.

4.3 **Test for thickness**

Test for thickness shall be carried out after application. Thickness at any point shall not be less than 2mm than the indicated designed thickness and excess thickness up to 115% of the designed thickness is permissible. .

4.4 **Testing for bulk density**

Testing of bulk density of the insulating materials shall be carried out before the application of insulation. This should be within ± 15% of the specified value. Test location shall be selected by owner and its repair shall be done by contractor.

5.0 **APPLICATION**

5.1 **General**

Insulation thickness shall be as per design calculations as specified in the drawings/ insulation schedule/ specification/isometric drawings prepared for equipments/piping.

Contractor shall submit detailed calculations and procedure for different insulation works based on relevant IS / ASTM codes.

5.2 **No. of Layers**

When insulation thickness exceeds 75 mm, the insulation shall be applied in multi-layers with all joints staggered. Each layer will be separately secured with metallic bands/wires.

No. of layers shall be as follows:

Insulation Thickness	**No. of Layers (Min.)**
Up to 75mm	1 Layer
76 to 150 mm	2 Layers
151 and above	3 Layers or more.

5.3 **GENERAL REQUIREMENTS**

5.3.1 **Surface preparation**

- Surface to be insulated shall be cleaned of all dirt. Oil loose scale etc. by wire brushing. Insulation works shall commence only after necessary clearance from QA/QC for painting works as per painting specification. All insulation shall be applied at ambient temperature and both the metal surface and insulation material shall be dry prior to application of insulation.

- The surface for cold insulation shall be then coated with a bitumen emulsion or a mastic coating.

- If the vessel is made of stainless steel, it shall be wire-brushed. with stainless steel wire brush**.**

5.3.2 **Expansion / contraction joint**

Depending on the type of insulation used the operating temperatures and nature of the material it may be necessary to provide expansion/contraction joints on vessels or pipes to prevent the insulation from rupturing/buckling when the surface expands/contracts. Joints are to be designed as per relevant IS / ASTM codes.

5.3.3 **Filling of Voids**

All voids, irregularities and joints shall be packed with loose insulation material/insulation cement trowelled smooth whichever is applicable.

6.0 **MEASUREMENT OF INSULATION WORK.**

6.1 Measurement of insulation works shall be as per IS: 14164.

7.0 **GUARANTEE**

- There shall be a surface temperature recording as mentioned in the Design Parameter to be performed with the help of Thermography Camera, post the line/ equipment is charged in operating conditions. The same shall be in LSTK's scope and LSTK shall give a detailed report of the same.

-The guarantee test shall be carried out when plant is fully operative.

-The surface temperature, reading shall be taken at six points per pipe line and at each point it shall be taken on all four sides in top, bottom, left side and right side.

-The above reading shall be taken at 2 hours intervals and shall be taken for 18 hours starting from 11 a.m. in the morning.

- Simultaneously ambient temperature shall be taken as per IS: 14164

- A graph shall be plotted between ambient and surface temperature reading

- From this graph the surface temperature against ambient temperature shall be found out

- The ambient and surface temperature shall be measured by the instrument provided by the contractor. The instrument shall be calibrated to the satisfaction of owner/consultant.

- The contractor is required to guarantee the surface temperature of 60ºC (max.) for equipments and piping in case of Hot Insulation. For cold insulation of equipments and

piping, the difference between skin temperature and ambient temperature shall not exceed 2 ºC.

- Ambient temperature and surface temperature shall be measured by duly calibrated instruments provided by CONTRACTOR.

- The CONTRACTOR shall undertake immediate replacement of insulation material damaged in transit, storage or application, at no additional cost to Owner.

- LSTK shall produce required number of copies of test certificates as per relevant IS/ASTM Standard. LSTK shall certify/ensure that Test to be done are from NABL approved laboratory, approved by Owner.

- All materials are new and unused and are as per specifications called for in this standard.

- The operating thermal conductivity shall be as specified

- The workmanship shall be in accordance with good practice.

- Other terms & conditions of the guarantee clause shall be as per NIT / purchase order / Commercial documents of ITB.

ANNEXURE- 7 – 2H

PAINTING SPECIFICATION

1.0 GENERAL

1.1 Scope

This specification covers the technical requirements for shop and site application of paint and protective coatings and includes; the surface preparation, priming, application, testing and quality assurance for protective coatings of mechanical equipment, structural steelwork, plate work, tankage, guards, pipe work, handrails and associated metal surfaces, which will be exposed to atmospheric for the Project**.**

1.2 Definitions

C.S	-	Carbon steel and low chrome (1-$^{1}/_{4}$ Cr through 9 Cr) alloys
S.S	-	Stainless steel, such as 304,316, 321, 347,
Non-ferrous		- copper, aluminium and their alloys.
High Alloy	-	Monel, Inconel, Incoloy, Alloy 20, Hastelloy, etc.
DFT	-	Dry Film thickness, the thickness of the dried or curved paint or coating film.

1.3 Safety Regulations

Protective coatings and their application shall comply with all national, state, and local codes and regulations on surface preparation, coating application, storage, handling, safety, and environmental recommendations.

Sand or other materials producing silica dust shall NOT be used for any open-air blasting operations.

1.4 Material Safety Data Sheets

The latest issue of the coating manufacturer's product datasheet, application instructions, and Material safety data Sheets shall be available prior to starting the work and shall be complied with during all preparation and painting / coating operations.

1.5 Materials

All paints and paint materials shall be obtained from the company's approved manufacturer's list. All materials shall be supplied in the manufacturer's containers, durably and legibly marked as follows.

Specification number
Colour reference number
Method of application
Batch number
Date of Manufacture
Shelf life expiry date
Manufacturer's name or recognised trade mark.

2.0 CODE AND STANDARDS:

Without prejudice to the provision of Clause 1.1 above and the detailed specifications of the contract, the following codes & standards shall be followed. Wherever reference to any code is made, it shall correspond to the latest edition of the code.

2.1 Indian Standards:

IS-5: 1994	Colors for ready mixed paints and enamels.
IS-2379: 1990	Color codes for identification of pipe lines.
IS-2629: 1985	Recommended practice for hot-dip galvanizing on iron and steel.
IS-2633: 1986	Methods for testing uniformity of coating of zinc-coated articles.
IS-8629: 1977	Code of practice for protection of iron and steel structures from atmospheric corrosion.
IS:110	Specification for Ready Mixed Paint, Brushing, Grey Filler, for Enamels, for Over Primers
IS:101	Methods of test for ready mixed paints & enamels.

2.2 Other Standards:

2.2.1 Swedish Standard: SIS-05 5900-1967 / ISO-8501-1-1988
(Surface preparations standards for Painting Steel Surface).
This standard contains photographs of the various standards on four different degrees of rusted steel and as such is preferable for inspection purpose by the Engineer-in-charge.

2.2.1 DIN: 53151 Standards for Adhesion test.

2.3 The paint manufacturer's, instructions shall be followed as far as practicable at all times. Particular attention shall be paid to the following:

a) Instructions for storage to avoid exposure as well as extremes of temperature.

b) Surface preparation prior to painting.

c) Mixing and thinning.

d) Application of paints and the recommended limit on time intervals between coats.

3.0 SURFACE PREPARATION

3.1 Metal Surface Preparation

3.1.1 Safety

All work in adjacent areas, which may negatively affect the quality of blast cleaning, and/or impose safety hazards, must be completed or stopped before the blasting operation starts.

3.1.2 Pre-cleaning

Prior to surface preparation all weld spatter shall be removed from the surface, all sharp edges ground down and all surfaces cleaned free of contaminants including chalked paint, dust, grease, oil, chemicals and salt. All shop primed surfaces shall be water washed by means of suitable solvent, by steam cleaning, with an alkaline cleaning agent if necessary or by high-pressure water, to remove contaminants prior to top-coating

3.1.3 Surface Decontamination

Surface decontamination shall be performed prior to paint application when uncoated surface is exposed to a corrosive environment or existing paint work is to be repaired.

Existing coatings shall be removed by abrasive blast cleaning, and then high pressure potable water shall be used to clean steel surfaces.

Prior to application of coatings, the surface shall be chemically checked for the presence of contaminants. A surface contamination analysis test kit shall be used to measure the levels of chlorides, iron salts and pH in accordance with the kit manufacturer's recommendations.

Swabs taken from the steel surface, using cotton wool test swabs soaked in distilled water shall not be less than one swab for every 25m2 of surface area to be painted.
Maximum allowable contaminant levels and pH range is as follows:

Sodium chloride, less than 50 microgram / cm2;

Soluble iron salts, less than 7 microgram / cm2; and

If the results of the contamination test fall outside the acceptable limits, then the wash water process shall be repeated over the entire surface to be painted, until the contaminant test is within the specified levels.

3.1.4 Abrasive Blasting

All C.S. materials shall be abrasive blast cleaned in accordance with Codes (Ref. Clause 2.0). To reduce the possibility of contaminating S.S., blasting is not usually specified. However, for coatings which require a blast-cleaned surface for proper adhesion, S.S. may be blast cleaned using clean aluminium oxide or garnet abrasives (Free from any chloride or Iron / Steel contamination).When hand or power tool cleaning is required on S.S., only S.S. wire-brushes (including 410 S.S.) which have not been previously used on C.S. surfaces may be used.

The surface profile of steel surfaces after blasting shall be of preparation grade Sa 2-1/2 of Swedish Standards SIS-05-5900 (Latest Revision) or better according to ISO 8501-1 and shall be measured using the replica tape method or the comparator method.

The roughness (profile) of blast-cleaned surfaces shall be Medium (G) according to ISO 8503-2: 1988 (appendix 1) unless otherwise specified. Medium defines a surface profile with a maximum peak-to-valley height of 60-100 microns, and G indicates that the surface profile is obtained by grit blasting. For the evaluation of surface roughness Comparator G shall be used.

Abrasive blast cleaning shall NOT be performed when the ambient or the substrate temperatures are less than 3^{o} C above the dew point temperature. The relative humidity should preferably be below 50% during cold weather and shall never be higher than 60% in any case.

Abrasive blast cleaning shall be performed with a clean, sharp grade of abrasive. Grain size shall be suitable for producing the specified roughness. Abrasives shall be free from oil, grease, moisture and salts, and shall contain no more than 50ppm chloride. The use of silica sand, copper slag and other potentially silica containing materials shall not be allowed

The blasting compressor shall be capable of maintaining a minimum air pressure of 7 kPa at the nozzle to obtain the acceptable surface cleanliness and profile.

The blast cleaning air compressor shall be equipped with adequately sized and properly maintained oil and water separators. The air supply shall be checked to ensure no oil and water contamination at the beginning of each work shift.

Blast cleaning abrasive shall be stored in a clean, dry environment at all times. Recycling of used abrasive is prohibited.

After blast cleaning, the surfaces shall be cleaned by washing with clean water (Pressure 7kg/Cm^2 using suitable nozzles. During washing broom corn brushes shall be used to remove foreign matter.

Assessment of the blast cleaned surfaces shall be carried out in accordance with reference code.

Blast cleaned surfaces which show evidence of rust bloom or that have been left uncoated overnight shall be re-cleaned to the specified degree of cleanliness prior to coating.

All grit and dust shall be removed after blasting and before coating application. Removal shall be by a combination of blowing clean with compressed air, followed by a thorough vacuum cleaning with an industrial grade, heavy duty vacuum cleaner.

All cleaned surfaces shall have protection from atmospheric corrosion as per IS8629:1977

3.1.5 Alternate Methods of Surface Preparation

When open air blasting is not permitted on site, or when space limitations or surface configurations preclude blasting, the alternate cleaning methods listed below may be used with prior approval. Alternate cleaning methods shall consider the degree of surface cleanliness and roughness profile required by the specified coating system.

- Vacuum or suction head abrasive blast-cleaning,
- Wet jet abrasive blast-cleaning,
- Compressed-air wet abrasive blast cleaning,
- Pressurized liquid blast-cleaning,
- Power tool cleaning,
- Hand or power tool cleaning,

Hand and/or power tool cleaning shall only be used for spot repair where abrasive blasting is not permitted or is impractical, and on items which could be damaged by abrasive blasting. Power tool cleaning shall not be carried out with tools which polish the surface, e.g. power wire brushes.

The surfaces of equipments and prefabricated piping etc. which are received at site Primerised or with finish paints, depending upon their conditions, shall be touched up and painted at site. For these surfaces sand blasting is not envisaged and these surfaces shall be prepared using power brushes, buffing or scraping, so as to achieve a surface finish to St-3 as per SIS-05-5900 . After wash-up the area to be touched up shall be jointly marked, measured and recorded for payment purposes. The type of system & nos. of coat (primer and/or finish paint) to be applied after touch up, which shall be decided by OWNER/CONSULTANT in writing before taking up the job.

When paint is to be applied on damaged painted surfaces of equipments all loose and flaking paint work should be removed to a firm feathered edge. Rusted spots should be cleaned by one of the methods specified in the clauses 4.4.1 & 4.4.2 above. In case the previous paint work is not compatible to the specified one the entire coating must be removed.

It shall be ensured that sand blasted surface/machine cleaned surface is not contaminated with oil and grease. Water shall also not be allowed to come in contact with sand blasted surface.

4.0 APPLICATION

4.1 General

The final specification of paint systems to be used to suit the exposure conditions of equipment and steelwork, shall be as specified on the scope of work, equipment data sheets or the drawings.

All coatings shall be in accordance with Indian / International Standards, the coating manufacturer's product data sheets and application instructions and the requirements contained in this specification.

4.1.1 General Requirements for Shop Application

All work areas which facilitates shop paint application shall be surface prepared for painting and have the paint system applied before installation.
Equipments assembled at site shall only receive primer coat in the shop and finish coatings will be applied at site.
In all cases, where surfaces will be inaccessible after shop assembly, they shall be prepared and have the paint system applied before assembly is carried out. Drying times between successive coats shall be at least those recommended by the manufacturer.

All known field weld areas shall be given the specified abrasive blast surface preparation but left uncoated for a distance of 50mm from the weld line. Such areas shall be given the appropriate touch-up treatment after installation.

The manufacturer's directions for preparation and application of coatings shall be followed to ensure that the durability of the coating system is not impaired.

The Contractor shall submit the full details of the proposed surface preparation and paint systems prior to the commencement of any surface preparation.

4.1.2 General Requirements for Site Application

Paint shall be stored only in accordance with the manufacturer's instructions.

All materials used for the specific system being applied shall be products supplied by one manufacturer and details of such product shall be submitted for approval before commencement of work.

The contents of cans shall be thoroughly stirred before being poured into paint pots and shall be thinned only in the specified proportions in accordance with the manufacturer's instructions.

Finish coats may be applied by spraying except where any over spray is likely to affect finished surfaces or where spraying constitutes a health hazard to workmen in the other areas. Brush and roller application will require multiple coats to achieve the specified dry film thickness.

Brush application may be used only with the approval of the company.

Roller application shall only be used on relatively large surface areas (i.e. > 50m2) and only if spraying is not an option.

The Contractor shall complete the application of any one type of paint or each coat thereof, before beginning the next coat on that section.

In cases nominated as critical, the application of each coat shall be approved before application of the next coat can proceed, in accordance with 'hold' points nominated in the Inspection and Test Plans (ITPs)

All fittings within any given area are to be painted with the same system as the area unless otherwise specified.

Where 2 coat of finish paint are indicated they shall be applied in two different shades to ensure that two coat are applied.

Paint shall not be applied in rain, snow, fog or mist or when the relative humidity is such as to cause condensation on metal surface.

The CONTRACTOR must ensure the availability of a specialist from the paint manufacturer, at SITE during pendency of CONTRACT within his quoted rates to ensure the quality of painting & procedure. Addition of drying agents, pigments or other substances is not allowed unless specifically prescribed or approved by paint manufacturer's specialist.

Name plates/tags attached to the equipments/machineries shall not be painted or removed during painting job. Failing to comply with above, the CONTRACTOR may be required to replace name plates/tags at his cost.

4.1.3 Qualifications and Materials

All surface preparation, coatings application and inspection, shall be carried out by personnel experienced in that particular field. Contractors shall submit the names of subcontractors to be employed for the specific work together with the brand names of coating materials for approval prior to commencement of application.

4.1.4 Handling and Transport

All pipe work, steelwork and equipment that have been finish coated shall be handled with care to preserve the coating in the best practical condition.

Painted materials shall not be handled until the coating has completely cured and dried hard Supports in contact with coated steel during transport and storage shall be covered with a soft material to prevent damage to the coating. Appropriate materials shall be used during transportation between coated steelwork and holding down chains to prevent damage to the coating.

4.2 Application of Coatings

4.2.1 General

The application method and type of equipment to be used shall be suitable for the paint specified and the surface being painted.

Paints and thinners shall be brought to the point of usage in unopened original containers bearing the manufacturer's brand name and colour designation and ready-mixed unless otherwise specified. Two-pack systems shall be mixed at the site of application to the paint manufacturer's recommendations. The mixed amount prepared shall be no more than the amount that can be applied during the stated pot life.

Paint shall be applied so that an even film of uniform thickness, tint and consistency covers the entire surface and is free of pin holes, runs, sags or excessive brush marks. Film finish shall be equal to that of first class brushwork.
Unless it is practical to do so colour shades for primer, intermediate coat and finish coat must be different to identify each coat without any ambiguity

Paint ingredients shall be kept properly mixed during paint application.

Equipment shall be kept clean to ensure dirt, dried paint and other foreign materials are not deposited in the paint film. Any cleaning solvents left in the equipment shall be completely removed before painting.
To ensure the required film thickness is achieved on angles, welds, sharp external edges, nuts and bolts, a coat shall be applied to such items/locations immediately prior to the application of each coating to the whole area.

Care shall be taken to ensure paint application into all joints and crevices.

The contact surfaces between steelwork to be fastened by means of friction grip bolting shall be abrasive blast cleaned and prime coated only, prior to erection.

4.2.2 Atmospheric conditions

Surface preparation and coating shall not be carried out in inclement weather and shall be carried out such that the surface being coated is free of moisture, wind-borne or blast cleaning dust.

Coatings shall not be applied if:

- The relative humidity exceeds 85%.
- The ambient temperature is less than 5^0C (depending on local condition)
- The metal temperature is less than 3^0C above the dew point.
- There is likely hood of an unfavourable change in weather conditions within two hours after painting.

As a general rule, sufficient ventilation, dehumidification and heating capacity to cope with local climatic conditions must be secured before any coating – related work is started.

In any case, humidity, ambient and surface temperature conditions at the time of paint application, and curing and drying time before application of the next coat, shall be in accordance with the paint manufacturer's recommendations. These conditions shall be recorded in the Inspection Test Record (ITR) by the Contractor and be available for review.

4.2.3 Conventional or Airless Spray

Spray equipment shall be equipped with accurate pressure regulators and gauges. Spray gun nozzles and needles shall be those recommended by the paint manufacturer.

Air from the spray gun shall be clean and dry with no traces of oil or moisture.

Coatings shall be wet on contacting the painted surface. Areas of dry spray shall be removed and the correct system re-applied.

4.2.4 Brush Application

The method of "laying-off" shall be suited to the paint specified and shall ensure minimum brush marking.

4.2.5 Roller Application

A uniform method of application shall be adopted when painting large areas. The rolling direction shall minimise paint joint build up. Edges and areas subject to possible roller damage shall be brush-painted prior to rolling.

4.2.6 Thickness of Coatings

The maximum thickness DFT in any one application shall not exceed that specified in Technical specifications/ recommended by the paint manufacturer.

Wet film thickness gauges shall be used to make frequent checks on the applied wet film.
The Contractor shall maintain at the site of painting operations, a dry film thickness tester of an approved type with a valid current calibration.

Coating thickness checks in accordance with reference code shall be performed, and the Contractor shall undertake remedial action if the measured thickness is less than specified.

Build up of each material to required thickness shall be made prior to the application of the subsequent coat; final film build shall be the minimum specified.

4.2.7 Multiple Coat Applications (Except Wet-On-Wet)

Before successive paint coats are applied, intermediate coats shall be inspected for surface contamination. The presence of any grease or oil, shall be removed by a suitable solvent, and any salt and dirt adhering to the surface shall be removed by scrubbing with a solution of non-toxic detergent (except those prescribed by the manufacturer as “wet-on-wet"). Removal of contaminants shall only be performed after an intermediate coat has had sufficient time to cure.

The surface shall then be pressure hosed or dusted down by brush to disturb and remove deposits not apparent on visual inspection.

Coatings shall be applied only under the following conditions:

- The surface has been cleaned and is dry;
- The manufacturer's stated minimum time for re-coat has elapsed;

- The manufacturer's stated maximum time for re-coat has not elapsed. If the maximum time has elapsed then pre-treatment shall be in accordance with the paint manufacturer's recommendations; and

  Damaged areas in preceding coat have been made good in accordance with this Specification.

When multiple coat of finish paint are indicated, they shall be applied in different shades to ensure that multiple coats have been applied.

4.2.8 Protective Coatings for Fasteners

Black and galvanised erection bolts/nuts and galvanised holding down bolts/nuts shall be prepared and painted in accordance with Section 4.4 of this Specification.

Black high tensile bolts/nuts shall be painted after erection to the same paint system specification as the surrounding structural steel.

4.3 Hot Dip Galvanising

All galvanising shall be carried out by the hot dipping process and conform to the requirements of IS-2629:1985 and uniformity of coating shall confirm to IS 2633:1986.

All welding slag shall be removed by chipping, wire brushing, flame cleaning or abrasive blast cleaning where necessary prior to galvanising

For temporary identification, either water-soluble marking paints or detachable metal labels shall be used. For permanent identification, figures/labels shall be heavily punched or embossed by the fabricator.

For galvanised items after pickling, the work shall be inspected and any defects that render the work unsuitable for galvanising shall be repaired. After such repairs, the work shall again be cleaned by pickling.

The coating mass of zinc shall be as specified on equipment data sheets and the Drawings. Galvanised coatings shall be tested by the methods described in referred code.

After galvanising all material shall be cooled to air temperature in such a manner that no embrittlement occurs.

Galvanised coatings shall be smooth, uniform, adherent and free from stains, surface imperfections and inclusions.

All gratings and fixtures including nuts, bolts and washers that are required to be galvanised, shall be hot dipped galvanised and all nut threads shall be re-tapped after galvanising and a lubricant applied on Cold working of galvanised steelwork shall be avoided.

4.4 Damaged or Inaccessible Surfaces

4.4.1 Damaged Paint Surface

Repair of damaged painted surfaces, as well as painting of galvanised and black bolts, and galvanised

holding down bolts after erection shall comply with this Clause. The treatment shall be:

- Pre-clean the damaged or unpainted areas in accordance with Section 4.2.1 of this Specification;
  - Disc or hand sand to clean bright metal;
- Inorganic zinc primers subject to mechanical damage or weld etc shall be power tool cleaned
- Feather backs by sandpapering or whip blasting the original coatings surrounding the damaged area over a 50mm distance. A rough surface shall be obtained on epoxy coatings;
  - Clean surface to remove all dust;
- Conduct surface contaminant test in accordance with Section 4.2.2 of this document; and

  Build up a new paint system over the affected area with paints equal to those originally used and having the same dry film thickness for each coat. As an exception, damaged inorganic zinc primers shall be repaired with epoxy organic zinc rich paint and shall be applied within four hours of blast cleaning.

The new coatings shall overlap the original coating over the 50mm prepared distance and shall be colour matched to the specified colour of the original coating.

4.4.2 Damaged Galvanised Surfaces

Damaged areas caused by oxy-cutting, welding or physical impact shall be treated as follows:

- Prepare the surface by removing any weld slag followed by vigorous power wire brushing of the coating surrounding the damaged area over a 50mm distance;
  - Clean surface to remove all dust; and
- Apply two coats of organic zinc-rich primer to a minimum DFT of 100 microns.

The area to be reinstated shall be colour matched to the surrounding finish colour with 40 microns of aluminium paint to the manufacturer's **written instructions.**

4.4.3 Inaccessible Surfaces

Surfaces that will be inaccessible after erection of other elements of the structure, shall be fully painted prior to the installation of the obstructing item.

4.5 Surfaces Not To Be Coated

The following surfaces shall not be blasted or coated unless specifically directed:

Machined surfaces, bearings, seals, grease fittings, adjusting screws and name plates, and identification tags.

- Valve stems;
- Raised faces on pipe and equipment flanges;
- Electrical cabling;
- Instrumentation, gauges and sight glasses;
- Titanium, stainless steel and non-metallic surfaces; and

  Field weld margins, 50mm either side of weld, on tankage and piping, prior welding.

The rear face of piping flanges shall be shop prime coated only. Flange holes for fasteners shall be fully coated.

4.6 Wash-Up

All surface of equipments/prefabricated piping etc. Primerised / painted at Vendor shop and received at site if required shall be washed up as follow:

a) Washing with clean water (Pressure 7 Kg/cm2) using suitable nozzles. During washing, broomcorn brushes shall be used to remove foreign matter.

b) Solvent washing, if required , to remove traces of wash up as per above procedure of all surfaces of equipment, piping, structure etc. completely painted at contractor's shop shall be included in the quoted rates of oil, grease etc. Wash up as per above procedure of all surfaces of equipment, piping, structure etc. completely painted at contractor's shop shall be included in the quoted rates.

4.7 Touch-Up Painting

Prior to the application of any coat, all damage to the previous coat(s) shall be touched-up. Damage to finished work shall be thoroughly cleaned and re-coated.

Surface preparation shall be done as per clause no. 3.0.....

Items supplied with the manufacturer's standard coating system shall be touched-up with the same generic coating system or recoated.

4.8 Paint Storage

The following must be ensured:

a) All paints and painting material shall be stored only in such rooms assigned for the purpose. All necessary precaution shall be taken to prevent fire. The Storage building shall preferably be separate from adjacent buildings. A sign-board bearing the Words "PAINT STORAGE- NO NAKED LIGHT" shall be clearly displayed outside. The building shall be properly ventilated and shall be adequately protected with fire fighting equipment.

b) Storage shall be far away from heated surface open flames, sparks & well protected from sun rays.

c) Ambient temperature at which paints are stored shall be intimated to paint manufacturer & their advice sought regarding precautions to be taken if any, regarding flammability, explosiveness & toxicity.

d) Maximum allowed storage time for various paint materials shall be clearly indicated on individual containers. Materials which have passed expiry date shall not be used.

e) Paints in non-original containers and/or in containers without seals, shall not be used.

5.0 COATING SYSTEM SELECTION

Coating Systems for Structures Piping and Equipment

The following Table 1 shall be used as a general guide for the selection of a paint system suitable for a particular plant area application. Paint systems specified on equipment data sheets and the Drawings shall take precedence over the general paint system area applications listed in Table 1.

TABLE - 1

Ref No.	Application	Surface Preparation	Generic Coating System	Minimum DFT	Remarks	
01	Structural Steel work with operating temp. Up to 90^{O} C (Steel structures, Piping support, uninsulated CS piping, flanges, valves, stairways, walkways etc. except grating).	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	P2 : ONE coat of two pack zinc rich epoxy Primer meeting SSPC Paint 20 level 1 F1 : One coat of two packs. Polyamide Cured Epoxy. F5 : One coat of two pack aliphatic acrylic polyurethane	P2 : 60 microns F1 : 120 – 200 microns F5 : 60 microns	Total dry film thickness of paint system: 240 microns as per C4 – High durability	Total dry film thickness of paint system: 320 microns as per C5 – High durability
02	Uninsulated CS piping, flanges, valves with operating temp. From Above 90^{O} C to 200^{O} C.	Blast cleaning to near white metal grade Sa-2½, of Swedish Standards SIS-05-5900 (Latest)	P1 : One coat of Ethyl Silicate zinc rich with solvent Primer meeting SSPC Paint 20 level 1 F3 : Two coats of single pack special Oleo resinous based heat resistant ready mixed Aluminium Paint.	P1 : 75 microns F3 : 2 x 25 microns for each coat Total - 125 microns.	Total dry film thickness of paint system: 125 microns.	
03	Uninsulated CS piping, flanges, valves with operating temp. Over 200^{O} C.	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	P1 : One coat of Ethyl Silicate zinc rich with solvent Primer meeting SSPC Paint 20 level 1 F4 : Two coats of Heat Resisting Silicon Aluminium Paint.	P1 : 75 microns F4 : 2 x 25 microns for each coat Total - 50 microns.	Total dry film thickness of paint system: 125 microns.	
04	Insulated CS piping flanges, valves with operating temp up to 90^{O} C	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	F8 : One coat of high temperature epoxy phenolic	F8 : 2 x 125 microns	Total dry film thickness of paint system: 250 microns.	

Ref No.	Application	Surface Preparation	Generic Coating System	Minimum DFT	Remarks	
05	Insulated CS piping, flanges, valves with operating temp. From 90^{O} C to 200^{O} C.	Blast cleaning to near white metal grade Sa-2½, of Swedish Standards SIS-05-5900	F8 : Two coats of high temperature epoxy phenolic (novolac)	F8 : 2 x 125 microns	Total dry film thickness of paint system:250 microns	
06	Insulated CS piping, flanges, valves with operating temp. Over 200^{O} C.	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	F9 : Two coats of Inorganic Co-polymer based coating With an Inert Multipolymer Matrix.	F9 : 2 x 150 microns	Total dry film thickness of paint system: 300 microns.	
07	Uninsulated CS equipment with operating temp. Up to 90^{O} C, to be treated at Manufacturer's shop.	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	P2 : ONE coat of two pack zinc rich epoxy Primer meeting SSPC Paint 20 level 1 F1 : One coat of two packs. Polyamide Cured Epoxy. F5 : One coat of two pack aliphatic acrylic polyurethane	P2 : 60 microns F1 : 120 – 200 microns F5 : 60 microns	Total dry film thickness of paint system: 240 microns as per C4 – High Durability	Total dry film thickness of paint system: 320 microns as per C5 – High Durability
08	Uninsulated CS equipment with operating temp. From 91^{O} C to 200^{o}C, to be treated at Manufacturer's shop.	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	P1 : One coat of Ethyl Silicate zinc rich with solvent Primer meeting SSPC Paint 20 level 1 F3 : Two coats of single pack special Oleouresinous based heat resistant ready mixed Aluminium Paint.	P1 : 75 microns F3 : 2 x 25 microns for each coat	Total dry film thickness of paint system: 125 microns.	
09	Uninsulated CS equipment with operating temp. Over 200^{o}C, to be treated at Manufacturer's shop.	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	P1 : One coat of Ethyl Silicate zinc rich with solvent Primer meeting SSPC Paint 20 level 1 F4 : Two coats of Heat Resisting Silicon Aluminium Paint.	P1 : 75 microns F4 : 2 x 25 microns for each coat Total - 50 microns.	Total dry film thickness of paint system: 125 microns.	
10	Insulated CS equipment with	Blast cleaning to near white	F8 : Two coats of high temperature epoxy	F8 : 2 x 125	Total dry film thickness of paint	

Ref No.	Application	Surface Preparation	Generic Coating System	Minimum DFT	Remarks	
	operating temp. Up to 90^{O} C, to be treated at Manufacturer's shop.	metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	phenolic (novolac)	microns	system:250 microns	
11	Insulated CS equipment with operating temp. From 91^{O} C to 200^{o}C, to be treated at Manufacturer's shop.	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	F8 : Two coats of high temperature epoxy phenolic (novolac)	F8 : 2 x 125 microns	Total dry film thickness of paint system:250 microns	
12	Insulated CS equipment with operating temp. Over 200^{o}C, to be treated at Manufacturer's shop.	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	F9 : Two coats of Inorganic Co-polymer based coating With an Inert Multipolymer Matrix.	F9 : 2 x 150 microns	Total dry film thickness of paint system: 300 microns.	
13	Surface of structural steel for furnaces, external surface of furnaces, external surface of flue duct, metal stacks and similar with operating temp. Up to 200^{o}C. (With exclusion of stair ways, walk ways etc.).	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	P1 : One coat of Ethyl Silicate zinc rich with solvent Primer meeting SSPC Paint 20 level 1 F3 : Two coats of single pack special Oleo resinous based heat resistant ready mixed Aluminium Paint.	P1 : 75 microns F3 : 2 x 25 microns for each coat	Total dry film thickness of paint system: 125 microns.	
14	For external surfaces of flue ducts, metal stacks, and similar with operating temp. Above 200^{o}C.	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	P1 : One coat of Ethyl Silicate zinc rich with solvent Primer meeting SSPC Paint 20 level 1 F4 : Two coats of Heat Resisting Silicon Aluminium Paint.	P1 : 75 microns F4 : 2 x 25 microns for each coat Total - 50 microns.	Total dry film thickness of paint system: 125 microns.	
15	For surfaces of	Blast cleaning	P2 : ONE coat of two	P2 : 60	Total dry	Total dry

Ref No.	Application	Surface Preparation	Generic Coating System	Minimum DFT	Remarks	
	air cooler heads not galvanized with operating temperature up to 90^0 C, treated at manufacturer's shop.	to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	pack zinc rich epoxy Primer meeting SSPC Paint 20 level 1 F1 : One coat of two packs. Polyamide Cured Epoxy. F5 : One coat of two pack aliphatic acrylic polyurethane	microns F1 : 120 – 200 microns F5 : 60 microns	film thickness of paint system: 240 microns as per C4 – High Durability	film thickness of paint system: 320 microns as per C5 – High Durability
		NOTE: All surfaces shall be galvanized at manufacturer's shop with exception of the end header of air cooled heat exchangers that shall be treated as described above at Manufacturer's shop. In case the same surfaces shall not be treated at shop, they shall be treated at site according to environmental and operating conditions.				
16	For surfaces of air cooler heads not galvanized with operating temperature up to 91^0 C TO 200^OC, treated at manufacturer's shop.	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	P1 : One coat of Ethyl Silicate zinc rich with solvent Primer meeting SSPC Paint 20 level 1 F3 : Two coats of single pack special Oleouresinous based heat resistant ready mixed Aluminium Paint.	P1 : 75 microns F3 : 2 x 25 microns for each coat	Total dry film thickness of paint system: 125 microns.	
		NOTE: All surfaces shall be galvanized at manufacturer's shop with exception of the end header of air cooled heat exchangers that shall be treated as described above at Manufacturer's shop. In case the same surfaces shall not be treated at shop, they shall be treated at site according to environmental and operating conditions.				
18	STORAGE TANKS					
a)	Acid / Alkali CS Storage Tank (External Surface including all stair ways)	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	P2 : ONE coat of two pack zinc rich epoxy Primer meeting SSPC Paint 20 level 1 F1 : One coat of two packs. Polyamide Cured Epoxy. F5 : One coat of two	P2 : 60 microns F1 : 120 – 200 microns F5 : 60 microns	Total dry film thickness of paint system: 240 microns as per C4 – High Durability	Total dry film thickness of paint system: 320 microns as per C5 – High Durability

Ref No.	Application	Surface Preparation	Generic Coating System	Minimum DFT	Remarks	
			pack aliphatic acrylic polyurethane			
b)	CS Storage Tanks, Excluding indicated in Sl. No. (a)	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	P1 : One coat of Ethyl Silicate zinc rich with solvent Primer meeting SSPC Paint 20 level 1 F1 : One coat of two pack Polyamide Cured Epoxy. F5 : Two-pack aliphatic Isocyanate cured acrylic finish paint	P1 : 60 microns F1 : 120 - 200 microns F5 : 60 microns	Total dry film thickness of paint system: 240 microns as per C4 – High Durability	Total dry film thickness of paint system: 320 microns as per C5 – High Durability
19	Cold Insulated Carbon Steel and low alloy Steel (1-$^{1}/_{4}$ Cr through 9 Cr) Piping and Equipment. (Upto 60 Deg. C)	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	F7 : Two coats of Tar Free Epoxy paint suitably pigmented	F7 : 2 x 125 microns	Total dry film thickness of paint system: 250 microns.	
20	Cold Insulated high alloy Steel piping and Equipment (Upto 200 Deg. C)	Lightly Blast cleaned as per Sa 1.0 Swedish Standards SIS-05-5900 (Latest).	F8 : Two coats of high temperature epoxy phenolic (novolac)	F8 : 2 x 125 microns	Total dry film thickness of paint system:250 microns	
21	DELETED					
22	Surface (CS) with Equipment with temp. Indicating paint from 220^{o}C to 240^{o}C treated at Manufacturer's shop	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	P1 : One coat of Ethyl Silicate zinc rich with solvent Primer meeting SSPC Paint 20 level 1 F6 : Temperature indicating paint	P1 : 75 microns F6 : 2 x 25 microns for each coat Total - 50 microns.	Total dry film thickness of paint system: 125 microns.	
23	PACKAGE:					
a)	Surface(CS) with operating temperature upto 90^{o}C treated at Manufacturer's	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900	P2 : ONE coat of two pack zinc rich epoxy Primer meeting SSPC Paint 20 level 1 F1 : One coat of two	P2 : 60 microns F1 : 120 – 200 microns	Total dry film thickness of paint system: 240	Total dry film thickness of paint system: 320

Ref No.	Application	Surface Preparation	Generic Coating System	Minimum DFT	Remarks	
	shop	(Latest).	packs. Polyamide Cured Epoxy. F5 : One coat of two pack aliphatic acrylic polyurethane	F5 : 60 microns	microns as per C4 – High Durability	microns as per C5 – High Durability
b)	Surfaces (CS) with operating temperature upto 91^0 C TO 200^OC, treated at manufacturer's shop.	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	P1 : One coat of Ethyl Silicate zinc rich with solvent Primer meeting SSPC Paint 20 level 1 F3 : Two coats of single pack special Oleouresinous based heat resistant ready mixed Aluminium Paint.	P1 : 75 microns F3 : 2 x 25 microns for each coat	Total dry film thickness of paint system: 125 microns.	
c)	Surface (CS) with operating temp. Over 200^oC, treated at manufacturer's shop.	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	P1 : One coat of Ethyl Silicate zinc rich with solvent Primer meeting SSPC Paint 20 level 1 F4 : Two coats of Heat Resisting Silicon Aluminium Paint.	P1 : 75 microns F4 : 2 x 25 microns for each coat Total - 50 microns.	Total dry film thickness of paint system: 125 microns.	
d)	Package in Carbon Steel and low Alloy Steel ($1\text{-}^1/_4$ Cr through 9 Cr) with cold insulated surface treated at manufacturer's shop (Upto 60 Deg. C)	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	F7 : Two coats of Tar Free Epoxy paint suitably pigmented	F7 : 2 x 125 microns	Total dry film thickness of paint system: 250 microns.	
e)	Package in Cold Insulated high alloy Steel. (Upto 200 Deg. C)	Lightly Blast cleaned as per Sa 1.0 Swedish Standards SIS-05-5900 (Latest).	F8 : Two coats of high temperature epoxy phenolic (novolac)	F8 : 2 x 125 microns	Total dry film thickness of paint system:250 microns	
f)	DELETED					
24	For internal surface of shell,	Blast cleaning to near white	F2 : Two coats of two pack amine adduct	F2 : 2 x 150	Total dry film thickness of paint	

Ref No.	Application	Surface Preparation	Generic Coating System	Minimum DFT	Remarks
	roof of CS tanks, with operating temp. Upto 110°C	metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	cured Phenolic (Novolac) epoxy (immersion grade)	microns for each coat	system: 300 microns.
25	For underside (soil side) of the tank bottom (CS) below only of the fixed tanks, bottom & shell shall be treated as follows:	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	F7 : Two coats of Tar Free Epoxy paint suitably pigmented OR F8 : Two coats of high temperature epoxy phenolic (novolac)	F7 : 2 x 200 microns OR F8 : 2 x 150 microns	Total dry film thickness of paint system: 400 microns. OR Total dry film thickness of paint system: 300 microns.
26	CS Equipment and associated piping subject to cyclic, intermittent or regeneration operating condition (e.g. Molecular Sieve Driers) subjected to very severe corrosion with wide operating temperature range.	Blast cleaning to near white metal grade 3, of Swedish Standards SIS-05-5900 (Latest).	Primer: One coat of Thermal spray Aluminium paint and sealed with a Silicon Aluminium seal Finish Coat: One coat of Thermal spray Aluminium paint and sealed with a Silicon Aluminium seal.	Primer: 125 microns Finish: 125 microns	Total dry film thickness of paint system 250 microns.

NOTES:

Primers

ZINC ETHYL SILICATE PRIMER – P1

The zinc ethyl silicate consists of two packs. One pack contains the ethyl silicate binder with suitable solvents. The other pack contains zinc dust (NOT Paste). Zinc dust shall be ASTM D 520 Type II. They have to be mixed in suitable proportions before application as recommended by manufacturer.

Volume solids	**:**	Min.64% ±2
DFT Range	**:**	50 – 75 microns
Theoretical Spreading Rate	**:**	12.8 – 8.53 sqm/litre
Colour	:	Grey
Application	:	Spray (airless/air)
Drying time (dry to handle)	:	< 45 mins. @ 30 Deg. C and 65% RH
Curing	:	<16 hrs @ 30 Deg. C and 65% RH

% of total metallic zinc in dry film (As per the ASTM D520 – Spherical size)	:	**(SSPC SP 20 Level 1) >85% by wt.**
Specific Gravity	:	**2.5 Kg/Litre min.**
Storage life	:	6 months under sealed conditions

Zinc silicate Material curing shall be checked using ASTM D 4752, minimum Acceptable value is 4.

ZINC RICH EPOXY PRIMER – P2

The zinc rich epoxy consists of two packs. One pack contains the epoxy binder with suitable solvents. The other pack contains zinc dust as per ASTM D520 Type II. They have to be mixed in suitable proportions before application as recommended by manufacturer.

Volume solids	**:**	65% min. ±2
DFT	**:**	50 – 100 microns
Theoretical Spreading Rate	**:**	13 – 6.5 sqm/litre
Colour	:	Grey
Application	:	Airless spray/air spray/brush
Drying time (dry to handle)	:	<10 min. @ 30 Deg C
Hared Dry	:	< 1.5 hrs @ 30 Deg C
% of total metallic zinc in dry film (As per the ASTM D520 – Spherical size)	:	**(SSPC SP 20 Level 2) 81% by wt. min.**
Specific Gravity	:	**2.3 Kg/Litre min.**
Storage life	:	12 months under sealed conditions

Finish Paints

HIGH BUILD EPOXY FINISH – F1

This finish paint is fast drying, high build, Two-pack polyamide cured epoxy resin

Volume solids	**:**	85% min. ±2
DFT Range	**:**	100 – 200 microns
Theoretical Spreading Rate	**:**	7.6 – 3.8 sqm/litre
Colour	**:**	As per Manufacturer List
Binder	**:**	Polyamide cured epoxy resin, Lead & Chrome Free
Application	**:**	Brush or spray
Drying time	**:**	< 2 hrs @ 30 Deg C
Over coating time	**:**	< 2 hrs @ 30 Deg C
Storage life	**:**	24 months under sealed conditions

HIGH BUILD EPOXY FINISH (Immersion Grade) – F2

This finish paint is high build, Two-pack phenolic (novolac) epoxy

Volume solids	**:**	68% min. ±2
DFT Range	**:**	100 – 150 microns
Theoretical Spreading Rate	**:**	6.8 – 4.5 sqm/litre
Colour	**:**	As per Manufacturer List
Binder	**:**	Amine adduct cured epoxy resin
Application	**:**	Brush or spray

Drying time	**:**	< 1.5 hrs @ 30 Deg C
Over coating time	**:**	< 6.5 hrs @ 30 Deg C
Storage life	**:**	24 months under sealed conditions

HEAT RESISTANT ALUMINIUM FINISH PAINT : F3

It is a single pack system based on oleo resinous general purpose aluminium paint with good heat resistance upto 250 Deg. C. and light reflection.

Volume solids	**:**	25% min. ±2
DFT Range	**:**	25 microns
Theoretical Spreading Rate	**:**	10 sqm/litre
Main pigment	**:**	Aluminium (ASTM 962), Lead & Chrome Free
Colour	**:**	Metallic Aluminium
Pigment Volume Concentration	**:**	15 – 20%
Application	**:**	Brush or spray
Drying time	**:**	Surface dry <1hr. @ 30 Deg. C
		Hard dry < 3 hrs. @ 30 Deg. C
Storage life	**:**	24 months under sealed conditions

HEAT RESISTANT SILICON ALUMINIUM FINISH PAINT : F4

It is a single pack system based on ambient curing silicone aluminium pigmented polysiloxane paint with maximum heat resistance of upto 600 Deg. C.

Volume solids	**:**	25% min. ±2
DFT Range	**:**	25 microns
Theoretical Spreading Rate	**:**	10 sqm/litre
Main pigment	**:**	Aluminium (ASTM 962), Lead & Chrome Free
Colour	**:**	Metallic Aluminium
Pigment Volume Concentration	**:**	15 – 20%
Application	**:**	Brush or spray

Drying time	**:**	Surface dry < 1hr. at 30 Deg. C
		Hard dry < 3 hrs. at 30 Deg. C
Storage life	**:**	12 months under sealed conditions

TWO PACK ALIPHATIC ACRYLIC POLYURETHANE FINISH PAINT – F5

It Consists of Acrylic Resin in Part A. Part B consists of an aliphatic poly-isocyanate with appropriate solvents and additives.

Volume solids	**:**	51% min. ±2
DFT range	**:**	50 – 100 microns
Theoretical Spreading Rate	**:**	10.2 – 5.1 sqm/litre
Main pigment	**:**	Suitable pigments to get the desired colour, **Lead & Chrome Free**
Colour	**:**	Metallic Aluminium
Binder	**:**	Shall not contain any binder other than acrylic resin; should not contain any **alkyd / acrylate alkyds / esters.**
Application	**:**	Brush or spray
Drying time	**:**	Surface dry < 1hr. @ 30 Deg. C
		Hard dry < 8 hrs. @ 30 Deg. C
ISO 11507/ASTM G 154, QUV A - Accelerated weathering	**:**	**Gloss retention: approx. 80 % and colour change approx. DE 1.2 after 3000 hours exposure**
Storage life	**:**	24 months under sealed conditions

TEMPERATURE INDICATING PAINT : F6

It is a single pack temperature indicating system based on silicone binder. Pigments change colour by heating. The colour change of the coating is permanent. At approximately 200°C, the colour changes from green to blue, above 310°C, the colour changes from blue to greyish white. Maximum service temperature is 400°C.

Volume solids	:	40% min.
DFT	:	25 microns
Theoretical Spreading Rate	:	16 sqm/litre
Main pigment	:	As per shade requirement, Lead & Chrome free
Colour	:	As per manufacturer
Binder	:	Based in silicone Resins
Application	:	Brush or spray
Drying time	:	Surface dry < 1hr. @ 30 Deg. C
		Hard dry < 4 hrs. @ 30 Deg. C
Storage life	:	12 months under sealed conditions

TAR FREE EPOXY – F7 (Coal Tar is Banned Globally being Carcenogic)

A high build two component abrasion resistant, pure epoxy with anti-corrosive properties meant for excellent performance.

Volume solids	:	Minimum 72%
DFT Range	:	150 – 200
Theoretical Spreading Rate	:	4.8 – 3.6 sqm/litre
Application	:	By brush or airless spray
Drying time	:	Touch Dry within 4 hrs. @ 30 Deg C
		Hard dry < 9 hours @ 30 Deg. C
Storage life	:	12 months under sealed conditions

EPOXY PHENOLIC (NOVOLAC) – F8

Two Pack epoxy-phenolic (novolac) cured with amine adduct used as an External coating for the protection of insulated (CUI) equipment.

Volume solids	:	68% min.
DFT Range	:	100 – 150 microns
Theoretical Spreading Rate	:	6.8 – 4.5 sqm/litre
Binder	:	Epoxy phenolic (novolac)
Dry Temp. Service	:	Min. -196 to max. 205 Deg. C.
Application	:	Airless Spray / Brush Touch up
Drying Time	:	Surface dry < 1.5hr. @ 30 Deg. C
		Hard dry < 6 hours @ 30 Deg. C
Storage life	:	12 months under sealed conditions

INORGANIC CO-POLYMER COATING – F9

MIO pigmented single component inorganic copolymer coating which cures to form an in polymer matrix able to resist temperatures up to 650°C/1202°F and thermal shock/cycling dry or dry/wet service.

Volume solids	**:**	74% min.
DFT Range	**:**	150 microns
Theoretical Spreading Rate	**:**	5 sqm/litre
Binder	**:**	Inorganic copolymer coating
Dry Temp. Service	**:**	Min. -196 to max. 650 Deg. C.
Application	**:**	Airless Spray / Brush Touch up
Drying Time	**:**	Surface dry < 0.5hr. @ 30 Deg. C
		Hard dry < 1.5 hours @ 30 Deg. C
Storage life	**:**	12 months under sealed conditions

6.0 MACHINERY, ELECTRICAL AND INSTRUMENT EQUIPMENT:

6.1 Machinery

Steel surfaces shall be treated with complete paint system at Manufacturer's shop. The paint system shall be according to Manufacturer's Std. However, suitable for operating condition and the environmental condition where the machinery will operate. Where necessary machinery shall be restored at site by Contractor with suitable finish.

6.2 Electrical and Instrument Equipment

Steel surfaces shall be treated with complete paint system at Manufacturer's shop. The paint system shall be according to Manufacturer's Std., however suitable for operating condition and the environmental condition where the electrical and instrument equipment will operate. Where necessary Electrical and Instrument Equipment shall be restored at site by Contractor with suitable finish.

NOTE-1: The colours shall be according to IS2379:1990/International STD. RAL or BS, proposed by Contractor or Manufacturer

7.0 LIST OF MANUFACTURERS :

1. M/s Berger Paints
2. M/s Jensons & Nickolson
3. M/s Jotun Paints
4. M/s Asian Paints
5. M/s Grauer & Weil (India) Limited
6. M/s Shalimar paints
7. M/s Garware Paints
8. M/s Goodlass Nerolac Paints Ltd
9. M/s.HEMPEL Paints
10. M/s International Paints (Akzo Nobel Brand)
11. M/s Carboline (India) Pvt. Ltd.
12. M/s Mohan Paints

8.0 WARRANTY:

Contractor along with Paint Manufacturer jointly shall develop the paint schemes following the system specification.

They shall jointly provide a performance guarantee for a period 5 years as stipulated below,

After 1 years – Corrosion in 3% of total painted area accepted

After 2 years – Corrosion in 6% of total painted area accepted

After 3 years – Corrosion in 9% of total painted area accepted

After 4 years – Corrosion in 12% of total painted area accepted

After 5 years – Corrosion in 15% of total painted area accepted

where spontaneous visible corrosion has broken down the paint film to a degree exceeding “Ri 3” (as defined in ISO 4628/3-2003).

ANNEXURE- 7 - 3

QUALITY CONTROL PROCEDURE AND INSPECTION REQUIREMENTS

1.0 LSTK CONTRACTOR'S QUALITY CONTROL

1.1 LSTK CONTRACTOR shall provide a quality control program manual include specific WORK methods and inspections, which assure quality.

This quality control program manual must be submitted to OWNER for Approval before starting the construction activities.

All installation WORK must be in strict accordance with this approved manual.

1.2 The quality control program shall include as a minimum the following:

- Methods use to control drawings; specifications and CONTRACT correspondence to assure that only the latest revisions are being used in the field.
- Inspection personal name, organization.
- Inspection methods and documentation of inspection (or tests) for shop fabrication, if required, and installation.
- Material control procedures from SITE receiving point, through "over, short and damage inspection" through storage and through installation.
- Positive material identification Procedures for:
- Electrical cable pulling and testing.
- Asphalt placement inspection.
- Handling and storage methods to prevent damage.
- Inspection and testing procedures and reports for civil, structural, piping, electrical, instrument, equipment and all installation WORK.
- Repair.
- Scrap and reject.
- Grouting.
- Welding.
- Welder qualification.
- Receiving all permanent plant material & equipment.
- Rigging.
- Welder's tests.
- Nondestructive examinations to be used.
- Positive material identification. etc.
- Identification of LSTK CONTRACTORS and ensuring their compliance with the manual and WORK required.
- Material certification verification methods.
- Calibration procedures for measurements and test equipment.
- Marking and identification of components in process and complete assemblies.

2.0 Shop fabrication and field installation inspection OWNER'S REPRESENTATIVE to ensure specifications. in the following areas will be performed by full adherence to Receiving and inspection.

- Calibration of test inspection equipment.

- Preventive maintenance and storage protection.
- Internal cleanliness.
- Proper material use and control.
- Nondestructive testing and its results.
- Workmanship.

3.0 OWNER'S REPRESENTATIVE or others as authorized by OWNER are to be permitted access to LSTK CONTRACTOR'S work areas for the purpose of inspection of material, equipment, documentation and other areas as required in LSTK CONTRACTOR'S quality assurance *I* quality control program.

4.0 No concrete will be placed by LSTK CONTRACTOR without an OWNER "Pour Release Form'.

5.0 OWNER'S construction inspections will not relieve. LSTK CONTRACTOR of inspection or other responsibilities.

6.0 For piping all welders test pieces shall be supplied by LSTK CONTRACTOR and fully prepared for welding by LSTK CONTRACTOR.

7.0 LSTK CONTRACTOR shall evidence its familiarity and experience with the execution of the installation of WORK to the requirements of the applicable codes and shall perform its WORK in accordance to these requirements and to instructions issued by OWNER'S REPRESENTATIVE in this regard.

8.0 **CHECK ON QUALITY OF WORK**

8.1 OWNER'S REPRESENTATIVE'S inspector shall have free access to the place where the WORK is performed at all times, in order to check the quality of WORK

8.2 If during inspection *I* check reveals unsatisfactory WORK, LSTK CONTRACTOR shall immediately at LSTK CONTRACTOR'S expense. take such corrective measures as deemed required.

9.0 **CONTROL SYSTEMS**

LSTK CONTRACTOR shall initiate and maintain the following control systems

9.1 **Backfilling**

- Compaction tests.

9.2 **Concrete**

- Design mix and approval record(s).
- Batch plant inspection record.
- Slump test record.
- Compressive test record.
- Pour release record.
- Grouting release record.
- Placement inspection records.
- Concrete curing records.

9.3 **Asphalt**

- Design mix and approval records.
- Batch plan inspection records. Placement inspection records.

9.4 **Piping**

- Weld x-ray file.
- Pipe and fitting certificate file.
- Isometric weld control sheet. Hydrostatic test records.

9.5 **Grounding**

Earth resistance test records.

9.6 **Electrical Cable and Instrument cable**

- Insulation resistance test records.
- Continuity test records.

9.7 **Material certification files**

9.8 **Equipment**

- Weld x-ray file.
- Material certificate files.
- Equipment installation records.
- Equipment maintenance record.
- Hydrostatic test records.
- Grouting release records.
- Alignment records.
- Vibration records.

10. **Requirements for Certification of Materials**

10.1 Mill certification of materials will be required based on the material type, the use and the codes and requirements.

10.2 LSTK CONTRACTOR shall provide:

Type A certification of compliance, for all but not limited to the following materials which LSTK CONTRACTOR is responsible to supply:

- Imported backfill materials.
- Ready mix concrete.
- Asphalt paving materials
- Prefab concrete items, including pre-cast manholes, catch basins, pits, sumps and sleepers.
- Paving stones and tiles.
- Inserted and embedded items, other than rebar, wire mesh and anchor bolts.
- Masonry blocks.
- Steel sliding plates.
- Special grouting materials, i.e. non-shrink type.
- Grouting materials, including grounding loop and branch wire which they are LSTK CONTRACTOR'S supply.

Type "B “certificate, for all but not limited to the following materials, which LSTK CONTRACTOR is responsible to supply:

- Materials to be considered structural or structural grade.
- Reinforcing grade.
- Wires mesh reinforcement fabric.
- Anchor bolts.

10.3 **Definition of Type of Certificates**
Type A (certificate of Compliance):

This is a certificate of compliance, issued by the manufacturing or processing works and signed by the quality department or persons to carry the responsibility for quality and conformity, stating that the materials) supplied correspond (5) with what was agreed in the purchase order.

Type B (mill Certificate) :
This is a certificate on which the manufacturer's head of quality department confirms that the product supplied corresponds with what has been agreed in the purchase order. Certification shall be on the basis of tests carried out on the material of the product itself, as per purchase order specification. The testing and certification are to be carried out by a testing center which is independent of the production section of the manufacturing works and which has the code-approved facilities.
Independence of such testing center should be warranted by LSTK CONTRACTOR.

10.4 LSTK CONTRACTOR will maintain a systematic filing system of all certificates and reports for all tests and inspections carried out by it under the applicable specifications, standards and codes of practice quoted therein.

LSTK CONTRACTOR may use its own format for records but this must be submitted to OWNER'S REPRESENTATIVE for his approval prior to use.

LSTK CONTRACTOR can expect to be audited on a continuous basis. Originals of all documents to be sent to OWNER'S REPRESENTATIVE.

ANNEXURE- 7– 4

SCHEDULE, PROGRESS EVALUATION AND PROGRESS REPORTING

1.0 GENERAL

1.1 WORK shall start and be completed in the field as indicated on the approved project construction schedule.

LSTK CONTRACTOR shall follow the sequence of construction in executing the WORK as shown in the schedule or as modified by OWNER.

The detailed scheduling of WORK will be supplied by the LSTK CONTRACTOR. WORK shall be conducted in such a manner that other construction activities are not affected.

Once detailed schedule, established and approved by OWNER, LSTK CONTRACTOR commits itself to follow the schedule in detail.

2.0 DETAILED & SCHEDULE

2.1 Detailed construction schedule must cover all construction work, from lowest level up to highest level.

2.2 Activities shown by means of a bar chart must include as a minimum the activities listed in 4.

3.0 PROGRESS REPORTING

LSTK CONTRACTOR shall issue a reporting procedure and a representative sample of all progress reports.

Following schedules and reports must be issued by LSTK CONTRACTOR to OWNER:

Construction schedule. (preliminary and detailed)
Monthly status report.
Weekly progress report.
Monthly construction guide schedule.
Daily manpower reports.

All except detailed construction schedule based on approved project construction schedule.

4.0 CONSTRUCTION SCHEDULE

Within **Two** months after Effective Date, LSTK CONTRACTOR will issue separate graphical "S" curves for the following work activities of total CONTRACT.

Installation of :

- Concrete foundations, pits. manholes. catch basins, trenches and concrete structures.
- Prefabricated concrete items
- Concrete paving and elevated slabs
- Other paving and final surfacing
- Grouting.

- Final road paving.
- Underground piping.
- Underground cable trenches and cables.
- Building erection.
- Structural steel erection.
- Engineering and design of small bore carbon steel piping systems.
- Prefabrication of piping.
- Electrical installation.
- Instrument installation.
- Equipment assembly and elect
- Erection of piping.
- Flushing and cleaning
- Hydro-testing
- Painting
- Insulation.

5.0 INTRODUCTION

The introduction to the monthly status report shall include LSTK CONTRACTOR'S comments on the overall construction schedule with a status update line as attachment, and shall consist of the following items:

- Goals achieved last month.
- Goals for next month.
- Reason for delay, if any. Reason for deviation of original schedule.
- Average manpower by craft, including management and indirect staff.
- LSTK CONTRACTOR'S comments to general situation.

6.0 CONSTRUCTION ACTIVITIES STATUS

This section consists of scheduled versus actual progress curves.

The progress curves are to be commented upon by LSTK CONTRACTOR.

The basis for reporting shall be the construction schedule:

The monthly status shall be reported as a percentage of the total WORK per type of WORK.

7.0 MANPOWER AVAILABILITY / REQUIREMENTS FOR THE MONTH COMING

LSTK CONTRACTOR shall submit its manpower availability requirements for the next month. This section consists also of the scheduled versus the actual manpower curves.

These manpower curves are accompanied by LSTK CONTRACTOR'S comments hereon.

8.0 MAIN CONSTRUCTION EQUIPMENT AVAILABILITY / REQUIREMENTS FOR THE

MONTH COMING

LSTK CONTRACTOR shall submit its main construction equipment availability / requirements for the next month. This section consists also of the scheduled versus actual construction equipment requirement curves. These by LSTK CONTRACTOR'S comments hereon.

9.0 WEEKLY PROGRESS REPORT

Progress reporting will be done on a weekly basis by the actually completed work based on details of work such as quantities or piece of equipment as a percentage of the total anticipated work per work activities as defined in item 4.

9.1 Progress will only be reported on the basis of completed activities as per the percentage breakdown of the major steps as follows:

Progress Measurement Parameters

Actual physical progress in the field shall be measured based upon standard percentage of completion of progress stages, that, they are to be prepared by LSTK CONTRACTOR and Approved by OWNER to calculate actual physical progress of the WORK, the exact weight value of each activity from lowest level up to highest level in each category of the WORK shall be specified by LSTK CONTRACTOR and supplied to OWNER.

After OWNER'S Approval this weight value can be used for calculation of actual progress of the WORK

10.0 WEEKLY PROGRESS MEETING

10.1 Weekly Work List

In the weekly progress review meeting LSTK CONTRACTOR shall forecast the WORK it plans to perform during the week by means of a weekly WORK list including its manpower resource allocation as per the activities listed in 4 and 6.

This weekly program shall be in accordance with the construction guide schedules.

10.2 Work Front

LSTK CONTRACTOR shall submit monthly and weekly a total recapitulation Of the total work front available with estimated manpower requirements, materials and equipment which shall be supplied by LSTK CONTRACTOR.

11.0 MONTHLY CONSTRUCTION GUIDE SCHEDULE

Based on approved overall construction schedule, LSTK CONTRACTOR must issue a monthly construction guide schedule covering a two (2) months period, for each individual activity.

Progress updating of construction guide schedules must be weekly and presented in the

weekly progress review meeting at site.

The updated issue will show for each individual activity:

- Percent complete.
- Weight factor complete.

12.0 DAILY MANPOWER REPORTS

LSTK CONTRACTOR shall be furnished daily manpower report as per agreed format.

ANNEXURE- 7 – 5

EXECUTION PLAN

1.0 BIDDER ORGANISATION

1.1 Company Organisation

Bid shall include a description of the organization, its management structure and organization chart of Bidder's company with particular reference to the means whereby the execution of this project will be related to the overall company organization.

The Bidder shall also furnish the name(s) of their partners, associated/ subsidiary companies & their activities, and whether any such associated/ subsidiary company will be involved in the execution of WORK, and if so, their scope thereof.

1.2 Project Organization

Bidder shall give charts of organization, which he intends to use in the execution of the work. Such charts must show lines of authority and communication of senior personals who will be assigned to this work in Bidder's home - office and other offices where WORK shall be performed (if any) and the lines connecting such Project Organization to the Bidder's internal overall organization including partners (if any). The chart shall be supported by a narrative, which shall explain how the proposed organisation will operate and in particular will provide

The name of the location of the office(s) in which the Basic and Detail Engineering Design Packages of the plant shall be carried out.

If any parts of the Basic and Detail Engineering Design Packages are to be carried out in more than one office, then details of the distribution of the jobs between offices and coordination procedure shall also be presented.

A description of the facilities offered to the OWNER'S resident engineers.

2.0 Estimated project and Engineering man-hours

Bidder shall give an estimate of the engineering man-hours and its break down for all activities

3.0 Methods and procedures

Bidder shall summarise the methods and procedures that BIDDER intends to implement during the performance of the WORK. It shall include the proposed procedures such as Engineering, Procurement, construction strategy, WORK Progress Measurement, Pre-commissioning, Commissioning of the PLANT, and Training.

BIDDER shall also furnish proposed procedures for the Project management, communication and method and frequency of reporting the progress of the WORK.

The final form for reports, which will be subject to OWNER's Approval, shall include as a minimum the following :

a) Planning and Scheduling

b) Work Progress

c) Safety and Security

NOTES:

a) Sample reporting forms and other key standard forms shall be included.

b) Bidder shall state the extent to which he will be using computerized drafting, etc.

4.0 Job descriptions and personnel resumes

Bidder shall include job descriptions and personnel resumes of his staff nominated to the key positions, including (where applicable) at least the followings, or Bidder's equivalent:

Project director
Process engineering co-ordinator
Construction manager
Process engineer
Project engineering co-ordinator
Senior pre-commissioning engineer
Senior commissioning engineer
Training co-ordinator and instructor.
Construction Engineering Coordinator
Construction Quality Control Engineer
Construction Project Control Engineer
Welding Specialists
Heavy Lift Rigging Specialist
Senior Specialist Engineers
Senior Planning Engineers
Materials Coordinators
Senior Construction Engineers
Senior Pre-commissioning Engineers
Warehousing Officer
Material Planning Engineers

Resumes shall give at least the name, age, nationality, education, professional exception/deviation and previous experience of each assigned personnel. Additionally, one alternative shall be offered for each position. **Bidder shall ensure that personnel to be deployed meet the minimum criteria specified in Annexure-7-6**

Bidder shall confirm that these key personnel will be made available to WORK on the Project as required by the schedule on full time basis.

Bidder shall furnish Summary of its Deployment Schedule Personnel as per **Annexure-7-7.**

Bidder understands that the said proposal represents the minimum deployment and the Bidder acknowledges that the said deployment may have to be augmented with additional number and/or categories, if required, if directed by Engineer-in-Charge in order to complete the work within the completion schedule and quoted lump sum price.

5.0 Construction equipment and machinery

The BIDDER shall furnish details of construction equipment & machinery, testing equipment, tools/tackles, etc., which will be made available by the Bidder at the Site. Bidder shall furnish Summary of such details as per **Annexure-7-8, Annexure-7-9.**

Such list shall, in no way limit the CONTRACTOR's responsibility to arrange & provide any additional construction equipment, tools, tackle, etc., which might be required to execute and complete the WORK as per contractual schedule.

BIDDER shall furnish the procedures and his tools for erection of the Heavy Lift Equipments including tall columns):

6.0 Heavy lifts

BIDDER shall furnish his proposed, site transportation, lifting, along with preliminary rigging schemes and erection procedure for the heavy lifts. Such plans / schemes shall be furnished along with detailed write -up on heavy cranes proposed to be deployed by CONTRACTOR, duly supported by relevant technical literature.

7.0 BIDDER experience & exception/deviation to perform the work

The BIDDER should have experience in the construction of similar Plants. The BIDDER should have successfully executed and completed construction of at least one similar Plant with his own project management and with complete responsibility of construction / erection and pre-commissioning.

The BIDDER shall furnish, as a part of his Tender Documents establishing the BIDDER'S experience and exception/deviation to perform the CONTRACT. Such documentary evidence shall also establish to OWNER's satisfaction that the BIDDER has the necessary financial, technical, project management capabilities and the requisite resources to execute the Work.

Such documentary evidence shall also be furnished for BIDDER'S proposed Subcontractors, if any. The Bidder shall furnish, in a tabular from, a list of jobs of similar type and magnitude executed by them in the past. BIDDER shall also furnish details of their experience in erection of heavy lifts. The Bidder shall furnish documentary evidence, establishing to OWNER satisfaction, that such jobs have been timely and successfully executed by them. The BIDDER shall also furnish the details of their present major commitments.

8.0 QA/QC Program

Bidder shall furnish a summary description of their proposed QA/QC program.

Bidder shall furnish any other technical information / details as per the requirements of ITB.

9.0 Technical assistance

The extent of the Technical Services and Assistance to be rendered by CONTRACTOR for commissioning .

10.0 Training

Bidder shall furnish the following details regarding the Training of OWNER'S personnel:

a) Bidder's organisation set up for Training program.

b) Training facilities available with the Bidder to train the OWNER'S personnel in

- Theory of process, operation, maintenance and manufacturing of products
- Field (on the job) training in process, operation, maintenance and manufacturing of products, to train the personnel on the job.

- Test procedure and other matters.

c) The courses and their duration, number of attendees in each course and location where such courses will be held that the Bidder would recommend OWNER to consider.

d) Bidder's experience of training the personnel for units similar to the subject PLANT.

11.0 Estimate of the number of personnel required for the safe and satisfactory operation of the Plant.

For and on behalf of ……

Stamp & Signature : ……

Name : ……

Designation : ……

Date : ……

ANNEXURE-7-6

Minimum Qualification & Exp. Of Key Supervisory Construction Personnel

SL. NO.	CATEGORY	QUALIFICATION & EXPERIENCE
1	RESIDENT CONSTRUCTION MANAGER / RESIDENT ENGINEER / SITE-IN-CHARGE	Degree in Engg. With minimum 20 years relevant experience in construction should successfully constructed & commissioned at least one process unit in hydrocarbon / fertilizer sector.
2	LEAD DISCIPLINE ENGINEER	Degree in relevant Engg. discipline with minimum 15 years experience in Construction or Diploma in relevant Engg. Discipline with minimum 20 years experience in Construction.
3	LEAD WELDING / NDT ENGINEER	Degree in Mechanical Engg./Metallurgy with minimum 15 years experience in Welding / NDT (Non-Destructive Testing) plus Level-II in RT (Radiographic Testing) or diploma in Mechanical Engg. / Metallurgy with minimum 20 years experience in Welding / NDT plus Level–II in RT.
4	LEAD QA/QC ENGINEER	Degree in Engg. With 15 years Construction Experience of which 5 years should be as QA Manager.
5	LEAD PLANNING ENGINEER	Degree in Engg. With 15 years experience in Planning & Scheduling.
6	LEAD SAFETY OFFICER	Degree / Diploma in Engg. And Diploma in Industrial Safety with min. 10 years relevant experience in Construction Safety.
7	WAREHOUSE-IN-CHARGE / MATERIALS MANAGER	Graduate in Science or Diploma in Engg. / Materials Management with 15 years experience in Warehousing / Stores Management of similar nature.
8	DISCIPLINE SURVEYORS	Degree in relevant Engineering Discipline with minimum 3 years experience in Construction or diploma in relevant Engineering Discipline with minimum 6 years experience in Construction.
9	QUANTITY SURVEYORS	Degree in relevant Engineering Discipline with minimum 3 years experience or diploma in relevant Engineering Discipline with minimum 6 years experience in quantity estimation, field measurement, rate analysis etc. in construction field.

For and on behalf of …….

Stamp & Signature : …….

Name : …….

Designation : ……

Date : ……

ANNEXURE-7-7

Deployment Schedule of Supervisory Personnel

SL.	DESCRITPION	DEPLOYMENT SCHDULE

NO.		1	2	3	4	5	6	7	8	9	10	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	35	36	37	TOTAL
1	**PROJECT MANAGEMENT**																													
1.1	PROJECT MANAGER																													
1.2	PLANNING MANAGER																													
1.3	PLANNING ENGINEERS																													
2	**RESIDUAL DESIGN AND DETAILED ENGINEERING**																													
2.1	PROJECT ENGINEERING MANAGER																													
2.2	ENGINEERING COORDINATOR																													
2.3	ENGG. PERSONNEL FOR VARIOUS DISCIPLINE																													
2.3.1	CIVIL STRUCTURAL																													
(i)	ENGINEERS																													
2.3.2	PRESSURE VESSELS																													
2.3.3	MECHANICAL EQPT/ ROTARY EQPT.																													
2.3.4	PIPING																													
(i)	ENGINEERS																													
2.3.5	ELECTRICAL																													
(i)	ENGINEERS																													
2.3.6	INSTRUMENTA-TION																													
(i)	ENGINEERS																													
2.3.	MISCELL-ANEOUS																													

7																														
3	**PROCUREMENT**																													
3.1	PURCHASE																													
3.1.1	PURCHASE MANAGER																													
3.1.2	PURCHASE COORDINATOR																													
3.1.3	PURCHASE OFFICER																													
3.2	INSPECTION																													
3.2.1	INSPECTION MANAGER																													
3.2.2	INSPECTORS																													
3.3	EXPEDITING																													
3.3.1	EXPEDITING COORDINATOR																													
3.3.2	EXPEDITORS																													
3.4	CUSTOM CLEARANCE, IMPORT LICENCE, TRANSPORTA -TION PERSONNEL																													
4	**SITE CONSTRUCTION**																													
4.1	PROJECT MANAGER																													
4.2	CONSTRUC-TION MANAGER																													
4.3	CIVIL STRUCTURAL																													
4.3.I	LEAD ENGINEER																													
4.3.2	SITE ENGINEER																													
4.3.3	SUPERVISORS																													

4.4	MECHANICAL WORKS																											
4.4.1	LEAD ENGINEER																											
4.4.2	SITE ENGINEER																											
4.4.3	SUPERVISORS																											
4.5	PIPING WORK																											
4.5.1	LEAD ENGINEER																											
4.5.2	SITE ENGINEER																											
4.5.3	SUPERVISORS																											
4.6	ELECTRICAL WORK																											
4.6.1	LEAD ENGINEER																											
4.6.2	SITE ENGINEER																											
4.6.3	SUPERVISORS																											
4.7	INSTRUMENTA-TION WORK																											
4.7.1	LEAD ENGINEER																											
4.7.2	SITE ENGINEER																											
4.7.3	SUPERVISORS																											
4.8	QUALITY ASSURANCE/ QUALITY CONTROL																											
4.8.1	QC/QA MANAGER																											
4.8.2	INSPECTOR (CIVIL)																											

4.8.3	INSPECTOR (PIPING)																												
4.8.4	INSPECTOR (MECH EQPT)																												
4.9	SAFETY ENGINEER																												
4.10	SITE ENGINEERING WORKS																												
4.10.1	ENGINEERS																												
4.10.2	SUPERVISORS																												
4.11	COMPUTER ENGINEER																												
4.12	ADMINISTRA – TION MANAGER																												
4.13	MISCELLAN-EOUS																												
4.14	WAREHOUSE PERSONNEL																												
4.15	MATERIAL MANAGER																												
4.16	COMMISSION-ING																												
i)	COMMISSION-ING COORDINATOR																												
ii)	COMM ENGINEER (SHIFT- IN-CHARGE)																												
iii)	CONTROL ROOM COORDINATOR																												
iv)	FIELD SUPERVISOR																												
v)	TECHNICIAN																												

For and on behalf of ……

Stamp & Signature : ……

Name : ……

Designation : ……

Date : ……

ANNEXURE-7-8

Deployment Schedule of Construction Equipment

SL. NO.	DESCRIPTION	CAPA-CITY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	..	33	34	35	36	37	TOTAL
1	CRANES																							

SL. NO.	DESCRIPTION	CAPA-CITY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	..	33	34	35	36	37	TOTAL
1.1	1200 MT																							
1.2	700 MT																							
1.1	500 MT																							
1.2	300 MT																							
1.3	150 MT																							
1.4	75 MT																							
1.5	50 MT																							
1.6	20 MT																							
1.7	15 MT																							
1.8	10 MT																							
1.9	5 MT																							
2	DIESEL GENERATORS																							
2.1	500 KVA																							
2.2	300 KVA/250KV																							
2.3	150 KVA/125KV																							
3	COMPRESSORS																							
3.1	600 CFT																							
3.2	350 CFT																							
4	WELDING M/CS																							
4.1	DIESEL WELDING M/C																							
4.2	DIESEL GENERATOR																							
4.3	WELDING TRANS FORMERS/RE C-TIFIERS																							
4.4	TIG WELDING M/CS																							

SL. NO.	DESCRIPTION	CAPA-CITY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	..	33	34	35	36	37	TOTAL
5	GRIT BLASTING M/CS																							
6	SPRAY PAINTING M/CS																							
7	STRESS RELIEVING M/CS																							
8	RADIO-GRAPHY M/CS																							
9	TEST PUMP																							
10	WATER PUMP																							
11	TRANSPORTA-TION EQPT																							
11.1	TRACTOR -TRAILOR																							
11.2	TRUCKS																							
11.3	BUS																							
12	JACKS																							
12.1	MECHANICAL																							
12.2	HYDRAULIC																							
13	CIVIL																							
13.1	EXCAVATORS																							
13.2	DUMPERS																							
13.3	BATCHING PLANT																							
13.4	CONCRETE PUMP CAR																							
13.5	TRANSIT MIXER																							
13.6	MIXER																							
13.7	VIBRATORS																							

SL. NO.	DESCRIPTION	CAPA-CITY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	..	33	34	35	36	37	TOTAL
13.8	COMPACTORS																							
13.9	THEODOLITES																							
14.0	OTHERS																							
14.1	INSULATION TESTING EQUIPMENT																							
14.2	SECONDARY INJECTION TESTING KIT																							
14.3	METERS, TOOLS & TACKLES ETC.																							
14.4	CALIBRATION EQUIPMENT																							
14.5	OTHER TOOLS & TACKLES																							
14.6	MULTI METERS CALIBERAT-ORS ETC.																							
14.7	INDUCTION PIPE BENDING PLANTS																							
14.8	METALOGRAPHY																							
14.9	SPECTRO-METERS																							

For and on behalf of :

……

Stamp & Signature : ……

Name : ……

Designation : ……

Date : ……

ANNEXURE-7-9

Details Of Equipment Proposed to be used for Tendered Work

I / We, shall use the following MAJOR equipments owned by the tenderer for the work, if awarded to me /us :

Sl. No	Description	Quantity. (Numbers)	Make	Capacity	Owner	Approximate date when it will	Period of retention at site

.						be deployed at site	

For and on behalf of …….

Stamp & Signature : …….

Name : …….

Designation : …….

Date : …….

SECTION VI- 5.0

DRAWINGS AND SOCUMENTS

UREA HANDLING & BAGGING PACKAGE

[UREA (NEEM OIL COATED) HANDLING SYSTEM, BULK SILO AND BAGGING SYSTEM INCLUDING FILLED BAGS STACKING/ LOADING TO WAGON & TRUCK]

PLANT: AMMONIA-UREA PLANT BASED ON COAL GASIFICATION

PROJECT: INTEGRATED ROM BASED FERTILISER COMPLEX AT TALCHER, ANGUL DISTRICT, ODISHA (INDIA)

CONTENTS

1.0 DRAWINGS & DOCUMENTS:

This chapter details out various drawings and documents to be generated at various stages during the course of execution of the Project by the Contractor/Bidder for different project activities. Categorization of the documents/ drawings for review/ information/ records of PMC and the review/ approval requirements of the Owner/ PMC along with routing of the documents/ drawings will be conveyed separately as a philosophy.

The efficient handling of drawings and documents to be prepared by the Contractor under the contract is the key to the timely completion of the plants. The Contractor undertakes to ensure that all drawings and documents to be submitted by him to the Owner/ PMC shall be of professional quality and conforming to the contractual requirements. The Contractor also undertakes to institute a formal drawing control system which will be documented and submitted to the Owner/PMC for review or approval.

Compliance of this chapter on drawings and documents is mandatory and is non-negotiable.

The drawings / documents are to be generated by the Contractor at various stages of the project covering different activities. The drawings / documents generated will be in the category of Approval/ Review/ Information. The list of drawings and documents required is enclosed; however, the categorisation for the drawings/ documents will be informed separately. However, this will in no way relieve the Contractor of responsibility to conform to drawings, standards, specification, codes and contractual requirements / obligations.

The Contractor shall prepare the drawing numbering procedure and submit to Owner/ PMC for approval. Each Drawing submitted by the Contractor shall be clearly marked with the name of the Owner, PMC with revision number & date. It should contain the minimum following details:

a. Size of Drawing.

b. Discipline of Engineering for which the drawing is issued.

c. Discipline wise segregation of numbering sequence for example:

   100 Series for Process. 200 Series for Mechanical etc.

For drafting of Drawings, Computer aided design and drafting, AutoCAD 2015 shall be used. Further, standard, approved and well established P.C. based computer programmes/software packages, available in market shall only be used by the Contractor/his subcontractors/vendors

etc. The Contractor shall bring out the list of all such packages in the offer for each discipline for evaluation of bid. Every time a computer aided design is submitted for review/ approval to Owner/PMC, it shall accompany with input/output data on Compact disc (CD) along with the name of the software package and operable on any system along with the requisite No. of Hard Copies (specified elsewhere in the Bidding document).

For drawing, data sheet and all graphic works Auto CAD 2015 and for all texts, MS Word Package 2012 shall be used. Hard Copies (3 nos.) and Soft Copies of all calculations & Drawings (applicable paper size) shall be made available by the Contractor for PMC review. Line List, Data Sheet & spread sheets shall be provided in MS Excel & all text items shall be in MS Word. All other documents like presentations etc. and other data shall be in MS Office; the required operating system for Data Exchange shall be at least Windows.

All documents before forwarding to Owner/PMC will have to be vetted in detail by the Contractor/duly approved engineering sub-contractor appointed by the Contractor. Document received without vetting will be returned.

The review by the PMC/Owner shall not be construed by the Contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and drawings.

Each drawing submitted by the Contractor shall be clearly marked with the name of the Owner, Unit Designation, Specifications, Title, Specification number and the name of the Project with Revision number and date. If standards, catalogue pages are to be submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawings shall be in English.

All the dimensions should be in metric units. Upon receiving comments on Drawings & Documents by the Contractor, the subsequent submission should give compliance report, separately on each of the comments, document-wise. Comments given by PMC/Owner to be discussed and finalised within agreed schedule.

The schedule of submission of the Drawings & Documents shall be in accordance with project plans only. The detailed list under different category, document-wise, shall be prepared by the Contractor for approval of Owner/PMC. This activity is to be completed within one month of Fax of Intent.

Sequence of submission of drawing is essential for proper review of documents and timely completion of the project is to be adhered. In case sequence is not maintained, the

documents submitted will not be reviewed by Owner/ PMC and responsibility of timely execution of plant shall be to the Contractor's account.

2.0 CATEGORY OF DOCUMENTS:

Category	Description	Action by Owner/ PMC
1	Records/ Information	Contractor can continue to progress with the work. This drawings or documents will be retained with Owner/PMC for information only. Owner/ PMC reserves the right to advise the Contractor of any comments (deviations from the contract) at any time and the contractor is liable to respond to satisfy that the work being done is in accordance with the contract; deviations, if any will be bidder's risk and cost.
2	Review/Approval	Owner/PMC will review and advise the Contractor of any Comments on Contractor's Drawings / documents within specified schedule (ie 2 weeks), from date of receipt in PMC office of Contractor's drawings/documents. The review period is defined as date of receipt of documents by PMC, to date of issue of comments by PMC. This review period shall be valid only if submission of drawings is done by Contractor in accordance with approved drawings / documents schedule as indicated in ITB. In case of any non-conformity to the above by Contractor due to which the period of review extends beyond 2 weeks by the PMC, schedule delay, if any will have to be absorbed by the Contractor. Review of documents / drawings shall be categorized as follows: i) Code-3: Not accepted. New Document / Drawing to be submitted ii) Code-2: Accepted with comments as marked iii) Code-1: Final approval

The documents falling under Review category will be returned with comments within specified time schedules subject to fulfilling other conditions enumerated. The information category document will be retained for information only but however Owner/PMC reserves the right to comment at any stage of the Project, but not later than two weeks of receipt.

Where clearance of Owner/ PMC is required for ordering of equipment materials, enquiry documents and one technically selected offer is to be submitted for review. The unpriced copies of purchase orders detailing both technical and commercial aspects for all items shall be submitted to PMC/ Owner within 15 days of issue of the same.

Each purchase order forwarded should contain complete technical documents. It is obligatory for the Contractor to obtain acceptance on all the technical documents and accepted copy only to be forwarded to Owner / PMC. Any inaccuracies /omissions/inconsistencies noticed and brought to the notice of the Contractor at any stage of the project will be rectified/ replaced by Contractor without any cost & time implication to the Owner/ PMC.

Detailed manufacturing schedules of fabricated/ manufactured items shall be submitted within one month of ordering, Status report for all the items in detail, will be submitted once in a month.

Documents to Boiler Regulation authorities shall be submitted and getting the documents reviewed by PMC/Owner. To any other agencies, documents shall be submitted under intimation to PMC/Owner.

As built drawings and documents will be generated within one month of completion of activities on respective items of work.

<u>As Built Drawings</u>:

Contractor will furnish reproducible and electronic files of all the drawings under their scope to Owner / PMC, certified as “As-Built Issue” by Third Party Inspection Agency (TPIA) for Vendor Items coming under Third Party Inspection / Contractor for all other drawings.

Upon completion of identifiable units or components of the fabrication, construction and installation phase of the project the Contractor will complete all the related plans to the "as built' stage including all Vendor drawings and furnish Owner/PMC with the following:

a. One complete set of all original tracings copies.

b. One complete set of reduced size (A3-297x420 mm) copies of all drawings.

c. One set of CD for all documents/drawings/data

d. All the as built drawings duly certified should be scanned and converted into electronic files made on magnetic/discs/optical long storage.

e. All other project documents such as operating and maintenance manuals, manufacturers' Catalogues etc. shall also be scanned on magnetic/optical discs for safe storage and retrievals by the Owner when needed.

f. 10 complete sets of full size prints of the drawings and 4 sets of reduced size prints.

g. 10 complete bound sets of Manufacturer's specifications including design calculations.

h. 10 complete sets in hard binders of the Manufacturers data book including certified prints and data for all items including test reports. Data Books shall be complete with index as tag numbers associated with Manufacturer's data shown. Equipment data shall include as a minimum requirement the principal and description of operation, drawings and dimensions, spare parts lists and un-priced purchase orders and bill of material.

i. 10 bound copies each of the Spare Parts data books and the Lubricants inventory Schedule.

j. 10 complete sets of field records shall be signed by both the Contractor's and Owner's Representative at the site.

k. Original approvals and related drawings and documents from the statutory authority.

l. Copies of correspondence with the statutory authorities.

3.0 PROCEDURE:

The procedure for compilation of final as-built documents / drawings shall be informed later. However the Procedure for routing the final / as built documents/ drawings to PMC / Owner shall be informed during the execution stage.

4.0 LIST OF DRAWINGS & DOCUMENTS:

Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
A.	**MATERIAL HANDLING**				
1.0	Flow Diagram of Material Handling system	Y	Y	-	Y
2.0	Conveyors Layout drg.	Y	Y	-	Y

Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
3.0	Bagging Plant Layout including scheme of filled bag stacking/loading	Y	Y	-	Y
4.0	Layout of all the Transfer Tower showing outline dimensions of all the equipments	N	Y	-	Y
5.0	General Arrangement drawing (showing part list, quantity, weight, main dimensions, all specifications etc.) of all equipments e.g – Bulk & Bag handling Conveyors, Bucket elevator, Bagging & Stitching m/c, Bunker, Wagon & Truck loader, Dust extraction system etc.	N	Y	-	Y
6.0	Data Sheet/Specification Sheet of all equipments completely filled in as per format	Y	Y	-	Y
7.0	Power, capacity and Pulley shaft dia calculations of all the conveyors as per CEMA / IS 11592.	N	Y	-	Y
9.0	Bunker/Hopper capacity calculation	Y	Y	-	-
10.0	Dust Extraction system design basis/calculation	Y	Y	-	-
11.0	Civil Scope Drg. with Load data for design of buildings, gantry, foundations etc	N	Y	-	-
12.0	Detail GA drg. of all conveyors gantry, transfer towers, bagging plant including railway platform showing all the equipments & machinery inline with Civil drg.(by others)	N	Y	-	Y
13.0	Catalogue for spare parts	N	-	Y	-
14.0	Design calculations of equipments structural including base plates	N	-	Y	-
14.0	Instruction manual showing installation, operation & maintenance procedure for all mechanical as well as electrical & Instrument items, parts list and bearing lubrication schedule substantiated by sketches and drawings.	N	-	-	-
15.0	Any other drawing required by owner / Consultant.	Y	Y	-	Y

Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
B.	**ROTATING EQUIPMENT**				
	PUMPS				
1	General Description and Equipment List	Y	Y	-	Y
2	List of drawings / documents including drawing number, revision number, description and approval status	N	Y	-	Y
3	Detailed manufacturing programme (Time bar chart)	N	Y	-	Y
4	Certified dimensional outline drawing	N	Y	-	Y
5	Cross sectional drawing and bill of material	N	Y	-	Y
6	Shaft seal drawing and bill of material	N	Y	-	Y
7	Shaft coupling assembly drawing and bill of materials including allowable misalignment clearances, shaft bores & key ways dimensions with tolerances and the style of coupling guard	N	Y	-	Y
8	Primary & auxiliary sealing schematic and bill of materials including seal fluid, fluid flows, pressure pipe and valve sizes, instrumentation, orifice sizes, and piping arrangement drawings	N	Y	-	Y
9	Cooling or heating schematic and bill of materials including cooling & heating media, fluid flows, pressure, pipe and valve sizes, instrumentation, orifice sizes and piping arrangement drawings	N	Y	-	Y
10	Lube oil schematic and bill of materials	N	Y	-	Y
11	Lube oil system arrangement drawing including sizes, rating and location of all customer connections	N	Y	-	Y
12	Lube oil component drawings data	N	Y	-	Y
13	Electrical and instrumentation schematics, wiring diagrams and bill of materials	N	Y	-	Y
14	Electrical and instrumentation arrangement drawing and list of components	N	Y	-	Y
15	Performance curves	N	Y	-	Y
16	Pump specification sheet with complete details in Performa enclosed with	N	Y	-	Y

Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
	enquiry / order				
17	Certified foundation assembly drawing of pump with driver & all accessories mounted on base plate with load diagram for foundation design	N	Y	-	Y
18	Engineering flow diagram showing:	N	Y	-	Y
	- Lubrication & sealing lines				
	- Flushing / washing lines				
	- Cooling / steam lines				
19	Reference list for pumps supplied in past for similar duty conditions. Reference list shall contain complete address of user, user's purchase order number, brief specifications and date of commissioning	Y	-	-	Y
20	Lube oil schedule	N	Y	-	Y
21	Automatic recirculation valve assembly drawing, sectional drawing with bill of material	N	Y	-	Y
22	Quality Assurance Plan.	N	Y	-	-
23	Material test certificates and Inspection & performance test report along with dispatch clearance certificates from inspector	N	-	-	Y
24	Instruction manuals describing installation, operation and maintenance procedures	N	-	-	Y
25	Spare parts list	Y	-	-	Y
26	Parts catalogue complete with reference drawing nos. and sketches etc.	N	-	-	Y
	FANS & BLOWERS				
1	General Description and Equipment List	Y	Y	-	Y
2	Specification sheets completely filled in proforma.	N	Y	-	Y
3	Characteristic Curves - Performance curves, showing discharge pressure, capacity, and brake horse power at the inlet specified conditions (Pressure, capacity, temperature, molecular weight).	N	Y	-	Y
4	Spare parts list	Y	-	-	Y
5	Details of Lubrication and sealing system	N	Y	-	Y
6	Data for selection of motor :	N	Y	-	Y
	a) Type				

Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
	b) HP absorbed at duty point				
	c) RPM				
	d) Recommended HP				
	e) Max. starting torque as % NRT				
	f) GD2 figure for rotating mass of the Fan / Blower				
	g) Speed vs. Torque for the Fan / Blower				
7	General Arrangement Drawing with all main dimensions, size and location of connections for ducting with all horizontal & vertical clearance necessary for installation and disassembly.	N	Y	-	Y
8	Cross sectional drawing of fan with parts list	N	Y	-	Y
9	Instruction manual for erection, installation operation and maintenance of fan and its accessories (Important clearances to be maintained should be clearly specified).	N	-	-	Y
10	Q.A.P and Test procedure	N	Y	-	Y
11	Lubrication schedule	N	Y	-	Y
12	Reference list indicating duty condition, location, year of installation, name of client etc.	Y	-	-	-
13	GA drawing with all details & dims. Including fan, drive, motor	N	Y	-	Y
	AGITATORS				
1	General Description and Equipment List	Y	Y	-	Y
2	Specification sheets completely filled in proforma.	N	Y		Y
3	General Arrangement Drawing with all main dimensions, size and location of connections for installation and disassembly.	N	Y		Y
4	Spare parts list	Y	Y		Y
5	Details of Lubrication and sealing system	N	Y	-	Y
6	Q.A.P and Test procedure	N	Y	-	Y
7	Instruction manual for erection, Commissioning operation and maintenance .	N	-	-	Y
8	Reference list indicating duty condition, location, year of installation, name of	Y	-	-	Y

Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
	client etc.				
	HVAC PACKAGE				
1	General Description and Equipment List	Y	Y	-	Y
2	List of drawings / documents including drawing number, revision number and description & approval status	N	Y	-	Y
3	Specification sheets - Completely filled in proforma.	N	Y	-	Y
4	General Assembly drawings - with main overall dimensions including those required for accessories and auxiliaries and all horizontal & vertical clearances for dismantling, direction of rotation etc.	N	Y	-	Y
5	Spare Part List	Y	Y	-	Y
6	Description of Lubrication and sealing system	N	Y	-	Y
7	Manufacturing schedule, QAP	N	Y	-	Y
8	Cross-Sectional drawing of AC Plant and auxiliaries alongwith Bill of Materials	N	Y	-	Y
9	Instruction manuals for erection, commissioning , operation and maintenance of AC Plant and accessories.	N	-	-	Y
10	Material test certificates and Inspection & performance test report alongwith despatch clearance certificates from inspector	N	-	-	Y
11	Reference list for similar types of AC Plant supplied in past for similar duty conditions. Reference list shall contain complete address of user, user's purchase order number, brief specifications and date of commissioning along with operating conditions..	Y	-	-	Y
12	Lube oil schedule.	N	Y	-	Y
	COMPRESSORS				
1	List of drawings / documents including drawing number, revision number, description and approval status	N	Y	-	Y
2	Detailed manufacturing programme	N	Y	-	Y

Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
	(Time bar chart)				
3	Specification sheet complete filled in PDIL proforma enclosed with enquiry/order.	N	Y	-	Y
4	Equipment layout with main overall dimensions including those required for foundations and piping design for compressor and auxiliaries. (This layout shall include the driven equipment and its auxiliaries).	Y	Y	-	Y
5	Performance curves for compressor.				
	i) For constant speed motor driven compressors Discharge pressure , Brake horse power , Polytropic head and Efficiency Vs Inlet capacity (from surge point to 115 % of rated capacity) of the compressor at specified inlet pressure, temp. and mol. wt of the gas for each stage and for overall compressor	N	Y	-	Y
	ii) Torque Vs Speed curve for the compressors.	N	-	Y	Y
6	Performance Curve of driver	N	Y	-	Y
7	i) Calculation of the lateral critical speeds of the compressors.	N	-	Y	Y
	ii) Calculation of the torsional critical speeds. Analytical report for torsional vibration of whole set.	N	-	Y	Y
	iii) Thrust loading curves for each casing / barrel for various operating conditions.	N	-	Y	Y
	iv) Response curve of deflection Vs RPM for varying amount of imbalance.	N	-	Y	Y
	v) Torsional critical response curve	N	-	Y	Y
8	Overall dimensional drawing with all main dimensions, size and location of piping connections for compressors and its auxiliaries.	N	Y	-	Y
9	Cross sectional drgs. Of the compressor showing details of construction including sealing details, bearing etc. With part no., description and material of construction.	N	Y	-	Y

Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
10	Coupling drawings	N	-	Y	Y
11	Seal assembly drawings & Bill of material	N	-	Y	Y
12	Lube oil Pumps				
	a) Specification sheet	N	Y		Y
	b) Performance curve	N	Y		Y
	c) Cross Sectional drawing	N			Y
13	Certified foundation scope drawing of the compressor with driver and all accessories resting on the foundation and control panel. In the event of motor not in the scope of supply of vendor the motor frame dimensions shall be supplied by the purchaser later). Direction and magnitude of all unbalanced forces, couples and centre of gravity along with direction of rotation shall also be mentioned	N	Y	-	Y
14	a) Engineering flow diagram indicating all instruments, valves, etc. marked with battery limit of supply of :	Y	Y	-	Y
	- Process Gas lines - Cooling Water lines - Lubricating Oil lines - Condensate drain and vent lines				
	The above drawings shall identify all components by size, pressure rating and material				
	b) Material balance for gas, lube & seal oil.				
15	Piping layout plan and elevation drawings for gas, cooling water and utility lines, lube and seal oil lines etc.	N	Y	-	Y
16	Driver : Selection details	N	-	Y	Y
	a) Speed - torque diagram				
	b) GD2 of the rotating masses of the compressor referred to the motor speed				
17	a) Piping isometrics for gas pipes DN>20, piping manifold and all oil lines.	N	-	-	Y
	b) Flexibility analysis for gas lines.				
18	Piping support location drgs. With forces, moments and movements for gas pipes and with weights for all lines.	N	Y	-	Y

Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
19	Certified allowable forces, moments, movements, stresses for compressor nozzles.	N	Y	-	Y
20	Bill of Material for Piping and supports.	N	Y	-	Y
21	Bill of Material for insulation for Pipings.	N	Y	-	Y
22	Bill of quantity for Painting for piping, equipments and auxiliaries.	N	Y	-	Y
23	Thermal calculation for heat exchangers, Mechanical calculation and fabrication drawings for heat exchangers and Pressure vessels.	N	Y	-	Y
24	Inspection and Test Procedure.	N	-	-	Y
25	Quality Assurance Plan.	N	Y	-	-
26	Inspection and test reports, material test certificates, radiographic reports duly approved by specified inspecting authority, certificates for compressors, heat exchangers, pressure vessels, pipings, valves, instruments and other auxiliaries.	N	-	-	Y
27	Lubrication schedule	N	-	-	Y
28	Instruction manual for erection, installation, operation and maintenance of compressor and its accessories (important clearances to be maintained should be clearly specified.).	N	-	-	Y
29	Recommended list of spares for two years trouble free operation	Y	-	-	-
30	List of special tools	Y	-	Y	Y
31	Installation list of similar machines shall also include the following : a) Client, location and year of installation b) Drive c) Model No. and type of compressor d) Duty condition of the compressor e) Speed and KW rating	N	-	-	-
C.	**STATIC EQUIPMENT**				
	STORAGE TANK				

Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
1	Outline Sketches Showing Thickness Of Main Parts, Details Of Internal Including Weight (Erection & Operating) And Anchorage Details Etc.	Y	-	-	-
2	General Arrangement Drawings Indicating Design Data , Fabricated Equipment Weight, General Notes, Nozzle Schedule, Details Of Shell, Supporting Arrangement , Main Weld Seams ,Nozzle Orientation Plan Etc.	N	Y	-	Y
3	Bottom And Annular Ring Layout & Weld Detail	N	Y		Y
4	Detail Of Sump For Drain Nozzles	N		Y	Y
5	Shell Plate Layout (Showing Location Of Nozzles And Manhole)	N		Y	Y
6	Mechanical Design Calculations Complying With The Specifications And Codes.	N	Y	-	Y
7	Detail Of Wind Girder	N	Y	-	Y
8	Stairways, Intermediate & Top Plateform	N	-	Y	Y
9	Roof Plate Layout & Weld Detail	N	Y	-	Y
10	Detail Of Nozzles On Shell & Roof	N	-	Y	Y
11	Details Of Internals Like Guide Rollers, Roof Stoppers, Still Wells, Dip Pipe, Heating Coil E.T.C	N	-	Y	Y
12	Materials Test Certificates Duly Stamped By Inspecting Authority (**)	N	-	-	Y
13	Qap & Inspection And Test Plan (**)	N	Y	-	Y
14	Welding Prcedure And Qualification Test Reports (**)	N	-	Y	Y
15	Destructive And Non Destructive Procedure & Test Reports (**)	N	-	Y	Y
16	Heat Treatment Procedure And Time Temprature Charts (**)	N	-	Y	Y
17	Radiographic Examination Reports & Films (**	N	-	-	Y
18	All Final As- Built Shop Drgs. & Design Calculations Duly Certified By Third Party Inspecting Authority (**)	N	-	-	Y
19	Completion Certificates (Including Inspection Certificate, Hydrostatic Test Certificate , Local Code Requirements)	N	-	-	Y
20	Final Civil Load Data Including Details Of Foundation/Anchor Bolts	N	-	Y	Y
21	List of Spare Parts And Details	N	Y	-	Y

Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
	VESSEL & COLUMN				
1	Outline Sketches Showing Thickness Of Main Parts,Moc, Details Of Internal Including Demister,Weight (Erection & Operating) And Anchorage Details	Y	-	-	-
2	General Arrangement Drawings Indicating Design Data , Fabricated Equipment Weight, General Notes, Nozzle Schedule, Details Of Shell, Heads Supporting Arrangement , Main Weld Seams ,Nozzle Orientation Plan Etc	N	Y	-	Y
3	Detail Of Nozzles, Manholes,Accessories Etc.	N	-	Y	Y
4	Detail Of Internals Such As Tray,Tray Support Ring, Bolting Bars Etc.	N	-	Y	Y
5	Detail Of Demister	N	Y	-	Y
6	Mechanical Design Calculations Complying With The Specifications And Codes.	N	Y	-	Y
7	Detail Of Packing Support,Demister Support, Grating & Grating Support	N	Y	-	Y
8	Detail Of Internal Distributor	N	Y	-	Y
9	Detail Of External Clips Such As Ladder, Plateform,Pipe Support	N	-	Y	Y
10	Detail Of Insulation ,Fireproofing	N	-	Y	Y
11	Detail Of Pipe Davit	N	-	Y	Y
12	Detail Of Lifting Lug, Tailing Lug & Trunion Etc. Including Design Calculation	N	-	Y	Y
13	Shell Development Drawings Incorporating All Attachements Amd Weld Seams	N	-	Y	Y
14	All Final As- Built Shop Drgs. & Design Calculations Duly Certified By Third Party Inspecting Authority (**)	N	-	Y	Y
15	Data Folder As Per Specification	N	-	Y	Y
16	Materials Test Certificates Duly Stamped By Inspecting Authority (**)	N	-	-	Y
17	Qap & Inspection And Test Plan (**)	N	Y	-	Y
18	Welding Prcedure And Qualification Test Reports (**)	N	-	Y	Y
19	Destructive And Non Destructive Procedure & Test Reports (**)	N	-	-	Y
20	Heat Treatment Procedure And Time Temprature Charts (**)	N	-	Y	Y
21	Radiographic Examination Reports & Films(**)	N	-	-	Y
22	Completion Certificates (Including	N	-	-	Y

Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
	Inspection Certificate, Hydrostatic Test Certificate , Local Code Requirements)				
23	Packing And Forwarding Instruction (**)	N	-	-	Y
24	Transportation Drawing Showing Overall Dimension, C.G. Weight And Handling Instructions Duly Approved By Appropriate Authority	N	-	Y	Y
25	Final Civil Load Data Including Details Of Foundation/Anchor Bolts	N	-	Y	Y
26	List Of Spare Parts And Details	N	Y	-	Y
D.	**PIPING**				
1	Equipment layout drawing.	Y	Y	-	Y
2	Piping Layout drg.	N	Y	Y	Y
3	Quality control plan	N	-	Y	Y
4	Filled in Valve Data Sheet.	N	Y	-	Y
5	Design data:				
5.1	Design basis	N	Y	-	Y
5.2	Piping material specification	N	Y	-	Y
6	Issued for construction (IFC) Drawing.	N	-	Y	Y
6.1	Piping GA DRGS.	N	-	Y	Y
6.2	Isometrics	N	-	Y	Y
6.3	Piping supports, operating platforms drg.	N	-	Y	Y
7	Material Take-offs	N	-	Y	-
8	Material Requisitions schedule	N	-	Y	-
9	Design calculation / Documents.	N	-	Y	-
9.1	Flexibility Analysis of Piping	N	Y	-	-
9.2	Support and load data	N	-	Y	-
10	Vendor Drawings(Valves, Strainers, Traps etc)	N	Y	Y	Y
11	All inspection, testing & NDT Records.	N	-	Y	Y

Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
12	As Built Drgs/Docs/MTCs	N	-	-	Y
13.	3D Model	N		Y	Y
E.	**ELECTRICAL**				
1	Load List indicating rated and absorbed power of loads and duty type (Continuous / Standby / Intermittent) at different voltages including emergency loads.	Y	-	Y	Y
2	Load Data indicating normal, peak, starting and construction power requirement at various voltage levels.	Y	-	Y	Y
3	Single line distribution diagram (power, lighting, DC supply and UPS supply) including protection and metering details giving rating of each equipment.	Y	Y	-	Y
4	Specification Sheets and Technical Particulars of Electrical Equipment	N	Y	-	Y
5	General arrangement and foundation drawings of all equipment.	N	-	Y	Y
6	Equipment layout in Sub Station, MCC room, and plant area showing location of all electrical equipment.	N	Y	-	Y
7	Civil scope drawing of Transformers, 415V switch boards, MLDB, Battery & Battery Charger, UPS and other substation equipment.	N	Y	-	Y
8	Cable schedule.	N	Y	-	Y
9	Cable rack / trench / pipe layout of substation and Plant.	N	Y	-	Y
10	Power Layout of Plant and Substation .	N	Y	-	Y
11	Schematic diagram for all control panel & switch boards.	N	Y	-	Y
12	Feeder Details of all switch boards	N	Y	-	Y
13	Interconnection & Terminal connection diagram	N	-	Y	Y
14	List of controls, interlocks, indication & metering at various locations for all drives.	N	-	Y	Y
15	Characteristic curves for motor/ relays etc.	N	-	Y	Y

Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
16	Sizing Calculations for Electrical System and Equipment.	N	Y	-	Y
17	Design calculations (for system design and equipment sizing, earthing & Lightning, lighting, cables, bus ducts etc.)	N	Y	-	Y
18	Earthing and lightning protection layout of substation and Plant	N	Y	-	Y
19	Lighting layout of substation and Plant with Distribution diagram	N	Y	-	Y
20	Drawings and documents asked for each equipment as per respective Technical Specifications	N	Y	-	Y
21	Control & operation write up/Block logic diagrams.	N	Y	-	Y
22	Catalogues for all bought out items	N	-	Y	Y
23	Bill of Materials covering all electrical equipment and installation materials	N	-	Y	Y
24	Installation operation and maintenance Manual	N	-	-	Y
25	Relay Co-ordination and settings	N	-	Y	Y
26	Spare Parts list	Y	-	Y	Y
27	Test Certificates	N	-	Y	Y
28	Guarantee Certificates	N	-	Y	Y
29	Quality Assurance Plan & Formats	N	Y	-	Y
30	Hazardous area Classification Drawing	Y	Y	-	Y
31	Erection Drawings & Details	N	Y	-	Y
32	Construction & Commissioning specification and procedure for all equipment.	N	-	Y	Y
33	Any other drawings & data as required for satisfactory installation, operation & maintenance.	N	Y	Y	Y
F.	**INSTRUMENTATION**				
1	Drawing & document schedule	--	Y	--	Y
2	Instrument Index	--	--	Y	--
3	Instrument sizing calculations (control	--	--	Y	--

Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
	vales, safety valves & flow elements)				
4	Utility requirements	--	--	Y	--
5	Level sketches	--	--	Y	--
6	Material Requisition	--	Y	--	Y
7	Purchase Requisition	--	--	Y	--
8	Vendor Drawings	--	--	Y	--
9	Functional Schematic	--	--	Y	--
10	Logic Diagrams as per ISA 75.2	--	--	Y	--
11	Instrument loop drawings	--	--	Y	--
12	Control room layout	--	Y	--	Y
13	Layout of equipment inside control room	--	Y	--	Y
14	Power supply distribution	--	Y	--	Y
15	Wiring diagram for panels	--		Y	
16	Configuration diagram	--	Y	--	Y
17	I/O assignment	--	Y	--	Y
18	DCS graphics, report/log formats & other DCS docs.	--	Y	--	Y
19	Instrument duct / tray layout	--	--	Y	--
20	Instrument cable schedule	--	--	Y	--
21	Instrument location plans	--	--	Y	--
22	Instrument installation drawings	--	--	Y	--
23	Bill of material for installation items	--	--	Y	--
24	Spare part list for :	--	--		--
	a. Mandatory Spares	--	--	Y	--

Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
	b. Start up & commissioning	--	--	Y	--
25	Inspection & test procedures	--	--	Y	--
26	Complete catalogues with part list for all vendor supplied instruments, control etc.	--	--	Y	--
27	Installation, operation & maintenance manuals	--	--	Y	--
28	As Built Drawings	--	--	Y	--
29	System Architecture	Y	--	Y	--
30	Instrument Control Philosophy	Y	--	Y	--
	This section is further elaborated in respective Section of Instrumentation and the same shall have precedence in case of conflict.				

Note:-

a. Various Layout drawing for Substation indicated herein shall refers to Bagging substation & Bagging MCC room, while plant indicated herein shall refers to complete urea handling & bagging package including Bagging building, Transfer tower, Conveyor gantry etc.

b. 4 hard copies & 1 soft copy shall be supplied with bid.

c. 3 hard copies & 1 soft copy shall be supplied for approval/information after order.

d. 8 hard copies & soft copies in CD/Pen drive shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

LEGEND: Y - Yes, N – No

SECTION VI- 6.0

SPARE PARTS

UREA HANDLING & BAGGING PACKAGE

[UREA (NEEM OIL COATED) HANDLING SYSTEM, BULK SILO AND BAGGING SYSTEM INCLUDING FILLED BAGS STACKING/ LOADING TO WAGON & TRUCK]

PLANT: AMMONIA-UREA PLANT BASED ON COAL GASIFICATION

PROJECT: INTEGRATED ROM BASED FERTILISER COMPLEX AT TALCHER, ANGUL DISTRICT, ODISHA (INDIA)

CONTENTS

1.0 SPARES PARTS FOR COMMISSIONING:

Contractor shall supply free of cost spare parts and consumables (except raw materials and Utilities supplied by others) required during Pre-commissioning & Commissioning of the plants until the plant is handed over to the Owner after Performance Test.

2.0 SPARE PARTS FOR TWO YEARS OPERATION (MANDATORY SPARES):

Contractor/Bidder shall provide the list of spare parts for first two years of operation of the equipment as recommended by OEM (Original Equipment Manufacturer) with recommended quantities and itemized prices covering the below listed spares. Proper coding and referencing of spare parts shall be done so that later identification with appropriate equipment is facilitated. Recommended spares and their quantities shall take into account related factors of equipment reliability, effect of equipment downtime upon production or safety, cost of parts and availability of vendor's service facilities around the proposed location of equipment.

A. Material Handling

SL. NO.	Description	Quantity (In % of total actual qty. used/Nos./Sets)
1.0	**Conveyors System**	
A.	**Pulleys**	
1.	Head Pulley for conveyors	10%, min. 1 no.
2.	Tail Pulley for conveyors	10%, min. 1 no.
3.	Snub Pulley for conveyors	10%, min. 1 no.
4.	Bend Pulley for conveyors	10%, min. 1 no.
5.	Take-up Pulley for conveyors	10%, min. 1 no.
B.	**Plummer Blocks**	
1.	Plummer block with bearing for Head Pulley	10%, min. 2 nos.
2.	Plummer block with bearing for Tail Pulley	10%, min. 2 nos.
3.	Plummer block with bearing for Snub Pulley	10%, min. 2 nos.
4.	Plummer block with bearing for Bend Pulley	10%, min. 2 nos.
5.	Plummer block with bearing for Take-up Pulley	10%, min. 2 nos.
C.	**Rollers**	
1.	Carrying Rollers for conveyors	10%
2.	Return Rollers for conveyors	10%

3.	Impact Rollers for conveyors	40%
4.	Guide roller for self-aligning idler	40%
D.	**Idlers**	
1.	Carrying Idlers for conveyors	10%
2.	Return Idlers for conveyors	10%
3.	S.A Carrying Idlers for conveyors	10%
4.	S.A Return Idlers for conveyors	10%
5.	Impact Idlers for conveyors	40%
E.	**Couplings**	
1.	Coupling	10%
F.	**Gear Box**	
1.	Gear box	10%
G.	**Bucket Elevators**	
1.	Chain links & pins set with lock pins and Buckets	15%
2.	Chain Sprocket (Head & Tail end)	2 Set
3.	Vibration pad	20%
4.	Bucket attachment fastener	15%
5.	Complete set of all Bearings	15%
H.	**Bagging & Stitching machine**	
1.	Air cylinder for gravity feeder	12 nos.
2.	Solenoid valve for gravity feeder	12 nos.
3.	Air cylinder for weigher	12 nos.
4.	Proximity switch for weigher	12 nos.
5.	Solenoid valve for weigher	12 nos.
6.	Air cylinder for bag holder	12 nos.
7.	Proximity switch for bag holder	12 nos.
8.	Slat	120 nos.
9.	Sprocket	12 nos.
10.	Chain link	60 m
11.	Needle	100 nos.

12.	Needle bar	12 nos.
13.	Needle tension spring	24 nos.
14.	Thread tension nut	24 nos.
I.	**Salt Scraper (Scraper Reclaimer)**	
1.	Blades for primary and secondary scrapper	6 nos. each
2.	Fastener for blades	6 sets each
3.	Sprocket assembly set for primary and secondary chain	1 no. each
4.	Roller and pin with lock pins assembly for scrape chain	18 nos.
5.	Fusible plug for torque converter	2 nos.
6.	Packing set for chain tension hydraulic cylinders for primary & secondary chain	2 sets each
7.	Seals for each category/application	1 No.
8.	Filters for cab pressurizing fan	2 Nos.
9.	Bearings for each category/application	1 No.
10.	Coupling for each category/application	1 No.
11.	Complete gear box unit for each drive	1 No.
J.	**Vibrating Screens & Feeder**	
1.	Vibrator Assembly for Oversize Process screens	1 No.
2.	Vibrator Assembly for Oversize Fine Process screens	1 No.
3.	Vibrator Assembly for Polishing screens	1 No.
4.	Clamp Plate (Wire Mesh)	6 Nos.
5.	Clamp Plate (Perforated Plate)	6 Nos.
6.	Washer seat	30 Nos.
7.	Spherical Washer	30 Nos.
8.	Wire Cloth (01 Set)	5 Nos.
9.	“J” Bolt	30 Nos.
10.	Bearing	2 Nos.
11.	Bearing Cartridge	2 Nos.
12.	Vibrator Assembly for Feeders	1 No.
13.	Spring	8 Nos.
14	Spring Mount Bolts	4 Nos.
15.	Perforated Plate Top Deck	9 Nos.

16.	V Belt	2 Sets
17.	Sheave (Drive)	1 No.
18.	Sheave (Driving)	1 No.
K.	**Delumper**	
1.	Bearings for each category/application	1 No.
2.	Shaft Rotor	1 No.
3.	V Belt	2 Sets
4.	Sheave (Drive & Driving)	1 No.
5.	Complete set of coupling with elements, if applicable	1 No.
6.	Coupling bushes, if applicable	1 No.
7.	Oil Seal & O Ring for each category/application	1 No.
L.	**Dry De-dusting system**	
1.	Bag filter bags for each DE system	1 No.
2.	Sequential timer for each DE system	1 No.
3.	Solenoid valves for each DE system	5 Nos.
4.	Diaphragm for Solenoid valves for each DE system	20 Nos.

B. Rotating Equipment

i. Centrifugal Fan / Blowers

Sl. No.	DESCRIPTION	QUANTITY For each type / size of working equipment
1.0	Completely dynamically balanced rotor assembly including impeller/wheel/ Lobes, key etc.	1 Set
2.0	Shaft sleeve	1 Set
3.0	Complete set of all Bearings	1 Set
4.0	Stuffing box packing rings	1 Set
5.0	Complete set of all Gasket & 'O' rings	1 Set
6.0	Complete mechanical seal , if applicable	1 Set
7.0	Coupling bushes	1 Set
8.0	Complete set of coupling with elements	1 Set.

ii Centrifugal Pump:

Sl. No.	Description	Quantity			
		No. of Pumps working			
		1	2	3	4
1.	Impeller	1 set	1 set	1 set	1 set
2.	Impeller locking nut	2 sets	2 sets	2 sets	2 sets
3.	Wear Rings complete set	1 set	2 sets	3 sets	4 sets
4.	Shaft with keys	1 No.	1 No.	1 No.	1 No.
5.	Shaft Sleeve	1 set	2 sets	3 sets	4 sets
6.	Interstage sleeves	1 set	2 sets	3 sets	4 sets
7.	Interstage Bushes	1 set	2 sets	3 sets	4 sets
8.	Complete Set of Mech. Seal where applicable	1 set	1 set	2 sets	2 sets
9	Constant level Oiler	2 sets	2 sets	2 sets	2 sets
10	Deflectors	2 sets	2 sets	3 sets	3 sets
11	Complete set of coupling with element and fasteners	1 set	1 set	2 sets	2 sets
12	Complete set of all Bearings	1 set	2 sets	2 sets	2 sets
13	Complete set of Gaskets & 'O' Rings	2 sets	3 sets	4 sets	6 sets
14	Labyrinths	2 sets	3 sets	4 sets	5 sets
15	Throat Bushing	1 No.	2 Nos.	3 Nos.	4 Nos.
16	Throttle Bushing	1 No.	2 Nos.	3 Nos.	4 Nos.
17	Complete set of Oil Seals	2 sets	3 sets	4 sets	6 sets
18	Balancing drum & sleeves, as applicable.	1 set	1 set	2 sets	2 sets
19	Leak-off valve-gaskets, 'O' Rings and springs	2 sets	3 sets	4 sets	5 sets
20	Spares for gear box (complete set of bearings, all gears wheels with shaft and seals)	1 set	1 set	1 set	1 set

iii Reciprocating Pump:

Sl No.	Description	Quantity			
		No. of Pumps working			
		1	2	3	4
A	**Main Frame**				
1.	Main Bearings	1 set	1 set	1 set	1 set
2.	Big End Bearings	1 set	1 set	1 set	1 set
3.	Thrust Bearings	1 set	1 set	2 sets	2 sets
4.	Crosshead shoes	1 set	1 set	1 set	1 set
5.	Crosshead bushes	1 set	1 set	1 set	1 set

6.	Connecting rod with complete Fasteners for all size	2 sets.	2 sets	4 sets	4 sets
7.	Crank shaft	1 No.	1 No.	1 No.	1 No.
8.	Lube oil pump	1 No.	1 No.	1 No.	1 No.
9.	Spare parts for lube oil pump (set of gears, bushes, gaskets etc.)	1 set	1 set	2 sets	2 sets
10.	Cartridge for oil filter.	2 Nos.	2 Nos.	4 Nos.	4 Nos.
11.	Special gaskets, oil seals, 'O' rings, special bolts etc.	2 sets	2 sets	4 sets	4 sets
B	**Fluid End**				
1.	Cylinders	1 No.	1 No.	2 Nos.	2 Nos.
2.	Plungers / piston & piston rod assembly, piston rings (if applicable)	1 set	1 set	1 set	1 set
3.	Stuffing box Packings	2 sets	2 sets	4 sets	4 sets
4.	Plunger Packings	2 sets	2 sets	4 sets	4 sets
5.	Complete set of Suction valve & seat	1 set	2 sets	3 sets	4 sets
6.	Complete set of Discharge valve & seat	1 set	2 sets	3 sets	4 sets
7.	Flushing pump (if applicable)	1 No.	1 No.	1 No.	1 No.
8.	Spares for flushing pump.	1 set	1 set	2 sets	2 sets
	- Plunger - Plunger Packings - Valves - Gaskets				
9.	Special gaskets, springs, 'O' rings, and ring nuts for stuffing box packing, cylinder bolts.	2 sets	2 sets	4 sets	4 sets
C	**Gear Reducer (If Applicable)**				
	Spares for gear box (complete set of bearings, all gears wheels with shaft and seals)	1 set	1 set	2 sets	2 sets
D	**Lube Oil Coolers (If Applicable)**				
1.	Special gaskets, if any	2 sets	2 sets	4 sets	4 sets
2.	Spare tubes.	10 %	10 %	10 %	10 %

iv. <u>Metering Pump:</u>

Sl. No.	Description	Quantity			
		No. of Pumps working			
		1	2	3	4
A	**POWER END**				
1.	Main Bearings	1 set	1 set	1 set	1 set
2.	Big End Bearings	1 set	1 set	1 set	1 set
3.	Crosshead shoes	1 set	1 set	1 set	1 set
4.	Crosshead bushes	1 set	1 set	1 set	1 set
5.	Connecting rod with complete Fasteners for all size	2 sets.	2 sets	4 sets	4 sets

6.	Special gaskets, oil seals, 'O' rings , special bolts etc.	2 sets	2 sets	4 sets	4 sets
B	**FLUID END**				
1.	Cylinders	1 No.	1 No.	2 Nos.	2 Nos.
2.	Plungers	1 set	1 set	1 set	1 set
3.	Diaphragm	1 set	2 sets	3 sets	4 sets
4.	Stuffing box Packings	2 sets	2 sets	4 sets	4 sets
5.	Complete set of Suction valve & seat	1 set	2 sets	3 sets	4 sets
6.	Complete set of Discharge valve & seat	1 set	2 sets	3 sets	4 sets
7.	Special gaskets , springs , 'O' rings , ring nuts for stuffing box packing , cylinder bolts	2 sets	2 sets	4 sets	4 sets

iv. <u>Centrifugal/ Axial/ Rotary Compressor:</u>

Sl. No.	DESCRIPTION	QUANTITY
1.0	**Compressor**	
1.1	Completely assembled dynamically balanced spare rotor including clearance check and mechanical run test	1 set
1.2	Complete spare coupling including distance piece and set of coupling bolts & nuts	1 set
1.3	Stator blade carrier with stator blades completely assembled (for axial compressor)	1 set
1.4	Complete set of radial bearing (Both suction & discharge side)	1 set
1.5	Complete set of Pads for radial bearing with built-in temperature elements (Both suction & discharge side)	1 set
1.6	Complete set of thrust bearings (Both active & inactive sides)	1 set
1.7	Complete set of Pads for thrust bearings with built-in temperature elements (Both active & inactive sides)	1 set
1.8	Complete set of labyrinth seals for each casing including labyrinths for balance piston , oil scraper rings etc.	1 set
1.9	Complete set of Dry Gas Seals & assembly (if applicable)	1Set
1.10	Complete set of all oil seals	2 sets
1.11	Complete set of 'O' rings, gaskets, sealing rings for compressor	4 sets
1.12	Sealing compound	1 charge
1.13	Timing gears for Rotary Compressor	1 set
2.0	**Gear Box**	
2.1	Complete set of bearings for gear box including driver end, intermediate stages and driven end	2 sets
2.2	Complete set of all gear wheels with shaft	1 set
2.3	Complete set of all Oil seals	2 sets

3.0	**Gas Coolers**	
3.1	Spare tubes for each cooler (when tubes can be easily replaced)	5% of total tubes
	In case of finned tube, complete tube bundle	1 set
3.2	Rupture disc for each cooler	2 nos
3.3	Set of all gaskets for each cooler	2 sets
4.0	**Lube Oil System**	
4.1	Spares for lube oil pump :	
	a) gears with Shaft	1 set
	b) complete set of bearings	1 set
	c) complete set of seal	2 sets
4.2	Lube oil filter cartridges	4 sets
5.0	**Accessories**	1 set
5.1	Set of spares for all valves (Isolation, control, safety, non return etc.) in gas lines consisting of spindle, seat , disc, flap, packing , fasteners etc.	1 set
5.2	Spare elements for permanent filters in gas line	1 set
5.3	Complete Set of inlet air Filters for Air compressor, as applicable	2 sets
6.0	**Instrumentation**	
	As per Instrumentation specification enclosed with enquiry / order specification.	

v. <u>Reciprocating Compressor:</u>

Sl. No.	DESCRIPTION	QUANTITY
1.0	**Compressor**	
1.1	Main bearings	1 set
1.2	Crankshaft journal bearings	1 set
1.3	Big end bearing	1 set
1.4	Cross head pin bearings	1 set
1.5	Complete Set of Connecting rod with fasteners	1 Set of each size
1.6	Complete Set Cross head body & guide assembly with fasteners	1 set of each size
1.7	Piston assembly complete with piston rod, piston, piston rings & lock nut etc. for each stage	1 set
1.8	Piston rings for each piston	2 sets
1.9	Complete stuffing box internal packing	1 set
1.10	Oil slinger ring	1 set
1.11	Liner for each stage	1 set
1.12	Complete inlet valves assembly with internals for each cylinder	1 set
1.13	Complete discharge valves assembly with internals for each cylinder	1 Set
1.14	Complete Set of all Gasket and O-Ring .	2 sets
2.0	**Gas Coolers**	
2.1	Tubes for gas cooler	1 set
2.2	Tubes for oil cooler (when tube are easily replaceable)	5 % for each cooler
2.3	Complete set of Gaskets for coolers & pressure Vessels	2 sets
3.0	**Lube Oil System**	
3.1	Spares for lube oil pump :	

	a) gears with Shaft	1 set
	b) complete set of bearings	1 set
	c) complete set of seal	2 sets
3.2	Lube oil filter cartridges	4 sets
3.3	Cylinder lubrication system :	
	a) Complete set of Lubricator bearings	1 set
	b) Pumping unit assembly	1set
	c) Check valves of each size	1 set of each size
	d) Sight glass	1 set
4.0	**Accessories**	1 set
4.1	Set of spares for all valves (Isolation, control, safety, non return etc.) in gas lines consisting of spindle, seat , disc, flap, packing , fasteners etc.	1 set
5.0	**Instrumentation**	
	As per Instrumentation specification enclosed with enquiry / order specification.	

vi. Screw Compressor:

Sl. No.	DESCRIPTION	QUANTITY
1.0	**Compressor**	
1.1	Completely assembled dynamically balanced spare rotor including clearance check and mechanical run test	1 set
1.2	Complete spare coupling including distance piece and set of coupling bolts & nuts	1 set
1.3	Complete Set of radial bearings (Both suction & discharge side)	1 set
1.4	Complete Set of Pads for radial bearings (Both suction & discharge side)	1 set
1.5	Complete Set of thrust bearings (both active & inactive sides), if applicable.	1 set
1.6	Complete Set of Pads for thrust bearings (both active & inactive sides), if applicable.	1 set
1.7	Complete Set of Mechanical seal	1 set
1.8	Complete Set of oil seals	2 sets
1.9	Complete Set of 'O' rings, gaskets, sealing rings. for compressor	4 sets
2.0	**Oil System**	
2.1	Spare for oil pump	
	- Complete rotating assembly	1 set
	- Bearings	1 set
	- Oil seal	1 set
	- Gaskets & 'O' rings	2 sets
2.2	Cartridge for oil filter	4 sets
2.3	Gaskets for Oil cooler	2 sets
3.0	**Gear Box**	
3.1	Set of bearings for gear box including drive end, intermediate stages & driven end	2 sets
3.2	Set of spare wheels & shaft	1 set
3.3	Complete Set Oil seals	2 sets

4.0	**Accessories**	
4.1	Set of spares for all valves (Isolation, control, safety, non return etc.) in gas lines consisting of spindle, seat , disc, flap, packing , fasteners etc.	1 set
4.2	Spare elements for permanent filters in gas line	1 set
5.0	**Instrumentation**	
	As per Instrumentation specification	

'Set' means complete replacement of particular part in the machine.

C. Static Equipment

Sl. No	Spare Items	Quantities
1.0	**Pressure Vessels**	
1.1	Gaskets for each nozzle with blind/companion flange	200 %
1.2	Bolting for each nozzle with blind/companion flange	10 % (Minimum 2 numbers) for each nozzles
1.3	Bolting for internal flange	10 % (Minimum 2 numbers) for each nozzles
1.4	Gasket for internal flange	200 %
1.5	Spare for internals Clamps Washer Stud & Bolt	 2 % excess, min. 5 piece 20 % excess, min. 3 piece 10% (Minimum 2 nos.)
1.6	Sight/light glass assembly complete with bolting and gasket	300% of each installed glass
2.0	**Tanks**	
2.1	Gaskets for each nozzle with blind/companion flange	200%
2.2	Bolting for each nozzle with blind/companion flange	10% (Minimum 2 numbers) for each nozzles

Notes:

1) Quantities shown are for each size and type of part.
2) The parts listed are the principal parts only. Other parts shall be considered for recommendation in quantities consistent with the above table.
3) All special tools and tackles required for maintenance for critical items shall be supplied along with equipment.

D. Piping Items

Sl. No.	Part Description	Size Range (NB)	Quantity Required (% of as built)	Remark
1	Pipes & Fittings	≤1.5”	5%	min. qty. 6 mtr. / 1 No.
2	Pipes & Fittings	≥ 2”	2%	min. qty. 6 mtr. /1 No.
3	Flanges	≤1.5”	5%	min. qty. 1 No.
4	Flanges	2” to 6”	5%	min. qty. 1 No.
5	Flanges	8” to 36”	2%	min. qty. 1 No.
6	Valves	≤1.5”	5%	min. qty. 1 No.
7	Valves	2” to 14”	5%	min. qty. 1 No.
8	Valves	≥16” with rating ≥900#		Note-5
9	Bolts, Nuts & Gaskets (For each size, rating, material)		10%	min. qty. 1 No.
10	Traps (For each size, rating, material)		2%	min. qty. 1 No.
11	Expansion Bellow (For each size, rating, material)		10%	min. qty. 1 No.
12	Strainer element (For each size, rating, material)		10%	min. qty. 1 No.
13	Complete Gear Box for gear operated Valves		5%	min. qty. 1 No.
14	Seal ring for the Pressure seal type valves		5%	min. qty. 10 Nos.
15	Hose assembly		50%	min. qty. 10 Nos.
16	Bolt torque wrenches (Manual)		1 set	min. qty. 1 set.
17	Bolt torque wrenches (Hydraulic)		1 set	min. qty. 1 set.
18	Bolt tensioning for equipment		1 set	min. qty. 1 set.

Notes (Piping items):

1. Percent of quantity required as mandatory spares is for each and every item/size/material consumed in as built.
2. No substitution in size, rating and material is allowed.
3. Pipe length in meter and other items in No. or Set shall be supplied.
4. Fractional part of quantity shall be converted into nearest upward whole part.
5. For rating ≥900# and sizes ≥16”, minimum one qty. valve spare shall be supplied for each size, rating & material.

E. Electrical

SL. No.	Item	Quantity
1.0	**UPS of Each Rating**	
A.	Semiconductor Fuses or HRC Fuse Links of each rating	30%
B.	MCB, MCCB and control switches of each rating	1 Set
C.	SCR, diodes and transistors of each type	50%
D.	Capacitors, resistors and chokes of each type	50%
E.	Signal Lamps of each colour& voltage	30%
F.	PCB of each rating	1 Set
G.	Semiconductor fuses & HRC fuse links of each type	1 Set
H.	IGBT of each type	1 Set
I.	Software and programming terminal	1 Set
J.	Isolator switch of each type	1 No.
K.	Ventilation Fan each type	2 Nos.
L.	PCBs of each type	1 No.
M.	Electrolyte	10%
2.0	**Power and Distribution Transformer (of each type & rating)**	
A.	HV Bushing complete with metal parts for all 3 phases	1 Set
B.	LV Bushing complete with metal parts for all 3 phases	1 Set
C.	Neutral Bushing complete with metal parts	1 Set
D.	NCTs of each type	1 No.
E.	Complete set of Gaskets	1 Set
F.	Complete set of valves (1 no of each type)	1 Set.
G.	Radiator	1 No.
H.	PRV with alarm and trip contacts	1 Set
I.	Explosion vent diaphragm	1 No.
J.	Oil level gauge	1 No.
K.	Complete charge of silica gel with breather	2 Sets
L.	Gland packing / O-ring for every valve	1 Set
M.	Buchhloz relay	1 No.
N.	Analog type OTI	1 No.
O.	Analog type WTI	1 No.
P.	CT for WTI	1 No.
Q.	Magnetic oil level gauge	1 No.
R.	Dial type thermometer	1 No.
S.	Sealing/gauge glass of conservator	1 No.
T.	Oil (% extra of total transformer oil)	10%
U.	Miscellaneous spares (control switches, fuses lamps) for Marshalling Box	2 Sets

V.	Cooler Fan with Motor	1 No.
W.	Remote tap position indicator	1 No.
X.	Oil surge relay for OLTC	1 No.
Y.	Starter contactors, switches and relays for electrical control panels	1 Set
3.0	**DRY TYPE Transformer (of each type & rating)**	
A.	HV Bushing complete with metal parts for all 3 phases	1 Set
B.	LV Bushing complete with metal parts for all 3 phases	1 Set
C.	Neutral Bushing complete with metal parts	1 Set
D.	Complete set of Gaskets	1 Set
4.0	Neutral Earthing Resistor (of each rating)	
A.	Bushing with accessories	1 Set
B.	Support Insulators	2 Nos.
C.	Bushing Insulator	1 No.
D.	Resistor Element	20% minimum one cartridge per type
5.0	**Each 11 kV Switchboard and 3.3 kV Switchboard**	
A.	Complete VCB (ready to use) of each rating	1 No.
B.	Trip bar spring and any other spring used in the circuit breaker mechanism for breaker of each rating	1 No.
C.	Shunt trip coil for breaker of each rating	10%
D.	Closing coil for breaker of each rating	10%
E.	Spring charging motor of each rating	1 No.
F.	Spring charging handle for breaker of each rating	1 No.
G.	Racking out handles for breaker of each rating	1 No.
H.	Secondary Isolating contact blocks for breaker of each rating	1 No.
I.	Micro Switch for Test/ Service Position for breaker of each rating	1 No.
J.	Micro Switch for Spring Charging for breaker of each rating	1 No.
K.	Main contact sets/ Jaw contact, Moving coil, Fixed coil compete for breaker of each rating	1 Set
L.	Trip-Neutral-Close Control Switch	2 Nos.
M.	Local-OFF-Remote Selector Switch	2 Nos.
N.	Ammeter Selector Switch	2 Nos.
O.	Voltmeter Selector Switch	2 Nos.
P.	Push Button Element of each type & rating	20 %
Q.	Push Button Actuator of each type	20 %
R.	Trip Selector Switch	2 Nos.
S.	Panel limit switches & interlocking switches	10% each type

T.	Panel operating switches (all types)	1 Set each
U.	Breaker limit switches & interlocking switches	10% each type
V.	Protection Relays for different type of feeders i.e Incoming Feeder, Bus-coupler Feeder, Outgoing feeder, Motor Feeder, Transformer Feeder etc.	1 No. for each type of feeder
W.	Trip relays of each type	2 Nos
X.	Auxiliary Relays of each Type	2 Nos.
Y.	Miniature Circuit Breaker of each type & rating	20 %
Z.	Meters (of each type & rating) i) Ammeter ii) Voltmeter iii) Multifunction Meter iv) Energy Meter	 1 No. 1 No. 1 No. 1 No.
AA.	Instrument Transformers of each type & rating i) CT ii) PT	 3 Nos. 1 Nos.
BB.	Fuses of each type & rating i) HRC HV for VT ii) HRC LV	 20 % 20 %
CC.	Alarm bell/ Alarm buzzer	1No.
DD.	Lamp Complete assembly of each colour& voltage	10%
EE.	Current transducers of each rating	20%
FF.	Voltage transducers of each rating	20%
GG.	Power Transducers of each rating	20%
HH.	Bus-Bar Support Insulators	1 Set
II.	Surge Arrestors	1 No.
JJ.	Inspection Glass	3 Nos.
KK.	Sprouts	1 Set
LL.	Panel Space Heaters with Thermostat	2 Nos.
MM.	Alarm Annunciator of each type	1 No.
NN.	Interpanel insulation barriers	20% Minimum 1 No.
OO.	Earthing Trolley	1 No.
PP.	Maintenance Trolley for breaker of all rating	1 No.
QQ.	Set of gaskets for all ratings & type	1 Set
RR.	Panel shutter assembly	2 No.
SS.	Removable bus bar shrouds	1 Set
TT.	Bus bar mounted power fix contacts	1 Set
6.0	**Each LT (415V) Switchboard (PMCC/EPMCC/APFC/PCC/MCC/ASDB/ DCDB/UPSDB/LSDB)**	
A.	Complete ACB (ready to use) of each rating	1 No.

B.	Trip coils for breaker of each rating	10%
C.	Closing coils for breaker of each rating	10%
D.	Spring charging motors of each rating	1 No.
E.	Secondary Isolating contact blocks for breaker of each rating	1 Set.
F.	Arcing contacts & arcing chutes block for breaker of each rating	1 Set.
G.	Main contact sets/ Jaw contact compete for breaker of each rating	1 Sets
H.	Trip-Neutral-Close Control Switch	2 Nos.
I.	Local-OFF-Remote Selector Switch	2 Nos.
J.	Ammeter Selector Switch	2 Nos.
K.	Voltmeter Selector Switch	2 Nos.
L.	Push Button Element of each type & rating	20 %
M.	Push Button Actuator of each type	20 %
N.	Trip Selector Switch	2 Nos.
O.	Panel limit switches & interlocking switches	10% each type
P.	Panel operating switches (all types)	1 Set each
Q.	Breaker limit switches & interlocking switches	10% each type
R.	Protection Relays for different type of feeders i.e Incoming Feeder, Buscoupler Feeder, Outgoing feeder, Motor Feeder etc.	1 No. for each type of feeder
S.	Trip relays of each type	2 Nos
T.	Auxiliary Relays of each Type	2 Nos.
U.	Thermal over Load Relay of each rating	2 Nos.
V.	Contactors of each type & rating	2 Nos.
W.	Coils for Contactors – each type/voltage	2 Nos.
X.	ELCB & RCBO of each type	2 Nos.
Y.	Miniature Circuit Breaker of each type & rating	20 %
Z.	SFU of each rating	20 %
AA.	Meters (of each type & rating) i) Ammeter ii) Voltmeter iii) Multifunction Meter iv) Energy Meter	 1 No. 1 No. 1 No. 1 No.
BB.	Instrument Transformers of each type & rating i) CT ii) PT	 3 Nos. 1 Nos.
CC.	Fuses of of each type & rating HRC LV	 20 %
DD.	Alarm bell	1No.
EE.	Alarm buzzer	1 No.
FF.	Lamp Complete assembly of each colour& voltage	10%
GG.	Current transducers of each rating	20%
HH.	Voltage transducers of each rating	20%
II.	Power Transducers of each rating	20%
JJ.	Bus-Bar Support Insulators	1 Set
KK.	Panel Space Heaters with Thermostat	2 Nos.

LL.	Alarm Annunciator of each type	1 No.
MM.	Interpanel insulation barriers	20% Minimum 1 No
NN.	Maintenance Trolley for breaker of all rating	1 No.
OO.	Set of gaskets for all ratings & type	1 Set
PP.	Panel shutter assembly	2 Nos.

QQ.	Removable bus bar shrouds	1 Set
RR.	Bus bar mounted power fix contacts	1 Set
7.0	**Each Bus Duct**	
A.	Bus support insulators each type	2 Nos.
B.	Flexible connector (for switchgear end connection)	1 Set
C.	Flexible connector (for Transformer end connection)	1 Set
D.	Gasket	1 Set
E.	Bus duct CT's / VT's	1 Set
F.	Set of special tools, for dismantling and maintenance	1 Set
8.0	**HV Motor (For each rating)**	
A.	Bearings housing (complete with End Shield) both Driving End and Non driving end	1 set
B.	Cooling fan	1 No.
C.	Space heater	2 Nos.
D.	Terminal box	1 No.
E.	Terminal stud with bushing & star links	2 sets
F.	RTDs for HV motors for Bearing/ hot air	2 Nos. each
G.	Dial Type thermometer	2 sets
H.	Grease nipple & Plug (if installed)	2 Nos.
I.	Charge of Lubricating oil (if not centrally lubricated)	1 Charge
9.0	**LV Motor (For each rating)**	
A.	Bearings housing (complete with End Shield) both Driving End and Non driving end	1 set
B.	Cooling fan	2 No.
C.	Terminal box	1 No.
D.	Terminal stud with bushing & star links	1 No.
E.	Space heater, if installed	2 Nos.
F.	Grease nipple & Plug, if installed	2 Nos.
G.	Cooling fan cover	1 No.
10.0	**Interlocking switch socket & plug**	
A.	Switch of each rating	3 Nos.

B.	Fuse base of each rating	3 Nos.
C.	Fuse of each rating	3 Nos.
D.	Plug Top	3 Nos.
11.0	**Lighting Fixtures**	
A.	LED Lighting fixtures (along with Driver) alongwith LED Lamp	10% of the total no. of fixtures (Minimum of 5 No's of each type)
B.	Terminal block of each type	5 Nos.
C.	Heat resistance toughened glass cover of each type	5 Nos.
D.	Allen keys of different sizes as applicable	2 Sets
12.0	**Battery Charger**	
A.	Set of diodes of each type and rating	2 Sets
B.	Set of silicon controlled Rectifiers	2 Sets
C.	Set of chokes of each type and rating	1 Set
D.	Set of resistors of each type and rating	1 Set
E.	Set of capacitors of each type and rating	1 Set
F.	Set of transistors of each type and rating	1 Set
G.	Set of load breaking switches of each type and rating	1 Set
H.	Off-Load Tap Changing Device	1 Set
I.	Current Regulator	1 Set
J.	Semiconductor fuses of each type and rating	3 Nos.
K.	Set of contactors of each type and rating	2 Sets
L.	Set of thermal overload relays of each type and rating	2 Sets
M.	Set of auxiliary contactors of each type and rating	2 Sets
N.	Set of power contactors of each type and rating	2 Sets
O.	Set of control and selector switches of each type and rating	2 Sets
P.	Set of controller cards of each installed charger	2 Sets
Q.	Indicating lights of each colour & voltage	2 Sets
R.	D.C. Ammeter	1 No.
S.	Miniature circuit Breaker of each type & rating	1 No.
T.	PCB's of each type	1 No.
U.	Float indicator	1 No.
V.	Thermometer	1 No.
W.	Under, over voltage and earth leakage protection devices	1 No.
X.	Panel / cabinet space heater	2 Nos.
Y.	Thermostat	2 Nos.
13.0	**Each Battery Bank**	
A.	Complete cells of each type	4 Sets

B.	Vent plugs	2 Nos.
C.	Inter cell connectors with nuts, bolts and washers	2 Sets
D.	P.V.C. Spill Trays	2 Sets
E.	Terminal Post	2 Sets
14.0	**Local Control Station**	
A.	Trip – neutral – close switch	20%
B.	Auto Manual / Local -Remote switch	20%
C.	Ammeters of different ranges	20%
D.	Terminal block	20%
E.	Indicating Lamps of different type	20%
F.	Push Buttons of different type	20%
G.	Complete LCS of each type	20%
15.0	**Junction Box**	
A.	Junction Box of each type	10 Nos.
16.0	**Electricals for Overhead Cranes & Hoists (per crane/hoist)**	
A.	Bearings of each type & no.	1 Set
B.	Contactor Coil of various ratings	1 Set
C.	Complete set of contactor of each rating	1 Set
D.	Limit switches of each type	2 Nos.
E.	Push Button Elements	20%
F.	Push Button Actuators	20%
G.	Fuses of various ratings	20%
H.	Fuse fittings of various ratings	20%
I.	Indication lamp fittings of each type	20%
J.	Overload relays of various ranges	1 Set
K.	Brake coils for various brakes	1 Set
L.	Set of carbon brushes in case of S.R. motors	1 Set
M.	Set of resistors for S.R. motors	1 Set
N.	Any special tools and tackles required for maintenance	1 Set
17.0	**Variable Frequency Drives**	
A.	Complete unit of each type	1 No.

B.	Set of fuses of all types & sizes used in system	5 Sets
C.	Controller Card of each type	1 Set
D.	Power Devices of each type	2 Nos.
E.	Software for parameter setting each type	1 Set
18.0	**Fire Alarm & Detection System**	
A.	Detectors of each type	20%
B.	Loop card of each type	10%
C.	Charger card	10%
D.	Interface Units of each type	10%
E.	Power supply unit of each type	10%
F.	PCB of all types	20%
G.	Manual Call Points	10%
H.	Fuses of each type & rating	10%
I.	Control relays of each type	10%
J.	Audible hooter/buzzer	10%
19.0	**Capacitor Bank**	
A.	Capacitor Unit of each rating	3 Nos.
B.	Fuses (if used) of each rating	3 Nos.
C.	Power Contactor of each rating	3 Nos.
D.	PF controller card/unit of each type	1 No.
E.	Limit Switch for Capacitor Bank of each type	**3 Nos.**
20.0	**Each ANNUNCIATOR PANEL**	
A.	Hooters	1 No.
B.	Push Buttons of each type	3 Sets
C.	Terminals	3 Nos.
D.	Acrylics	1 No.
E.	PCB card of each type	1 No.
F.	LED of each colour & voltage	3 Sets
G.	DIP Switches	3 Nos.
H.	CPU	1 No.
I.	SMPS	1 No.
J.	Relays of each type	20%
21.0	**BAGGING & STICHING MACHINE WITH WEIGHING CUM TIPPING MACHINE**	
A.	Contactors of each type and rating	1 Set

B.	Selector switches of each type	1 Set
C.	Limit switches of each type	1 Set
D.	Push buttons of each type	2 Sets
E.	Push button elements of each type	2 Sets
F.	Push button actuators of each type	2 Sets
G.	Fuses of each type and rating	3 Sets
H.	Fuse fitting of each type and rating	3 Sets
I.	Control transformer of each type and rating	1 Set
J.	Indication lamps of each type	1 Set
K.	Break Coil of each type of each type	1 Set
22.0	**SCRAPPER**	
A.	Contactors of each type and rating	1 Set
B.	Selector switch of each type	1 Set
C.	Fuses including fittings of each type	1 Set
D.	Indicating lamps of each type	1 Set
E.	Overload relay of each type and rating	1 Set
F.	Trailing cable	1 length
G.	Control transformer of each type	1 Set
H.	For motor of each rating	
	DE bearing	1 Set
	NDE bearing	1 Set
	Cooling fan	1 No.
	Grease nipple & plug	1 No.

1) Set means complete replacement of particular part in one machine.
2) The above spares do not includes commissioning spares and shall be purely warehouse spare.
3) Wherever "Each Type" is specified, it means "of the Type/make/model/size/rating and exactly replaceable"
4) Wherever "% qty." is specified, Bidder to quote in next higher rounded figure
5) Out of % age spares and minimum qty specified against each item - higher of the two shall be supplied.
6) Electrical EQUIPMENT which has not been mentioned in this table and needs spare parts, CONTRACTOR shall consider spare parts for them, the quantities for such spare parts shall then be APPROVED by OWNER/CONSULTANT.

F. Instrumentation

1) Set means complete replacement of particular part in one machine.
2) Wherever "Each Type" is specified, it means "of the Type/make/model/size/rating and exactly replaceable"
3) Wherever "% qty." is specified, Bidder to quote in next higher rounded figure
4) Out of % age spares and minimum qty specified against each item - higher of the two shall be supplied.

Sl. No.	DESCRIPTION	QUANTITY
1.0	**Field instruments**	
	Pressure Gauges, Differential Pressure Gauge, Draft Gauges, Field Indicators, RTD/T/C with Thermowells, welded thermowell, Skin Thermocuple Sets, Speed Probes with Cables and Fixing Screws and Bolts, Vibration Probes, with Cables (including extension cable) and Fixing Screws and Bolts, Speed Transmitter with Cables and Fixing Screws and Bolts, Proximeters of diff. model and Fixing Screws and Bolts, Gas Sensors with Cables and Fixing Screws and Bolts	10% of each type of instruments, subject to minimum 2 nos. of each type
	Pressure Switches, DP Switches, Purge Rotameters	10% of each type of instruments, subject to minimum 2 nos of each type
	Special thermocouples (like reactors) /multipoint thermocouples,	10% of each length subject to minimum 1 number of each type.
	Skin Type Thermocouple-	10% of total subject to minimum 1 number Complete Set of each type.
	Float and micro switch assembly for level switch	10% of each length subject to minimum 1 number of each type.
	Transmitters for Flow, Pressure, Temperature, Level, Diff. Pressure application, Remote Seal Transmitter, Transmitter for LEL/GAS Detector System including Sensors .	10% of each type of instruments, subject to minimum 2 nos of each type
	Hydra Step	1 no. Electronic unit or 10% subject to minimum. 20% or Min 3 Nos of Sensor Probes
	Mass flow meter & Mag Flow meter	A) Power fuses 6 nos per set B) Sensor assembly-10% min 1 no

		C) 10% or minimum one number complete electronic head unit
	Vortex Flow Meter	A) One sensing probe ,one set of gasket and Packing for each type and Size B) 10% or minimum one number complete electronic head unit
	Ultrasonic Flow meter	A) 1 pair probe for each instrument B) 1 number electronic card of each type C) 2 numbers fuses of all Types.
	Glass tube Rota meters	20% or min 2 Nos of glass tubes of each size/rating /make.
	Variable Area Flow meter (Rota meters)	10% or minimum one no. float & set of Packing for each type, size, rating and material
	Averaging Pitot Tube	Set of Gasket, O-ring, Packing for Retract Mechanism and one no. Needle Valve with each Pitot Tube.
	Flame scanners and optical pyrometer a) Electronics b) Detectors / sensors or spares with limited life	a)10% subject to minimum 1 No. of each type. b)As required for 1 year operation or Min 2 Nos Complete flame scanner
2.0	Displacer type Level Transmitters	A) 10% of each type of instruments head with Torque Tube Assembly and Transmitter, subject to minimum 2 nos of each type. 1 No of float of each type. B) 10% Electronic cards and Display module – Minimum 1 no. of each type
2.1a	Ultrasonic / Guided Wave Radar Type – Level Instrument	A) 10% complete Instrument – Minimum 1 No. of each Type / Range / Material B) 10% Electronic – module / Cards /Display module – Minimum 1 no. of each type

2.2	Level gauge- Transparent / Reflex Type	20% subject to minimum 10 numbers of glass along with pair of Gaskets and glands sets for I/V valves of each type, size (Cushion & Wet Gaskets), whichever is higher.
2.2.1	Level Gauge- Magnetic Type	10% subject to minimum 1 set of Float, Magnet/ball follower-ring gaskets of each type.
3.0	**Control Valve, Shut Down, On-Off, Butterfly, Ball Valves, Gate Valves, Angle Valves, PCV, MOV, Safety Valve Spares**	
3.1	Soft part / actuator spares, including actuator diaphragm, actuator seal kit and spring sets, for each type of actuator	20% of each type of instruments, subject to minimum 1 no. of each type
3.2	Trim Set	Trim set consisting of seat ring / seal ring, plug with stem, cage (wherever applicable), packing material for each make, type , size, □reassure rating valve to be provided as spare
3.3	Complete Actuator with Hand Wheel assembly	one complete Actuator for each type and size
3.4	Complete Spare Control Valve for Antisurge Control Valve	One No
3.5	Gland packing, O rings, Packing and Bonnet gasket, seat gasket	100 % for each valve. i.e. one set for each tag.
3.6	Greases and grease guns	5 sets of each type of grease and 1 grease gun of each type
3.7	Solenoid valves	10% of each type of instruments, subject to minimum 2 nos of each type
3.8	Proximity switches including enclosure	10% of each type of instruments, including enclosure- subject to minimum 2 nos of each type
3.9	SMART Positioners	10% of each type of instruments, subject to minimum 2 nos of each type
3.11	Other accessories: Quick Exhaust relay, Volume Boosters, Air Filter regulators, position Transmitters, change over relay, NRV, Pilot valves.	10% of each type of instruments, subject to minimum 3 nos of each type. Air filter regulator shall be minimum 20%.
3.12	PRDS & De-super heater unit	a)Same as those of Control

		Valves
		b) Gaskets for valve and connections per unit (if such gaskets, are special and supplied by PRDS/De-Super heater vendor
3.13	For PCV Repair kit consisting of (orifice, plug, spring, gasket, diaphragm, spring, O-ring for each valve.	20% or minimum 1 no. in each type
3.14	HHT loaded with latest HART configurator software (Emerson make)	1 no. minimum
3.15	Safety Valve:	Set of each type/ size. 1 Set comprising of 1 upper adjusting ring, 1 lower adjusting ring, 1 disk, 1 Nozzle, 1 stem & 1 Gasket set
		20% of each size and rating of Discs, Nozzles, bellows, springs etc. Additionally Minimum 2 Nos of Complete PSV for critical application (Very high pressure PSV's e.g Boiler drum application etc.)
4.0	**DCS, ESD, F&G PLC, Storage PLC, Analyser PLC, Any other Control and PLC system.**	
4.1	CPU	10% or minimum 1 no. each type.
4.1a	Communication cards, Processor cards (Controller) ,FTA cards	2 nos of each type of cards.
4.2	System Pre-fab cables, I/O Card cables, communication bus cables.	10% or min. 5 sets of each type with all connectors, plugs,
4.3	Racks, Backplane units	2 Nos each type
4.4	Local Panel, Hardwire console & annunciator All items like Push buttons, indicators, hand switches lamps, relays selector switches, IS type indicators / Annunciators, holders etc. mounted in the local panel	10% or minimum 2 no. each type.
4.5	HDD unit	2 set of each type (normal as well as Raid-5) with all connectors, plugs.
4.6	Various Keyboards (including operator keyboard) /mouse	2 nos. of keyboard each type and 5 Nos. of mouse.
4.7	Relays	5% of each type of relays, including relevant terminal modules/sockets minimum 5 nos of each type

4.8	Pushbuttons, Lamps, Selector switches	10% of each type , including relevant terminal modules/accessories as a complete set
4.10	All type of system/PDB/Marshalling cabinet /console filters	100%
4.11	All type of system/PDB/Marshalling cabinet/console fan	2 Nos of each type including relevant terminal modules/pre-fab system cables.
4.12	All type of system/PDB/Marshalling cabinet/console Tube light	2 Nos of each type.
4.13	All type of various PDBs Voltmeters	2 Nos of each type.
4.14	I/O Cards	20% of each type of card, including relevant terminal modules/pre-fab system cables, etc., subject to minimum of 5 nos. each
4.15	Various System Battery, Terminators	1 no. of each type
4.16	All system Fuses and various glass fuses	100% for imported fuses
4.17	All PDB fuses, like HRC, GSA Fuses	100% of total qty. of each type
4.18	MCBs	5 Nos. of each type
4.19	Terminal Blocks	Spare Terminal Blocks along with DIN rail – 100 nos each type
4.20a	Cables for wiring inside Marshalling Racks of DCS of relevant size	100 mtr of each color and size
4.20b	Cables for wiring inside Marshalling Racks of ESD of relevant size	100 mtr of each color and size
4.21	24 V DC Bulk Power Supply modules	Min. 2 nos of each type
4.22	System DC Power supply for DCS	Min. 2 nos of each type
4.23	System DC Power supply for ESD	Min. 2 nos of each type
4.23 a	Diode-o ring modules	10% or minimum 1 no. each type.
4.24	Safety barriers, active isolators, signal convertors, trip amplifiers, signal multipliers	10% of each type of instruments, subject to minimum 5 nos of each type
4.25	Hubs, Bus units, Switches, Routers	20% or Min 1 nos of each type
4.26	OPC / Modbus interface Cards	1 No each along with connectors / cables
4.27	DCS operator and engineering subsystem	
	Communication card Operator Station communication bus	1 No.
	Communication card for Engineering Station communication bus	1 No.

	Motherboard for Operator Workstation	1 No.
	Motherboard for Engineering Workstation	1 No.
	SMPS	1 No.
4.28	PLC operator and engineering subsystem	
	Communication card for PLC programming Station communication bus	1 No.
	Communication card for PLC SOE Station communication bus	1 No.
	Communication card for PLC Operating Station communication bus	1 No.
5.0	**Special control system modules** a) WoodWard Digital Governor, b) WoodWard PROTECH 2oo3/Braun Speed Trip unit, Speed Probes c) Any other Control system module associated with Speed trip and Monitoring system. d) Voith Make E/H Converters.	1 no. of each (Controller, IOs ,cables, barriers Complete unit). Speed Probe - 2 nos of Speed Governing, 2 nos for Over speed Trip. • 1 no of each electronics & sensor • 1 no I/H converter complete set.
6.0	**Bentley Nevada 3500 Series Vibration Monitoring System Spares**	
6.1	Central Rack cards : Power supply card, Vibration/Thrust Monitoring card, Axial displacement card, Speed monitor card, Key phasor module, Relay module, Display Unit., transducers and transmitters	20% of each type of cards, subject to minimum 2 nos of each type
6.2	Vibration probes with leads, axial displacement probes with leads, Bearing thermo elements, speed probes with leads, I/H converter, E/H Convertor, trip solenoid valves, transducers, barriers for vibration probes/ Proximeter.	10% or minimum 1 no. of each type. Proximeter 20%
7.0	**Consumables for DCS**	
7.1	Printer papers A3, A4 size	A3- 10 Rims, A4- 50 Rims
7.2	Laser Cartridges (Black and Color)	For 6 month usage, min. 2 sets for each printer
7.3	DATs of HP/ 3-M	25 nos. each
7.4	CDs of HP/Samsung	200 with individual casing
7.5	DVDs of HP/Samsung	200 with individual casing
8.0	**GC Spares**	
a	Set of Filters	1 set
b	Detector Assembly	1 set
c	PCB assembly Power Supply	2 nos.
d	PCB assembly Digital temp control	2 nos each type
e	Pressure Regulator	1 no

f	Thermocouple Assembly	1 no
g	Sol Valve	1 no
h	Backplane Assembly	1 no
i	PCB Assembly	1 no
j	Ignitor Assembly	1 no
k	Pressure Sensor	1 no
l	Filament Kit	2 nos
m	Set of Fuses	1 no
n	Set of Fittings	1 no
o	Pressure Gauge	1 no
p	Temperature gauge	1 no
q	Sample flow meter	1 no
r	Bypass flow meter	1 no
9.0	**Gas Analyzer Spares applicable for all Gas Analyzers / MassSpectrometer**	
a	Sample Flow Meter	1 no
b	By pass Flow meter	1 no
c	Solenoid Valve	1 no
d	Communication board	1 no of each type
e	Display Unit	1 no each type
f	CPU Board	1 no each type
g	Sensor Electronic	1 no each type
h	Modulation Unit	1 no each type
i	Sample Cell	1 no
j	Sensor	1 no each type
k	O Ring	3 sets
l	Thermal fusses	2 sets
m	Heating cartridge	1 set
n	Thermal trip	2 set
o	Analogue module	1 set each type
p	Filter membrane (pack of 25)	1 set
q	Fuse	1 set each type
10.0	**pH / Conductivity Analyzer**	2 (Two) Complete Analyzer complete with sensor, cables, transmitters etc of each type
11.0	**Silica Analyzer/Sodium/chlorine/ moisture /Turbidity /density/O2/CO/NOx/SPM Spares**	
a	Sensor board	1 no.
b	Sensor and Detector	1 no each type
c	Rotameter (if applicable)	1 no.
d	Pressure Control Valve (if applicable)	1 no.
e	Fuses	5. sets.
f	Electronic card	1 no. each type
g	Other Aux. Cards	1 each

h	Probe	1 no. each type
i	Filters, O-rings, Gaskets	2 sets
j	Consumable Kit	2 sets
12.0	**Sample Conditioning system applicable for all analyzers / Mass spectrometer**	
a	Complete sample kit for sample pumps inclusive of 'O' rings, Seal ring, Diaphragm	1 set
b	Solenoid valve for, more than one stream application	1 no
c	Flow switch	1 no
d	Vaporization system if required, which includes vaporizer, thermostat, electrical tracing cable and heater	1 set
e	Cooling system if required, which includes one cooler, flow conditioning system	1 set
f	Sample handling system fitting, valves, pressure gauges, regulators, solenoid valves, flow meters / flow switches and other components, etc	10% or minimum 1 no. of each type
g	Consumables like filters, membranes, reagents, cal. Gas, carriers	For 1 year of continuous operation
13.0	**Flame Scanner**	Two complete instrument of each type
14.0	**Ferruling machine**	1 no along with printer ribbon and sleeves size of 5.0 mm2 and 3.5 mm2 100 meter each
	Other Items	
15.0	**Snubber, Syphon, Gauge Saver**	10% (subject to minimum of 2) of each item used, whichever is higher
16.0	**Loop powered indicators**	10% (subject to minimum of 2) of Loop powered indicators used, whichever is higher
17.0	**Panel mounted instruments**	10% or minimum one no. whichever is higher
25.0	**Tools**	
25.1	Technician's Tool Kit Set including screw drivers, slide wrench, O & D Spanners Kits	10 nos
25.2	Crimping Tool for RJ-45 Connector, Tapria	5 nos
25.3	Crimping Tool 0.5 to 4.0 mm2 wire, Tapria	5 nos
25.4	Crimping Tool BNC connector for Bentely Neveda	2 nos
25.5	Torque Wrench (Adjustable)	2 nos
25.6	Insulation Remover	5 nos
25.7	IC Puller	2 nos of each type

25.8	Logic probe	2 nos.
25.9	Screw driver kit (Taparia make)	5 set
25.10	Allen Key Set (1mm to 8 mm)	5 set
25.11	Lamp puller	3 nos.
25.12	Torches (LED) handheld	10 nos
25.13	Torches (Head Lamp)	10 nos
25.14	Battery charger alongwith 1 set of batteries	2 nos of each type
26.0	CCTV camera, camera station, lens with zoom, Pan & Tilt Unit, Receiver Unit, electronic unit, , power supply, etc.	10% or minimum one of each type of module.
27.0	EPABX Unit, Electronic Card each type	10% or minimum one of each type of module.
28.0	Gas Detector system a) Transmitter assembly (including field display) b) Sensors	10% subject to minimum 1 No. of each type. 20% subject to minimum 2 No. of each type
29.0	Smoke Detectors , MCP, Sounders, Hooters	10% or minimum one of each type of module.
30.0	Pressure Relief Valves/Thermal Relief Valves/ Vacuum Relief Valves / Low Pressure Relief Valves / Pilot Operated Valves	10% of minimum one of each type & size for nozzle, disc insert, guide whichever is higher
30.0a	Rupture Disc	2 spare disc for each Tag.
31.0	MOVs Main PCB of each type Local / Remote / off Selector Switch each type Open / close / stop Selector Switch each type	 1 Nos 1 Nos 1 Nos
31.0	**Installation Material**	
31.1	Instrument valves and	10% subject to minimum 1 no. of each type.
31.1.1	Valve manifolds	10% subject to minimum 3 no. of each type.
31.2	Tube fittings	10% subject to minimum 10 no. of each type.
31.3	Tubes	10% of the total length of each type
31.4	Cables	10% of the total length of each type
31.5	Junction boxes and cable glands	10% subject to minimum 1 no. of each type

NOTES:-

1. The above spares do not include installed spares / commissioning spares. The above shall be 2 years spares.

2. Set means complete replacement of particular part in one machine/equipment/Reformer/Fired heater etc.
3. Item wise price against each item shall be furnished.
4. Wherever "Each Type" is specified, it means "of the Type/make/model/size/rating and exactly replaceable"
5. Wherever "% qty." is specified, Contractor to quote in next higher rounded figure
6. Out of % age spares and minimum qty specified against each item - higher of the two shall be supplied.
7. Spares mentioned above to be offered as 2 years spares. However, if these spares are not used in the equipments being offered / supplied, the same need not be supplied. Bidder shall clearly indicate against each such spare that these spares / items are not used in their equipments.
8. The above is owner's recommended list of spares. The supplier may add other items as per their recommendations.
9. The quotation should contain sectional drawing showing location & part no. (For exact identification) & material specification.
10. If any item is not mentioned above but supplied by the bidder. Bidder to consider 10% or minimum ONE for such items.

3.0 VENDOR'S RECOMMENDED SPARE PARTS

Contractor shall submit list of recommended spare parts of specialised items not covered in mandatory spares, along with itemised price. Owner will review and decide the recommended spares required for the project.

NOTES:-

1. The above nos. of spares are minimum.
2. The word 'TYPE' means the Make, Model no., Type, Range, Size/ Length, Rating, Material as applicable.
3. Wherever % age is identified, Contractor shall supply next rounded figure.
4. The terminology used under 'Part Description' is the commonly used name of the part and may vary from manufacturer to manufacturer.
5. Mandatory spares shall be applicable for Electrical / Instrumentation items of sub packages also as per above mandatory spares philosophy.
6. Mandatory spares shall be procured along with the main equipment. These spares include only those spares, which are critical for equipment and require longer delivery periods.
7. The word 'Set' means the quantity required for full replacement of that part in one machine.
8. The Bidder shall quote for all the mandatory spares as defined above & as applicable to the proposed design of the equipment. In case, any spare which is listed above but not applicable

due to specific construction/design of the equipment, the same shall be highlighted as 'Not Applicable' against that spare supported with proper technical explanation.

9. Spare parts shall be identical in all respects to the parts fitted on the main equipment, including dimensions, material of construction, testing & heat treatment.

   Mandatory spares as specified elsewhere in the engineering specifications for other items are also to be provided by the contractor before Commissioning of the plant.

SECTION VI- 7.0

SITE WORKING AND SAFETY CONDITIONS

FOR

UREA HANDLING & BAGGING PACKAGE

[UREA (NEEM OIL COATED) HANDLING SYSTEM, BULK SILO AND BAGGING SYSTEM INCLUDING FILLED BAGS STACKING/ LOADING TO WAGON & TRUCK]

PLANT: **AMMONIA-UREA PLANT BASED ON COAL GASIFICATION**

PROJECT: **INTEGRATED COAL BASED FERTILISER COMPLEX AT TALCHER, ANGUL DISTRICT, ODISHA (INDIA)**

0	18.06.2021	Issued for enquiry	JKY	JKY	RRK
REV	**REV ATE**	**PURPOSE**	**PREPD**	**REVWD**	**APPD**

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1.0 SITE LOCATION

The proposed project will be located within the premises of existing closed coal based Ammonia- urea complex of TALCHER FERTILIZERS LIMITED, Talcher, ANGUL DISTRICT, ODISHA (INDIA).

2.0 SITE ESTABLISHMENT

2.1 The LSTK contractor shall provide all huts, stores, tarpaulins and other covers for the accommodation of his staff, workmen and materials. All materials likely to deteriorate in the open shall be stored under suitable cover.

2.2 The LSTK contractor shall advise the owner within 15 days of the placement of LOI his space requirement which shall include for office, covered storage, open storage, fabrication space, etc. Depending on availability & requirement, space shall be allotted to the contractor for the duration of this contract. He will not be permitted to make use of any other space without the sanction of the Owner. The use of this space shall strictly be made for the execution of this contract only. The sanitary conditions of the ground in or around such structures shall, at all times, be maintained by the contractor in a manner satisfactory to the owner.

2.3 The security of the LSTK contractor's equipment and materials is his own responsibility.

2.4 The LSTK contractor's shall clear away periodically any rubbish, scrap materials, etc. and dump the same in the area indicated by the owner/consultant. All construction material shall be neatly stacked in an orderly manner as directed by the owner and care shall be taken to allow proper access to workmen and easy movement of men, vehicles, cranes and materials.

2.5 The LSTK contractor shall maintain all the drawings carefully mounted on the board of appropriate size and well protected from the ravages of weather termites and other insects.

2.6 The LSTK contractor shall not permit the entry to the site of any person not directly connected/concerned with the work without first having obtained the written permission of owner.

2.7 The LSTK contractor shall submit a list of plant, equipments, tools, tackles, etc. which he will use, to perform the work. The contractor shall submit a list in duplicate of all materials, tools and tackles etc. brought inside the plant site duly signed by owner's security staff as per the rules laid by owner. These tools, etc. shall not be removed from the site till the completion of job. A gate pass must be obtained from the owner in order to remove from site any plant, machinery, tools, materials and equipment.

2.8 All items such as instructions and other pertinent data regarding erection/commissioning and maintenance should be typed and classified for transmittal in a manner approved by the owner.

2.9 All employees of the LSTK contractor shall conform to any rules of conduct, etc. established by owner. Failure to comply with the rules of coduct will be sufficient cause for removal of such person from the site.

2.10 The LSTK contractor will be responsible for providing all plant, tools and tackles, consumables and scaffolding required for the execution of his work as per the best engineering practices.

2.11 The receipt, unloading, movement and storage at site of all the LSTK contractor plant, tools and materials is his responsibility. The receipt, movement & storage of material issued by owner also shall be the responsibility of the Construction Contractor.

2.12 **ELECTRICITY**

Construction power shall be arranged by LSTK contractor as per NIT, elsewhere mentioned.

2.13 **CONSTRUCTION WATER**

The LSTK contractor shall communicate his water requirements to the Owner within 7 days of the placement of LOI. Construction water shall be arranged by LSTK contractor as per NIT, elsewhere mentioned.

2.14 **FIRST AID**

The LSTK contractor may have access to the Owner's qualified first aid personnel and ambulance, in case of accidents, if available. The contractor will, however provide a first aid post for minor injuries to their staff.

3.0 SUPERVISION OF WORK

3.1 The LSTK contractor shall submit to the Owner resume of his site supervisors for approval prior to commencement of the work. Once approved, the LSTK contractor shall not remove his site supervisors without prior concurrence of the Owner.

3.2 The entire work is to be completed as per the agreed time schedule. The programme of work in details shall be submitted by the LSTK contractor before commencement of work. The detailed programmes prepared by the LSTK contractor shall conform to the targets set forth in the time schedule and will be subject to the approval of the owner. All the work shall be carried out in such a manner that the work of other agencies at site is not hampered due to any action of the LSTK contractor.

4.0 INSPECTION

The work of the LSTK contractor shall be subject to inspection by the Owner at all times.

5.0 EMPLOYMENT OF LABOUR

5.1 The LSTK contractor will be expected to employ on the work only his regular skilled employees with experience of this particular work. The permission of the Owner must be obtained before tradesman is recruited locally for the work. This rule does not apply to unskilled labour. No female labour shall be employed in dark hours/ i.e. hours prohibited under the applicable law. No person below the age of eighteen years shall be employed at any point of time.

5.2 All traveling expenses including provision of all necessary transport to and from site, lodging allowances and other payments to the LSTK contractor employees are his own responsibility.

5.3 The hours of work on LSTK Contractors / Owner and contractor shall adhere to the same.

5.4 All Construction contractors employees shall wear safety helmet and such identification marks as may be provided by LSTK contractor on work site and duly approved by Owner.

5.5 All notices displayed on the site and any instructions issued by the Owner shall be strictly adhered to by the LSTK Contractors and/or his LSTK contractor employees.

5.6 It shall be the responsibility of LSTK contractor to provide suitable accommodation including necessary facilities for their labour and staff.

5.7 LSTK contractor will arrange for Ration Cards and Permits for labour as per statutory provisions for its labour, as necessary.

5.8 The LSTK contractor shall be required to maintain employment records as covered in relevant Acts and produce documentary evidence to the effect that he has discharged his obligations under the Employees Provident Fund Act 1952 for the workmen working at site.

5.9 In case the Owner becomes liable to pay any wages or dues to the labour of the LSTK Contractors or his contractor or any Govt. agency under any of the provision of the Minimum Wages Act, Workmen Compensation Act or any other law due to act of omission of the contractor, the Owner may make such payment and shall recover the sum from Contractor's bills or any other dues.

6.0 COMPLETION OF WORK

Before finally leaving site, the entire LSTK contractor store, huts, plant, tools and rubbish shall be removed and the site left clean and tidy. The space allocated by Owner shall be vacated and handed over to the Owner.

7.0 WORKING AND SAFETY REGULATIONS

7.1 The LSTK Contractor shall observe all statutory safety and legal requirements regulations issued by Central and State Governments applicable to the work as well as any local regulations applicable to the site issue by the consultant or any other authority.

7.2 Particular attention is drawn to the following:

a) In case of accident, the Owner shall be informed in writing forthwith. The LSTK Contractor shall strictly follow regulations laid down by Factory Inspector, Govt. and State authorities in this regard.
b) LSTK contractor shall fence his plant, platforms, excavations etc.
c) Compliance with all electricity regulations.
d) Compliance with statutory requirements for inspection and test of all lifting appliances and auxiliary lifting gear.
e) Safety belts proposed to be used, shall be got checked by Fire & Safety Department of LSTK Contractor / OWNER in written before use.
f) Before using the lifting or pulling equipment, LSTK contractor shall carryout load test which shall be witnessed by LSTK Contractor / OWNER.

7.3 Staircase, doors or gangways shall not be obstructed in any way that will interfere with means of access of escape.

7.4 No excavations will be started without the permission of the LSTK Contractor / OWNER, who will inform the LSTK contractor of the position of any pipes or cables known to be buried in the area. All excavations must be effectively railed off at all times, or completely boarded over properly marked during the hours of darkness by red warning lamps, using Flame proof warning lamps in non smoking areas. Debris or material which cannot be immediately removed must be heaped in such a way as to be immediately remove and also to leave adequate passage way. Any finds such as relics or antiques coins or fossils etc. shall be promptly handed over to the Owner.

7.5 The LSTK contractor will notify the Owner of his intention to bring on the site any equipment, such as, space heating or welding apparatus or any container holding liquid or gaseous fuel or other substance which might create a hazard. The Owner will have a right to prohibit the use of such equipment or to prescribe the conditions under which such equipment may be used. The LSTK Contractor will have the right to inspect any construction plant, and to forbid its use if in his opinion it is un-suitable or unsafe. No claim arising there from shall be made by the LSTK Contractor.

The LSTK contractor or any one acting on his instructions will not bring on to the site any radio active substance or any apparatus using such substances or any X ray apparatus until written permission and direction regarding the use of such equipment has been received from the Owner.

The LSTK contractor shall be responsible for the safe storage of the radio graphic sources or those of his Construction contractors.

7.6 The LSTK contractor will meet all requirements, and act on the instructions of the Owner where it is necessary to operate a permit to work system.

7.7 Where it is necessary to provide and/or store petroleum products or petroleum mixtures and explosive, the LSTK contractor shall be responsible for carrying out such provision and/or storage in accordance with the rules and regulation laid down in Petroleum Act 1934, Explosive Act 1948 and Petroleum and Carbide of Calcium Manual Published by the Chief Inspector of Explosive of India. All such storage shall have prior approvals of the Consultant. In case any approval or clearance from Explosive or any statutory authorities is required, the contractor shall be responsible for obtaining the same.

7.8 The LSTK contractor shall have his own Fire Fighting Extinguishers and Equipment.

7.9 The LSTK contractor shall be responsible for the provision of all safety notices safety equipments including the safety gadgets for his workmen required by both the relevant legislation and such as the Owner may deem necessary.

7.10 While working at heights, safety belts shall necessarily be used.

7.11 "LSTK contractor shall employ a safety officer for safe executing the construction activities of the project who will be responsible for implementing safety requirement contained in the documents.
The safety officer shall possess a recognised degree in engineering discipline preferably, F&S or (Any branch of engineering) and had a post qualification construction experience of minimum two years.
In addition, he/she shall also possess a recognised degree or diploma in industrial safety and preferably have adequate knowledge of the language spoken by majority of the workers at the construction sites.
Contractor shall ensure physical presence of safety personnel at each work location wherever Hot Work permit is required. No work shall be started at site until above safety personnel are physically present at site. The contractor shall submit a safety organogram clearly indicating the lines of responsibility and reporting system and elaborate the responsibilities of safety personnel in the HSE MAUAL/Program. The contractor should furnish Bio-Data/Resume of the safety personnel as above, at least 01 month before the mobilization for PDIL/owner's approval.

7.12 LSTK contractor shall use only steel planks and clamps executing scaffolding. Wooden planks and rope shall not be allowed for this purpose.

7.13 LSTK contractor shall use asbestos cloth to ensure falling of weld spatters down below during above ground welding to ensure safety of electrical cables and personnel and avoiding any fire hazards.

8.0 ELECTRICAL SAFETY REGULATIONS

8.1 In no circumstances will the LSTK contractor interfere with fuse and electrical equipment belonging to the owner or other contractors.

8.2 Before the LSTK contractor connects any electrical appliances to any plug or socket belonging to the other contractor or owner, he will -

i. Satisfy the Owner that the appliance is in good working condition.

ii. Uses of matching sixes plug & does not uses bare wire to insert in socket.

iii. Inform the Owner of the maximum current rating, voltage and phase of appliance.

iv. Obtain permission of the Owner dealing the sockets to which the appliance may be connected.

v. Use distribution board with ELCB for feeding power to hand held tools.

8.3 The Owner will not grant permission to plug in until he is satisfied that-

i. The appliance is in good condition and is fitted with a suitable plug.

ii. The appliance is fitted with a suitable cable having two earth conductors, one of which shall be earthed metal sheath surrounding the cores.

8.4 No electric cable in use by the other LSTK contractor/owner will be distributed without prior permission. No weight of any description be imposed on any such cable and no ladder or similar equipment will rest against or be attached to it. Cables / Wires used shall be in good condition without cuts & in insulation & joints.

8.5 The voltage for all portable equipment e.g. drilling machines, temporary lighting etc. will not exceed 240 volts.

8.6 No work must be carried out on any live equipment. The equipment must be made safe and a “permit to work” issued before any work is carried out.

8.7 LSTK contractor shall employ electrician to maintain his temporary electrical installation.

8.8 Take necessary clearance for working in hazardous area.

9.0 REPORTING

a) The LSTK contractor must report the following information to the Owner in writing daily. Number of men employed, trades-wise,

- Progress achieved;
- Concrete pour card, if any.

b) If during excavation any materials such as but not limited to precious materials or treasure troves etc are found, the same shall be reported to owner immediately and shall be the property of owner.

10.0 GENERAL SAFETY REQUIREMENTS TO BE OBSERVED DURING SITE FABRICATION AND ERECTION BY THE CONSTRUCTION CONTRACTOR

1. Before starting the work, **LSTK contractor** should get safety work permit and should strictly follow instructions written by the concerned authority in work permit. Permit is required for all types of job i.e. Hot, Cold Excavation, Chipping, Grinding etc.

2. Smoking is strictly prohibited inside factory areas.

3. Safety appraisal and equipments shall be provided to workmen as per the nature of work. Welders shall use gloves, goggles, shields etc. during welding, gas cutting etc. All technicians shall use gloves, goggles during grinding, chipping etc. If any unsafe practice is observed Fire & Safety Sections or the authority issuing the work permit is authorized to stop the work without any prior notice.

4. Temporary fire extinguishers, water hose shall be available near work place and in case of fire, Owner's Fire & Safety Section should be immediately informed by LSTK contractor from nearest available telephone. Project Manager should also be immediately informed.

5. LSTK contractor shall secure necessary insurance of his workmen for the entire duration of works under the contract. Owner is not responsible for any accident/injury caused whatsoever, to any person employed by the Construction Contractor. However, LSTK contractor has to inform Owner's Fire & Safety Section about accident, if any, immediately.

6. Temporary switch boards, cables, wires and electrical equipments should be installed in accordance with standard electrical practice with proper earthing etc. and should have prior approval of LSTK Contractor / Owner electrical engineer. Switch board shall be suitably protected against rainwater. The cable used for welding machine should have flexible tough rubber sheathing.

7. Temporary cables and wires including welding cables should be routed as not to cluster the work areas. Also any possibility of damage to live wires by falling objects should be avoided. Temporary electrical lines for power & lighting shall run overhead or underground so that they should not hinder the movement of men, materials and vehicles.

8. Portable hand lamps being used by construction crew shall be preferably of 24 Volts supply bulb to be protected with safety shields.

9. Earthing for welding shall not be taken through existing structure or equipments due to the very explosive nature of the plant, raw materials, reaction during process and final product. There is every possibility of fire and explosion in the equipment due to electric spark caused by loose earthing connection etc.

10. LSTK contractor should be careful while excavating so that no underground cable or pipe line is damaged. As soon as any brick cover or under ground cables are exposed he should stop the work and inform Construction Manager immediately for necessary action.

11. LSTK contractor should not leave any welding machine etc. running after the work is stopped. Before leaving the work place, Contractor should ensure that welding sets are disconnected from welding socket outlet.

12. All work areas shall be kept reasonably clear and clean for easy movement of men & material. Also all approach roads shall be free from obstacles for easy movement of cranes, vehicles, fork-lifts, trollies etc. and all debris shall be periodically removed.

13. All temporary structure and supports for erection purpose such as scaffolding, ladders, walkways, platform, shuttering etc. shall be sufficiently strong for safe use and to prevent collapse & accidental fall of workman. Same shall be removed immediately after the work is completed.

14. All workmen working at unsafe elevation during the construction activity such as concreting, plastering, welding, erection work, painting, insulation etc.

shall be safe and sufficient passage and should be properly instructed to take necessary safety precautions and observe safe practice to prevent accidental fall. Safety belts and helmets shall be used wherever necessary.

15. All supervisors, welders, electricians, technicians, riggers, engaged in the work shall be adequately skilled, experienced and acquainted with standard rules, regulation & practices of the work.

16. All open trenches, pits and other excavation carried shall be barricaded out by Construction Contractor, to avoid accident.

17. All lifting tools, tackles & accessories shall be in good working condition and of suitable capacity for the purpose for which they are used. All certificates/permits/licenses etc. required under any law or regulation for the same shall be available and valid during the entire period of the execution of the work under this WO/Contract.

18. LSTK contractor shall not use any structure or equipments erected or under erection for fastening, lifting or flying tackle guy-ropes etc. which may impose such loads for which structure or equipments are not designed to carry. However, LSTK contractor has to get prior approval from Construction Manager of Owner before using beams, permanent structure for the above purpose.

19. When work is carried out at high elevations, it is the responsibility of the LSTK contractor to ensure that tools and materials are not left in a position where they can fall on peoples moving /working below. Where necessary, places below should be cordoned off and caution boards be provided by contractor. Also, LSTK contractor should not cut existing hand railing/structure.

20. Contractor's men must not tamper with any machines, switches, valve or equipment not connected with their work. Welding holders should not be tested on running pipe lines.

21. Nylon rope should not be used for scaffolding where hot line is running near by, because there is every possibility of wire rope catching the fire. Also, no scaffolding is to be made on hot as well as insulated lines.

22. Necessary sign boards clearly indicating "RADIOGRAPHY HAZARDS" on all the four sides of the cordoned area surrounding radiography source will have to be displayed by Construction Contractor. Surrounding area will be cordoned with the help of manila rope and his personnel will be kept for watching/guard on all the four sides to prevent entry of personnel till the radiography work is completed. Construction Contractor's personnel should be able to communicate clearly/properly to stop entry of unauthorized personnel within the area cordoned for the radiography work.

Refuse Disposal

23. Refuse must be removed daily to prevent accumulation. Materials liable to cause persons to slip or trip and fall should be cleared immediately.

24. Refuse removal teams working after work hour should be organized where normal cleaning can not cope with the build up of waste materials.

25. Projecting nails should be removed or bent over.

Personal Protective Equipments

26. Helmets should be provided for all who are exposed to the dangers of falling material or structures they might strike against.

27. Suitable eye protection should be provided for all who are exposed to flying particles, harmful glare and dangerous substances.

28. In the handling of rough objects, gloves should be provided and used.

29. Safety footwear should be provided to all who are exposed to foot injury, should be good fitting and comfortable to wear.

30. Safety belts should be provided where other means are not practicable. Both the anchorage points and lifelines provided for attaching safety belts should be of adequate strength. The umbilical line should be fixed in such a way that user's freefall will not exceed 1 metre.

31. Catch net should be used where persons are liable to fall and these should be securely supported at a level as near as possible to the working level.

32. Noise defenders should be provided for work area where the noise level exceeds 85 dBA.

33. Respiratory protection should be provided by employers and used by workers where the dust level remains high and where control at source is not practicable.

Inspection & Record Keeping

34. Where defects render the scaffolds unsafe, they should be rectified immediately. Where this is not practicable, a sign should be put warning against using it.

Winches

35. Adequate foundations should be provided for winches.

Lifting Gear

36. All lifting gear and slinging should be tested before use and thereafter inspected regularly by competent engineers. Workers should also check the lifting gear visually before using them.

37. Each piece of lifting gear should bear its safe working load, its identification number and its last inspection date. It could in addition be colour coded according to due date of inspection.

38. Wire ropes should be preserved against rusting, kinking, fraying, birdcaging and heat damage. Defective wires should be destroyed to prevent recycling.

Concrete Mixers

39. Moving parts which are liable to become nip points, such as gears, chains and rollers should be guarded.

40. Where concrete mixers are driven by internal combustion engineers, exhaust points should be located away from the workers' work station so as to eliminate their exposure to obnoxious fumes.

Electrical Components

41. All components and conductors used must be in good condition.

42. Proper junction boxes and distribution boards from which electric power could be tapped should be provided at every floor level.

Demolition: General Provisions

43. Uncontrolled collapse of walls or other structures under demolition should be prevented.

44. The throwing of materials over the sides of the buildings should not be permitted.

Waste Handling

45. Where demolition is carried out near public areas:

a) Hoardings slopping inwards should be erected around the building.
b) Protective nettings should be hung around the building to prevent materials falling outside the periphery shelter
c) asbestos

Where asbestos materials are present, appropriate dust control and respiratory protection approved by the local authority must be used.

Excavation: General Provisions

46. Test for toxic gases should be carried out where their presence is suspected.

47. Exposure of shorings to vibration such as that produced by engines or vehicular traffic should be kept to a minimum.

General – Ventilation, Fire Protection/Fighting

48. Where flammable gas concentration could reach explosive levels, it may be necessary to provide intrinsically safe electrical equipments.

49. Adequate lighting and emergency lighting should be provided.

50. Adequate evacuation stairways should be provided for rapid evacuation in case of an emergency.

First Aid

51. Sufficient First Aid Boxes containing simple dressings and supplies should be provided on the site under the control of the foreman.

Awareness

52. The contractor shall brief the visitor about HSE precautions which are required to be taken before proceeding to site and make necessary arrangement to issue appropriate PPE's like HELMET, Safety shoes etc. to the visitors.
The contractor shall promote and develop consciousness about Health, safety and environment among all personnel working for the contractor. Regular awareness programmes and fabrication shop/work site meeting at least on fortnightly basis shall be arranged on HSE activities to cover hazards involved in various operations during construction phase. During the awareness program, step shall be taken by the contractor to motivate & encourage the workmen and supervisory staff by issuing/awarding them the tokens/gifts/mementos/ Monitory incentives.
A verbal warning shall be given to the workers during the first HSE violations. A written warning shall be issued on second violations and thereafter for the third volitions; the services of worker shall be terminated. For all these violations, a penalties' shall be imposed, separately on the contractor. Records of warning for each worker shall be kept in the records**.**

53. Penalty

The Contractor shall adhere consistently to all provisions of HSE requirements. In case of noncompliance's and also for repeated failure in implementation of any of the HSE provisions,

Consultant/Owner may impose stoppage of work without any cost & time implication to the Owner and/or impose a suitable penalty.

The amount of penalty shall be limited to 0.5 % (Zero decimal five percent) of the contract value for LSTK contract.

The amount of penalty applicable for the Contractor on different types of HSE violations is as below.

1. For not using personal protective equipment (Helmet, Shoes, Goggles, Gloves, Full body harness, Face shield, Boiler suit, etc.)
Rs 500/- per day/ Item / Person.

2. Working without Work Permit/Clearance Rs 20000/- per occasion.

3 Execution of work without deployment of requisite field engineer / supervisor at work spot Rs. 5000/- per violation per day.

4. Unsafe electrical practices (not installing ELCB,using poor joints of cables, using naked wire without top plug into socket, laying wire/cables on the roads, electrical jobs by incompetent person, etc.)
Rs 10000/- per item per day.

5. Working at height without full body harness, using non-standard/ rejected scaffolding and not arranging fall protection arrangement as required, like handrails, life-lines, Safety Nets etc.
Rs. 10000/- per case per day.

6. Unsafe handling of compressed gas cylinders (No trolley, jubilee clips double gauge regulator, and not keeping cylinders vertical during storage/handling, not using safety cap of cylinder).
Rs 500/- per item per day.

7. Use of domestic LPG for cutting purpose / not using flash back arresters on both the hoses/tubes on both ends.
Rs. 3000/- per occasion.

8. No fencing/barricading of excavated areas /trenches.
Rs. 3000/- per occasion.

9. Not providing shoring/strutting/proper slope and not keeping the excavated earth at least 1.5M away from excavated area.
Rs.5, 000/- per occasion.

10. Non display of scaffold tags, caution boards, list of hospitals, emergency services available at work locations.
Rs.1000/- per occasion per day

11. Traffic rules violations like over speeding of vehicles, rash driving, talking on mobile phones during vehicle driving, wrong parking, not using seat

belts, vehicles not fitted with reverse horn / warning alarms / flicker lamps during foggy weather.

Rs. 2000/- per occasion per day

12. Absence of Contractor's RCM/SIC or his nominated representative (prior approval must be taken for each meeting for nomination) from site

HSE meetings whenever called by Consultant/Owner & failure to nominate his immediate deputy (in the site organ gram) for such HSE meetings.

Rs10000/- per meeting.

13. Failure to maintain HSE records by Contractor

Safety personnel, in line with approved HSE Plan/Procedures/Contract specifications.

Rs 10000/- per month.

14. Failure to conduct daily site safety inspection (by Contractor's safety engineers/safety officers), internal HSE meeting, internal HSE Awareness/Motivation Program, Site HSE Training and HSE audit at predefined frequencies (as approved in HSE Plan).

Rs.10000/- per occasion.

15. Failure to submit the monthly HSE report by 5th of subsequent month to Project's Engineer-in-Charge /Owner

Rs. 10000/- per occasion and Rs.1000/- per day of further delay.

16. Poor House Keeping Rs. 5000/- per occasion per subject

17. Failure to report & follow up accident (including Near Miss) reporting system within specific timeframe.

Rs. 20000/- per occasion

18. Degradation of environment (not confining toxic spills, spilling oil/lubricants onto ground).

Rs10000/- per occasion

19. Not medically examining the workers before allowing them to work at height / to work in confined space / to work in shot-blasting / to work for painting / to work in bitumen or asphalt works, not providing ear muffs while allowing them to work in noise polluted areas, made them to work in air polluted areas without respiratory protective devices,etc.

Rs 5000/- per occasion per worker

20. Violation of any other safety condition as per job HSE plan / work permit and HSE conditions of contract (e.g. using crowbar on cable trenches,

improper welding booth, not keeping fire extinguisher ready at hot work site, unsafe rigging practices, non-availability of First-Aid box at site, not using hood with respiratory devices by blaster for shot//grit blasting, etc.)

Rs. 5000/- per occasion

21. Failure to carry-out Safety audit in time (internal & external), close-out of identified shortfalls of Observations of Safety Aspects(OSA),etc

Rs. 20,000/- per occasion

22. Carrying out sand blasting instead of grit/shot blasting

Rs. 50,000/- per day

23. Failure to deploy adequately qualified and competent Safety Officer

Rs. 10000/- per day per Officer

24. Utilization of hydra/ back-hoe loader for material shifting or any other unauthorized /unsafe lifting works

Rs 25,000/- per occasion

25. Any violation not covered above to be decided by Consultant/Owner.

26. Any physical injury - maximum of Rs.2,00,000 per injury

27. Fatal accident - Rs. 25,00,000 per fatality

Note:- This penalty shall be in addition to all other penalties specified elsewhere in the contract. The decision of imposing stop-work instruction and imposition of work penalty shall rest with PDIL/Owner. The same shall be binding by the contractor. Imposition of penalty does not make the contractor eligible to continue the work in unsafe manner.

SECTION VI- 8.0

PERFORMANCE AND GUARANTEE

UREA HANDLING & BAGGING PACKAGE

[UREA (NEEM OIL COATED) HANDLING SYSTEM, BULK SILO AND BAGGING SYSTEM INCLUDING FILLED BAGS STACKING/ LOADING TO WAGON & TRUCK]

PLANT: AMMONIA-UREA PLANT BASED ON COAL GASIFICATION

PROJECT: INTEGRATED ROM BASED FERTILISER COMPLEX AT TALCHER, ANGUL DISTRICT, ODISHA (INDIA)

1.0 PERFORMANCE GUARANTEE:

i. Contractor/bidder shall be fully responsible for design and manufacturing work as well as the smooth functioning of the equipment covered under the mentioned specification as a minimum.

ii. The system shall be performance tested at site after commissioning. The guaranteed parameters shall be checked during the performance test. The performance testing procedures shall be mutually decided after finalization of order.

iii. Necessary Instruments for performance testing shall be arranged by the contractor/bidder and calibrated before undertaking the performance test.

iv. All the equipments shall be designed for minimum life of 25 years.
The complete Urea Handling & bagging package shall be guaranteed for satisfactory operation while handling the specified capacity continuously for 24 hours per day, 7 days per week and 330 days per year to ensure trouble free performance

v. All equipment and component parts shall be guaranteed by the contractor/bidder against faulty design, effective material or poor workmanship for a period stipulated in the bid package.

vi. If any equipment or component(s) fail to perform the stipulated duty or malfunction, contractor shall rectify, modify, replace or make good the defective equipment/component(s) free of cost on notification by the purchaser within a reasonable time period mutually agreed upon.
In case, the contractor/bidder fails to achieve the specified performance even after the modifications within one month time of the trial runs, the Owner reserves the right to make alternative arrangements for modification/rectifications at contractor/bidder's cost & risk without any prejudice to any terms of the contract.

vii. All the equipments of the complete Urea Handling & Bagging package including bagging system should be able to achieve 100% of the specified design capacities at a particular period and normally. However, a margin of 5% should be kept over the specified design capacity while designing the equipment, for occasional over-loading.
Contractor shall guarantee the capacity of the following equipment as enlisted:

a) All Belt conveyors
b) Scraper system
c) Vibrating Screen & Delumper
d) All Bagging machines
e) Bucket Elevator
f) All Wagon loading machines
g) All Truck loading machines

h) Empty Bag Handling System with Electric hoist
i) All Dust Extraction System
j) Neem oil separation system, etc.

viii. For other equipment, performance as per data sheet/ specifications shall be demonstrated.

ix. Contractor shall demonstrate re-starting of conveyors under loaded belt conditions for load not exceeding the rated load.

x. Capacity shall be determined based on the electronic weigh scale readings duly calibrated prior to the PG test and no. of bags loaded/hr through counter installed on wagon loader/ truck loading machine. Measuring tolerance shall be as per the accuracy limit of the instrument.

xi. Duration of the test (PGTR) shall be a continuous period of 6 hours/day for 4 consecutive days. During the PG test, system shall be operated at rated capacity. Acceptance of the system shall be based on its capability to handle urea prills (Neem Oil coated) and filled bag of 45 kg at its rated capacity for duration of 6 hours (continuous) without any spillage or undue vibration & noise.

xii. If the system fails to achieve PG parameters, Contractor/bidder shall carry out necessary modification at his own cost till the rated/design capacity is achieved within a reasonable period not exceeding six (6) months from the date of failure of PG test and a second PG test shall be organized or as per Special Condition of Contract (SCC)

xiii. Contractor shall have to additionally demonstrate sustained urea (Neem Oil coated) conveying at design capacity (i.e 120% of the rated capacity) on spec for prilled urea (Neem Oil coated) and filled bag of 45 kg without any bottle neck for a period of 24 hours. The demonstration run will be executed along with the performance guarantee test run.

xiv. Utility (Power) Consumption:

Power consumption shall be considered for calculation of guaranteed work cost. Contractor/Bidder to quote accordingly in the Price Bid. For equipments to be considered for guaranteed power consumptions refer to Clause No. 8 (xvii) of Material Handling Design Specification (Section VI-3.1.1)

xv. Noise Pollution

The equipment shall be guaranteed against excessive noise pollution. Noise should not exceed 85 dBA measured at a distance of 1.0 meters from the noise emitting source.

xvi. Accuracy

Accuracy of all equipments & items shall be guaranteed as mentioned.

xvii. Training

Bidder / Contractor shall provide training to five (5) persons for seven (7) days for smooth operation of plant. Owner's manpower shall be able to develop a thorough understanding of the plants and the know-how and processes behind it, be in a position to take positive and corrective action to prevent any upset and breakdown conditions from occurring, and to optimize plants' operations, maintenance and organization.

xviii) Bidder /Contractor shall provide two (2) months supervision assistance (minimum 2 persons) to this package for smooth and trouble free operation.

SECTION VI- 9.0

INFORMATION REQUIRED IN TECHNICAL BID

UREA HANDLING & BAGGING PACKAGE

[UREA (NEEM OIL COATED) HANDLING SYSTEM, BULK SILO AND BAGGING SYSTEM INCLUDING FILLED BAGS STACKING/ LOADING TO WAGON & TRUCK]

PLANT: AMMONIA-UREA PLANT BASED ON COAL GASIFICATION

PROJECT: INTEGRATED ROM BASED FERTILISER COMPLEX AT TALCHER, ANGUL DISTRICT, ODISHA (INDIA)

CONTENTS

INFORMATION REQUIRED IN THE TECHNICAL PROPOSAL:

The Technical proposal of the bid shall include, but not necessarily be limited to the following:

1.0 **Design Basis:**

Design basis for all Process, Mechanical, Electrical, Instrumentation items shall be submitted by the Contractor/bidder.

2.0 **Flow diagram** indicating the major equipment in proper Flow sequence, Critical Instrumentation, Control points and the material of construction adopted.

3.0 **Design calculations**

Design calculations for capacity of bunker/hopper, Dust extraction system etc.

4.0 **Piping & Instrument Diagram (P & ID)** applicable for this package.

5.0 **Details of Equipment and Machinery** (Mechanical, Electrical, Instrumentation included in the proposal). Data sheets of equipment indicating design code used and sufficient specification such as those used in enquiry documents giving details like, size, overall dimensions, thickness, weight, material of construction, lining/cladding (if any), details of internals and packing materials, distributors, design conditions and corrosion allowances used etc.

6.0 **Design Philosophy for the Electrical System,** List of Electrical Drives with normal & design ratings, a Single Line Electrical Distribution Diagram showing Loads at various voltage levels, Protection/ metering and interlocking scheme, Hazardous area classification drawing for the plant and list of vendors. Specification of all electrical equipments.

7.0 **Normal & Emergency Power Requirement** and the list of equipments connected to it.

8.0 **Plant Layout for Battery Limit plant** showing principal equipment and machinery including detailed floor plans and elevations. The plot plan should show clearances required, roads and all principal racks.

9.0 **Details of Instrumentation System** including the proposed models etc. as also details of the proposed control systems (DCS) Safety Interlock and Trip system shall be enclosed. Instrumentation Control Philosophy, Logic Diagrams & Safety valve Specifications shall also be enclosed.

10.0 **Detailed Technical Specifications** of piping & valves with approximate tonnage/quantities in the form of Bill of Material.

11.0 **Comprehensive Engineering Specification/Standards and Design Codes** for all types of Equipments/items including Mechanical, Electrical, Instrumentation, Structural proposed to be adopted by the Contractor.

12.0 **Details of Shop & Field Testing and Inspection Procedures** proposed to be adopted. Inspection of equipment & machinery should be carried out by a Third Party Inspector. Owner also has the right to inspect any equipment, machinery at any stage.

13.0 **An Implementation Plan showing man-power deployment schedule** during various stages of implementation period, including peak requirements. Contractor/bidder shall indicate the schedule, category and number of personnel proposed for supervisory services during different phases of work, indicating clearly as to how many of them would be deployed by Contractor. Contractor shall also indicate the correspondence and documentation system to be followed.

14.0 **Project Plan** showing Project Organisation, Project team, Project services offered by the Contractor/bidder at home office and at site. Contractor/bidder would also indicate the activities proposed to be carried out.

15.0 **Time Schedule Network.** A time schedule for the complete project in the form of a Bar Chart and Network indicating the time allocated for various activities. Master time schedule/ network (PERT Network/ Bar chart) showing all activities shall be submitted by the Contractor/bidder.

16.0 **List of Vendor's not covered under ITB Vendor List.**

Bidder shall furnish list of vendors with proven track record for approval for the items not covered under ITB which shall be discussed & finalised with selected contractor/bidder.

17.0 **Quality Assurance & Quality Control procedure** to be followed by Contractor/bidder for the implementation of this project.

18.0 **List of Spare part**. Complete list of itemised commissioning, mandatory & recommended spare (spare parts not covered under mandatory spares list) parts for 2 years operations for all Process, Mechanical, Electrical, and Instrument items considered for this project.

SECTION VI- 10.0

VENDOR LIST

UREA HANDLING & BAGGING PACKAGE

[UREA (NEEM OIL COATED) HANDLING SYSTEM, BULK SILO AND BAGGING SYSTEM INCLUDING FILLED BAGS STACKING/ LOADING TO WAGON & TRUCK]

PLANT: AMMONIA-UREA PLANT BASED ON COAL GASIFICATION

PROJECT: INTEGRATED ROM BASED FERTILISER COMPLEX AT TALCHER, ANGUL DISTRICT, ODISHA (INDIA)

SUB-VENDOR LIST:

Contractor/Bidder shall select sub vendors from the vendor list as specified below. However, if, bidder is the manufacturer of any item, it shall be acceptable subject to furnishing of proven track record/credential by bidder for similar or comparable plant design capacity and approval of owner/consultant during detail engineering stage. Bidder shall ensure that sub vendor for the specified item has supplied item for the specified service & the supplied item is in satisfactory service since last 3 years as on date of offer.

Any equipment/item for which vendor list is not enclosed; Contractor/Bidder shall furnish a list of proposed vendors along-with their references for supply for the specified services of similar type of equipment. However, all proposed additional sub-vendors shall have proven track record/credential and shall be subjected to owner's / consultant approval during detail engineering.

A. MATERIAL HANDLING

SL. No.	Vendor's Name	Country
Conveyor Belting		
1.	MRF Ltd.	India
2.	Phoenix conveyor belt limited	India
3.	Oriental Rubber Industries Ltd.	India
4.	Universal Conveyor belting ltd.	India
5.	Anil Rubber pvt. Ltd.	India
Gear Reducer & Gear Boxes		
1.	Radicon	India
2.	New Allenbury Works.	India
3.	FMG	India
4.	Elecon Engg. co. Ltd.	India
5.	Shanti	India
6.	Premium	India
Couplings		
1.	Fenner India ltd.	India
2.	New Allenbury Works	India
3.	Elecon Engg. co. Ltd.	India
4.	Hi-Cliff	India
5.	David Brown	India
6.	FMG	India
Bearings		
1.	SKF India Ltd.	India
2.	FAG Bearing India Ltd.	India

SL. No.	Vendor's Name	Country
Skirt Board Sealing System		
1.	TEGA India Ltd.	India
2.	Kaveri ultra-polymers Ltd.	India
External Belt Cleaner		
1.	Hosch equipment India Ltd.	India
2.	Kaveri ultra-polymers Ltd.	India
Continuous Belt weigher		
1.	Encardio-rite Electronics pvt. Ltd.	France
2.	Transweigh (India) ltd.	India
3.	Weitex India limited	India
4.	Preciamolen	India
5.	Schenck Process	India
Bucket Elevator		
1.	Elecon Engg Co.	India
2.	Bengal Tools ltd.	India
3.	Indiana Conveyors pvt. Ltd.	India
4.	Mcnally Bharat Engg. Co.	India
5.	Rexnord	USA / India
6.	J & H Equipment	USA
7.	TRF Ltd.	India
8.	Rud Chain Pvt. Ltd.	India
9.	Aumund	Germany
Weighing-Cum-Tipping / Bagging Machine		
1.	Chronos Richardson (I) Pvt ltd	India
2.	Newlong Machine Co.	Japan
3.	Concetti	Italy
4.	Statec Binder	Austria
Bag Stitching Machine		
1.	Gabbar Engg Co.	India
2.	Newlong Machine Co.	Japan/India
3.	Union Special	Germany
4.	Fischben Packaging (Singapore) PTE Ltd.	Singapore
5.	Reed Medway Packaging Co. Ltd.	India
Wagon & Truck Loader		
1.	Elecon Engg. Co. Ltd	India
2.	Beumer India Private Limited	India
3.	Mollers Gmbh	Germany
4.	Boubiela Moret	France
Vibrating Screen and Delumper/Crusher		
1.	Elecon Engg. Co. Ltd	India
2.	Mcnally Bharat Engg. Co.	India
3.	TRF Ltd.	India

SL. No.	Vendor's Name	Country
4.	International Combustion India Ltd.	India
5.	J&H Equipment	USA
6.	Rhewum	Germany
Electric Hoists		
1.	Elecon Engg. Co. Ltd	India
2.	Greaves Ltd.	India
3.	W.H. Brady & Co. Ltd	India
4.	Hercules Hoists Ltd.	India
Chain Pulley Block		
1.	Hercules Hoists Ltd.	India
2.	W.H. Brady & Co. Ltd	India
3.	Mangla Hoist & Hydraulics Ltd.	India
4.	Tractel Tirfor India Pvt. Ltd.	India
Magnetic/Metal Separator		
1.	Magnet India	India
2.	Electro zaved	India
3.	Krupp	India
Weigh Bridge		
1.	Avery India Ltd.	India
2.	Mettler Tolledo India pvt. Ltd.	India
3.	Ashbee Systems Pvt. Ltd.	India
4.	Hyderabad Tulamen Ltd.	India
5.	Schenck Process	India

B. ROTATING EQUIPMENT

Pumps for Chemicals/ Acid/ Alkali/ BFW/ Condensate Use		
1.	A.R WILFLEY INDIA PVT. LTD	INDIA
2.	AKAY INDUSTRIES PVT. LTD	INDIA
3.	BEACON WEIR LTD	INDIA
4.	ITT CORPORATION INDIA PVT. LTD.	INDIA
5.	KIRLOSKAR BROTHERS LTD.	INDIA
6.	KIRLOSKAR EBARA PUMPS LTD	INDIA
7.	KISHORE PUMPS PVT. LTD	INDIA
8.	KSB PUMPS LTD	INDIA
9.	MICROFINISH PUMPS PVT. LTD	INDIA
10.	SAM TURBO INDUSTRY PRIVATE LTD. (CHEMICAL PUMPS CAPACITY- 900 M3/HR. HEAD- 60 M)	INDIA
11.	SULZER PUMPS INDIA LTD. (SINGLE STAGE ONLY)	INDIA
12.	PUMPEN FABRIK ERNST VOGEL	AUSTRIA
13.	ENSIVAL S.A	BELGIUM
14.	GE POWER (NUOVO PIGNONE SPA)	ITALY

15.	WEIR GABBIONETA SRL(FORMERLY POMPE GABBIONETA SPA)	ITALY
16.	ARAI PUMP MFG. CO. LTD	JAPAN
17.	SANWA HYDROTECH CORPORATION	JAPAN
18.	GOULD PUMPS INC.	SINGAPORE
19.	FLOWSERVE (IDP)	U.K
20.	LABOUR PUMP CO. LTD	U.K
COOLING WATER PUMPS (HORIZONTAL)		
1.	A.R WILFLEY INDIA PVT. LTD	INDIA
2.	BEACON WEIR LTD	INDIA
3.	FLOWMORE LTD (FORMALLY FLOWMORE PVT. LTD.)	INDIA
4.	JYOTI LIMITED	INDIA
5.	KIRLOSKAR BROTHERS LTD.	INDIA
6.	MATHER & PLATT (INDIA) LTD. (A SUBSIDIARY OF WILO SE GERMAN)	INDIA
7.	SAM TURBO INDUSTRY PRIVATE LTD. (CHEMICAL PUMPS CAPACITY- 440 M3/HR. HEAD- 44 M)	INDIA
8.	VOLTAS LTD. (PUMPS & PROJECTS BUSINESS DIVISION)	INDIA
9.	KSB AG	GERMANY
10.	MITSUBISHI HEAVY INDUSTRIES LTD	JAPAN
11.	SHIN NIPPON MACHINERY CO. LTD	JAPAN
12.	TORISHIMA PUMP MFG. CO. LTD	JAPAN
13.	FLOWSERVE (IDP)	U.K
PUMPS FOR SLURRY SERVICE		
1.	A.R WILFLEY INDIA PVT. LTD	INDIA
2.	AKAY INDUSTRIES PVT. LTD	INDIA
3.	BEACON WEIR LTD	INDIA
4.	BEST & CROMPTON ENGG. CO.	INDIA
5.	FLOWMORE LTD. (FORMALLY FLOWMORE PVT. LTD.)	INDIA
6.	GREAVES LTD.	INDIA
7.	KISHORE PUMPS PVT LTD	INDIA
8.	KSB PUMPS LTD	INDIA
9.	MICROFINISH PUMPS PVT. LTD	INDIA
10.	SAM TURBO INDUSTRY PRIVATE LTD.	INDIA
11.	SU MOTORS PVT. LTD	INDIA
12.	SULZER PUMPS INDIA LTD.	INDIA
PUMPS FOR UTILITY SERVICES		
1.	AKAY INDUSTRIES PVT. LIMITED	INDIA
2.	BEACON WEIR LTD	INDIA
3.	BEST & CROMPTON ENGG. CO.	INDIA
4.	FLOWMORE LTD. (FORMALLY FLOWMORE PVT. LTD.)	INDIA
5.	FLOWSERVE INDIA CONTROL LTD.	INDIA
6.	KIRLOSKAR BROTHERS LIMITED	INDIA
7.	KIRLOSKAR EBARA PUMPS LIMITED	INDIA
8..	KISHORE PUMPS LTD	INDIA
9.	MICROFINISH PUMPS PVT. LTD	INDIA
10.	SU MOTORS PVT. LTD	INDIA
11.	SULZER PUMPS INDIA LTD.	INDIA
CENTRIFUGAL MONOBLOCK PUMP SET		

1.	CROMPTON GREAVES LTD	INDIA
2.	JYOTI LIMITED	INDIA
3.	KIRLOSKAR BROTHERS LTD.	INDIA
4.	MATHER & PLATT (INDIA) LTD.(A SUBSIDIARY OF WILO SE GERMAN)	INDIA
5.	PRECISION ENGINEERING INDUSTRIES (SMALL PUMPS UPTO 2 HP)	INDIA
6.	UJALA	INDIA
SUMP PUMPS		
1.	AKAY INDUSTRIES PVT. LTD	INDIA
2.	BEACON WEIR LTD	INDIA
3.	KISHORE PUMPS PVT. LTD	INDIA
4.	SAM TURBO INDUSTRY PRIVATE LTD. (CAPACITY – 550M3/HR. HEAD- 35M)	INDIA

PUMPS FOR CHEMICAL DOSING/ METERING		
1.	BRAN & LUEBBE INDIA	INDIA
2.	MATZ PUMPS PRIVATE LIMITED	INDIA
3.	MILTON ROY INDIA (P) LTD	INDIA
4.	POSITIVE METERING PUMPS (I) PVT. LTD.	INDIA
5.	SHAPO TOOLS	INDIA
6.	SWELORE ENGINEERING PVT. LTD	INDIA
7.	V.K PUMPS INDUSTRIES PVT. LTD	INDIA
8.	VARICON SYSTEMS (MOTOR DRIVEN/ PNEUMATIC)	INDIA
9.	DOSAPRO MILLTON ROY	FRANCE
10.	LEWA HERBERTOTT GMBH & CO	GERMANY
11.	PERONI POMPE SPA	ITALY
12.	NIGATA WORTHINGTON PUMPS	JAPAN
13.	NIKKISO CO. LTD.	JAPAN
14.	BRAN & LUEBBE LTD.	U.K
PUMPS FOR MISC. SERVICE		
1.	A.R WILFLEY INDIA PVT. LTD	INDIA
2.	KSB PUMPS LTD.	INDIA
3.	SULZER PUMPS INDIA LTD	INDIA
4.	V.K PUMPS INDUSTRIES PVT. LTD (FOR NON CRITICAL USE)	INDIA
5.	UT PUMPS & SYSTEM PVT. LTD (HP TRIPLEX PLUNGER PUMPS CAPACITY 215 LPH, PR. 250 BAR)	INDIA
6.	LEWA HERBERTOTT GMBH & CO	GERMANY
7.	URACA PUMPENFABRIK GMBH & CO	GERMANY
8.	DOSAPRO MILLTON ROY	ITALY
9.	PERONI POMPE SPA (CAPACITY = 95 M3/HR, PRE = 306 KG/CM2)	ITALY
10.	NIGATA WORTHINGTON PUMPS	JAPAN

11.	NIKKISO CO. LTD.	JAPAN
12.	BRAN & LUEBBE LTD.	U.K
ROTARY PUMPS AND SCREW PUMPS		
1.	AIRAUTO INDUSTRIES	INDIA
2.	DELTA CORPORATION	INDIA
3.	ROTO PUMPS LTD	INDIA
4.	UT PUMPS AND SYSTEMS LTD (SINGLE SCREW: CAP. 5M3/HR PR. 0.06 BAR, TWIN SCREW: CAP 25M3/HR PR. 25 BAR, TRIPLE SCREW: CAP 53.4 M3/HR PR. 10 BAR)	INDIA

COMPRESSOR FOR MP SERVICE (PROCESS AIR, REF, CO2,N2, NG)		
1.	BHEL	INDIA
2.	CAMERON COMPRESSION SYSTEM (API 617: 60000 CFM@ 80 BAR, API 672: 950000 CFM@ 80 BAR)	INDIA
3.	MANNESMAN DEMAG AG	GERMANY
4.	GHH BORSIG TURBOMASCHINEN GMBH	GERMANY
5.	SIEMENS AG PGI	GERMANY
6.	GE POWER (NUOVO PIGNONE SPA)	ITALY
7.	HITACHI LTD	JAPAN
8.	KOBE STEEL LTD	JAPAN
9.	MITSUBISHI HEAVY INDUSTRIES LTD.	JAPAN
10.	DRESSER-RAND CO.	SINGAPORE
RECIPROCATING COMPRESSOR		
1.	ATLAS COPCO (FOR AIR SERVICE ONLY)	INDIA
2.	DRESSER-RAND INDIA PVT LTD.	INDIA
3.	BURCKHARDT COMPRESSION (INDIA) PVT. LTD.	INDIA
4.	CAMERON COMPRESSION SYSTEM	INDIA
5.	INGERSOLL RAND INDIA LTD. (FOR AIR & N2)	INDIA
6.	KIRLOSKAR PNEUMATIC CO. LTD (FOR AIR SERVICE ONLY)	INDIA
7.	HOWDEN (FORMERLY BURTON CORBLIN)	FRANCE
8.	LINDE AG WERKSGRUPPE	GERMANY

9.	GE POWER (NUOVO PIGNONE SPA)	ITALY
10.	ISHIKAWAJIMA HARIMA HEAVY INDS CO. LTD (IHI)	JAPAN
11.	KOBE STEEL LTD.	JAPAN
12.	MITSUI ENGINEERING & SHIP BUILDING CO. LTD	JAPAN
13.	BURCKHARDT COMPRESSION AG	SWITZERLAND
14.	THOMASSEN TURBINE SYSTEMS B.V	NETHERLANDS
PASSIVATION AIR COMPRESSOR		
1.	BURCKHARDT COMPRESSION (INDIA) PVT. LTD. (CAPACITY UPTO 100 NM3/HR. PRESSURE UPTO 160 KG/CM2G)	INDIA
2.	HOWDEN (FORMERLY BURTON CORBLIN)	FRANCE
SCREW COMPRESSOR		

1.	ATLAS COPCO KOMPRESSORTEKNIK AIS	DENMARK
2.	MAN TURBOMASCHINEN AG GHH BORSIG	GERMANY
3.	KOBE STEEL LTD.	JAPAN
4.	SULZER TURBO LIMITED	SWITZERLAND
5.	HOWDEN SIROCCO LIMITED	U.K
STEAM TURBINE UPTO 3 MW		
1.	ASEA BROWN BOVERI LIMITED	INDIA
2.	BHEL	INDIA
3.	TRIVENI ENGG. WORKS LIMITED	INDIA
4.	KIRLOSKAR EBARA PUMPS LIMITED (UPTO 1562 KW API 611 & API 612) FOR YR SERIES TURBINE)	INDIA
5.	ABB TURBINEN NUMBERG GMBH	GERMANY
6.	ALSTOM POWER TURBINEN GMBH	GERMANY
7.	ALTHOM POWER	GERMANY
8.	GHH BORSIG TURBOMASCHINEN GMBH	GERMANY
9.	SIEMENS AKTIENGESELLSCHAFT	GERMANY
10.	TUTHILL NADROWSKI TURBINEN GMBH	GERMANY
11.	GE POWER (NUOVO PIGNONE SPA)	ITALY
12.	EBARA CORPORATION	JAPAN
13.	KAWASAKI HEAVY INDUSTRIES LTD.	JAPAN
14.	MITSUBISHI HEAVY INDUSTRIES LTD.	JAPAN
15.	MITSUI ENGINEERING & SHIP BUILDING CO. LTD	JAPAN
16.	SHIN NIPPON MACHINERY CO. LTD	JAPAN
17.	DRESSER RAND CO.	U.S.A
18.	ELLIOT OVERSEAS CORPORATION	U.S.A
19.	TRANSMERICA DELAVAL INC.	U.S.A
20.	TUTHILL ENERGY SYSTEMS	U.S.A
STEAM TURBINE ABOVE 3 MW		
1.	BHEL	INDIA
2.	ABB TURBINEN NUMBERG GMBH	GERMANY
3.	ALSTOM POWER TURBINEN GMBH	GERMANY
4.	GHH BORSIG TURBOMASCHINEN GMBH	GERMANY
5.	SIEMENS AKTIENGESELLSCHAFT	GERMANY
6.	GE POWER (NUOVO PIGNONE SPA)	ITALY
7.	EBARA CORPORATION	JAPAN
8.	FUJI ELECTRIC SYSTEMS CO. LTD	JAPAN
9.	KAWASAKI HEAVY INDUSTRIES LTD.	JAPAN
10.	MITSUBISHI HEAVY INDUSTRIES LTD.	JAPAN
11.	MITSUI ENGINEERING & SHIP BUILDING CO. LTD	JAPAN
12.	ASEA BROWN BOVERI	SWEDEN
13.	DRESSER RAND CO.	U.S.A
14.	ELLIOT OVERSEAS CORPORATION	U.S.A
15.	TRANSMERICA DELAVAL INC.	U.S.A

16.	TUTHILL ENERGY SYSTEMS	U.S.A
FANS & BLOWERS		
1.	ABB FLAKT INDIA LTD.	INDIA
2.	AEROTO BOLDROCCHI INDIA PVT. LTD. (ID& FD FANS / BLOWERS.CAPACITY 0.84 M3/S TO 423.9 M3/S, PR. 0.16 KPA TO 64.6 KPA, POWER 2 KW TO 2000 KW	INDIA
3	BHEL	INDIA
4..	TLT ENGINEERING INDIA PVT. LTD	INDIA
5.	ILLONOIS BLOWERS INC	U.S.A
COUPLINGS		
1.	ELECON ENGG. CO. LTD (FOR FLEXIBLE COUPLING)	INDIA
2.	FENNER INDIA LTD. (FOR FLEXIBLE COUPLING)	INDIA
3.	HI-CLIFF (FOR GEAR COUPLING)	INDIA
4.	RATHI TRANSPOWER PVT. LTD	INDIA
5.	RATHI TURBOFLEX PVT. LTD	INDIA

EOT CRANE		
1.	AVON CRANES	INDIA
2.	SAMCO ENGINEERING PVT. LTD (upto 30 tonnes capacity)	INDIA
3.	THE ACME MANUFACTURING CO.LTD.	INDIA
4.	WMI CRANES	INDIA
HOT CRANE		
1.	ANUPAM INDUSTRIES LIMITED.	INDIA
2.	CONSOLIDATED HOISTS PVT.LTD.	INDIA
3.	GRIP ENGINEERS PVT. LTD.	INDIA
4.	HERCULES HOISTS LTD.	INDIA
5.	LIFTING EQPT.& ACCESSORIES LTD.	INDIA
6.	MEEKA MACHINERY CO.	INDIA
7.	REVA ENGG. INDUSTRIES LIMITED	INDIA
8.	UNICON TECHNOLOGY INTERNATIONAL (P) LTD.	INDIA
9.	W.H.BRADY & CO LTD.	INDIA
ELECTRIC HOISTS		
1.	ELECON ENGG. CO. LTD.	INDIA
2.	GREAVES LTD.	INDIA
3.	HERCULES HOISTS LTD.	INDIA
4.	HOIST-O-MECH.LTD.	INDIA
5.	HOPES METAL INDUSTRIES(I) LTD.	INDIA
6.	SAMCO ENGINEERING PVT. LTD (upto 20 tonnes capacity)	INDIA
7.	SAYAJI IRON & ENGG.CO(P)LIMITED	INDIA
8.	VAUGHAN BURN CRANE CO.LIMITED	INDIA
9.	W.H. BRADY & CO. LIMITED	INDIA

GEAR REDUCER & GEAR BOXES		
1.	RADICON	INDIA
2.	NEW ALLENBURY WORKS.	INDIA
3.	FMG	INDIA
4.	ELECON ENGINEERING CO. LTD.	INDIA

AIR CONDITIONING SYSTEM		
1.	AIR CONDITIONING CORP. LTD	INDIA
2.	BLUE STAR LTD.	INDIA
3.	KIRLOSKAR ELECTRIC COMPANY LTD.	INDIA
4.	PATELS AIR TEMP INDIA LTD.	INDIA
5.	SUVIDHA ENGINEERS	INDIA
6.	VOLTAS LTD.	INDIA

C. STATIC EQUIPMENT

S.NO	ITEM DESCRIPTION	COUNTRY
VESSELS IN CS/AS/SS PRESSURE UPTO 10 Kg/cm2g		
1	AERO ENGINEERS	INDIA
2	AIRFRIGE INDUSTRIES	INDIA
3	ARTSON ENGINEERING LIMITED	INDIA
4	B H P V	INDIA
5	BHARAT HEAVY ELECTRICALS LTD.	INDIA
6	FABTECH PROJECTS & ENGINNERS LTD. (For CS Only)	INDIA
7	FLOWLINK INDUSTRIES PVT. LTD. (CS/SS Except Urea Service)	INDIA
8	FURNACE FABRICA (INDIA) LTD. (CS/SS)	INDIA
9	G R ENGINEERING PRIVATE LIMITED	INDIA
10	GANSONS LTD.	INDIA
11	GEMINI ENGI-FAB PVT. LTD. (Excluding AS Mati)	INDIA
12	GHANSHYAM STEEL WORKS LTD. (CS/SS)	INDIA
13	GMM PFAUDLER LIMITED	INDIA
14	GODREJ & BOYCE MFG. CO. LTD	INDIA

15	GRAND PRIX ENGINEERING PVT. LTD. (upto 4m D x 6m L x80mm Thk)	INDIA
16	GRASIM INDUSTRIES	INDIA
17	HEATEX INDIAN CORPORATION	INDIA
18	HINDUSTAN DORR-OLIVER LTD.	INDIA
19	ICEM ENGG. CO. LTD.	INDIA
20	INDIA TUBE MILLS & METAL INDUSTRIES LTD. (For CS/SS only)	INDIA
21	INDUS PROJECTS LTD (FORMERLY INDUS ENGG)	INDIA
22	ISHAN EQUIPMENTS PVT. LTD. (CS/SS only)	INDIA
23	KINETICS TECHNOLOGY INDIA LTD.	INDIA
24	LARSEN & TOUBRO LTD.	INDIA
25	LLOYDS STEEL INDUSTRIES LIMITD	INDIA
26	LOYAL EQUIPMENTS PVT. LTD. CS/SS and Non IBR only)	INDIA
27	MARS DESIGN PVT. LTD.	INDIA
28	MISTRY PRABHUDAS MANJI ENGG. PVT. LTD.	INDIA
29	MOD FABRICATORS	INDIA
30	MULTI-MAX ENGINEERING WORKS PVT. LTD. (CS and SS Material only)	INDIA
31	NAVA BHARAT FERRO ALLOYS LTD	INDIA
32	NEW FIELD INDUSTRIAL EQUIPMENT PVT. LTD. CS/SS Only)	INDIA
33	NIVITA ENGINEERING WORKS	INDIA
34	NOVATECH PROJECTS INDIA (P) LTD. (CS and SS material only)	INDIA
35	ORIENTAL MANUFACTURERS PRIVATE LIMITED (CS/SS only)	INDIA
36	PATELS AIRTEM (INDIA LIMITED	INDIA
37	PRECISION EQUIPMENTS (CHAANAI) PVT LTD	INDIA
38	PROJECT TECHNOLOGISTS PVT. LTD.	INDIA
39	R.D. ENGINEERS (INDIA) PVT. LTD.	INDIA

40	RAJ ENGG. CO.	INDIA
41	RELIANCE FABRICATIONS PVT. LTD.	INDIA
42	REYNOLDS CHEMEQUIP PRIVATE LIMITED (CS/SS)	INDIA
43	SHRENO LTD. (UNIT 2)	INDIA
44	TAS ENGINEERING CO. (P) LIMITED	INDIA
45	TATA CHEMICALS LTD	INDIA
46	THE ANUP ENGINEERING LIMITED	INDIA
47	ISGEC HEAVY ENGINEERING LIMITED	INDIA
48	TITANIUM EQUIPMENT AND ANODE MFG. CO. LTD.	INDIA
49	TRIVENI STRUCTURALS LTD.	INDIA
50	UNITOP ENGINEERS PVT. LTD. (Max. Shell Dia 4.65, Water vol. 140m3)	INDIA
51	HYOSUNG CORPORATION (CS/SS/LAS only)	KOREA
52	APPARATEBAU SCHWEISS TECHNIK GMBH	AUSTRIA
53	SCHOELLER-BLECKMANN NITEC GMBH	AUSTRIA
54	OLMI SPA	ITALY
55	JAPAN STEEL WORKS LTD	JAPAN
56	DOOSAN MECATEC CO. LTD.	KOREA
57	HANJUNG DCM CO. LTD.	KOREA
58	HUNDAI HEAVY INDUSTRIES	KOREA
59	KOREA HEAVY INDUSTRIES & CONSTN. CO. LTD	KOREA
60	CHEM PROCESS SYETEM PVT. LTD. (CS/SS ONLY)	INDIA
61	COPERION IDEAL PVT. LTD.	INDIA
62	ESSAR HEAHY ENGINEERING SERVICES	INDIA
63	PHILS HEAVY ENGINEERIG PVT. LTD.	INDIA
64	PRAJ INDUSTRIES LIMITED	INDIA
65	SPETECH PLANT EQUIPMENT PVT. LTD. (CS ONLY)	INDIA

66	TECHNO PROCESS EQUIPMENT (I) LTD. (CS/AS/SS(AS only for P3 Material))	INDIA
67	UNIVERSAL HEAT EXCHANGER LIMITED (CS/SS/LTCS only)	INDIA
68	VIJAY TANKS & VESSELS LIMITED (CS/LAS AND SS ONLY)	INDIA
69	VIJAY TANKS & VESSELS LIMITED (KANDLA) (CS/ SS ONLY)	INDIA
70	CRYOSTAR TANKS & VESSEL PVT. LTD.(CS ONLY)	INDIA
71	BTL EPC LIMITED (CS ONLY)	INDIA
72	THE KCP LIMITED	INDIA
73	SUNGJIN GEOTECH CO. LTD. (CS and SS only)	KOREA
VESSELS IN CS/AS/SS PRESSURE 11 TO 60 Kg/cm2g		
1	ALTECH INFRASTRUCTURE (INDIA) PVT. LTD. (Upto 20 Kg/cm2(g)CS Material)	INDIA
2	ARIEN NEW DELHI PRIVATE LIMITED (CS/SS UP TO 11 to 30 kg/cm2(g))	INDIA
3	B H P V	INDIA
4	BHARAT HEAVY ELECTRICALS LTD.	INDIA
5	EXPO GAS CONTAINERS LTD. (Upto 30 Kg/sq cm (g) CS/SS Material.)	INDIA
6	FABTECH PROJECTS & ENGINNERS LTD. (For CS Only)	INDIA
7	FURNACE FABRICA (INDIA) LTD. (CS/SS UP TO 11 to 30 kg/cm2(g))	INDIA
8	G R ENGINEERING PRIVATE LIMITED	INDIA
9	GANSONS LTD.	INDIA
10	GHANSHYAM STEEL WORKS LTD (CS/SS)	INDIA
11	GODREJ & BOYCE MFG. CO. LTD	INDIA
12	GRAND PRIX ENGINEERING PVT. LTD.	INDIA
13	GRASIM INDUSTRIES (upto 30Kg/cm2g)	INDIA
14	HEATEX INDIAN CORPORATION	INDIA
15	HINDUSTAN DORR-OLIVER LTD. (CS/SS Only)	INDIA
16	INDIA TUBE MILLS & METAL INDUSTRIES LTD. (For CS/SS only upto 30 Kg/cm2g)	INDIA
17	INDUS PROJECTS LTD (FORMERLY INDUS ENGG)	INDIA

18	ISHAN EQUIPMENTS PVT. LTD. (CS/SS Upto 30 Kg/Cm2(g) only)	INDIA
19	KAVERI ENGG. INDUSTRIES LTD.,	INDIA
20	LARSEN & TOUBRO LTD	INDIA
21	LLOYDS STEEL INDUSTRIES LIMITED	INDIA
22	LOYAL EQUIPMENTS PVT. LTD. (Upto 11-30 Kg/cm2, CS/SS and Non IBR only.)	INDIA
23	MULTI-MAX ENGINEERING WORKS PVT. LTD. (Up to 30 Kg/cm2g (CS and SS Materials only)	INDIA
24	NEW FIELD INDUSTRIAL EQUIPMENT PVT. LTD. (Upto 30 Kg/cm2g (CS/SS Only)	INDIA
25	ORIENTAL MANUFACTURERS PRIVATE LIMITED (CS/SS only)	INDIA
26	PATELS AIRTEMP (INDIA LIMITED (CS & SS only)	INDIA
27	PRECISION EQUIPMENTS (CHENNAI) PVT. LTD (upto 44 Kg/cm2g)	INDIA
28	RAJ ENGG. CO. (up to 30kg/cm 2 (g) CS/SS/AS (P3 & P4 only)	INDIA
29	THE ANUP ENGINEERING LIMITED	INDIA
30	BTL EPC LIMITED (up to 36 kg/cm2 (CS Only))	INDIA
31	THE INDIAN SUGAR & GENERAL ENGG. CORPN. (ISGEC), DAHEJ (Except Urea Plant Critical Equipment)	INDIA
32	THE INDIAN SUGAR & GENERAL ENGG. CORPN. (ISGEC), YAMUNA NGR	INDIA
33	HYOSUNG CORPORATION (CS/SS/LAS only)	KOREA
34	SCHOELLER-BLECKMANN NITEC GMBH	AUSTRIA
35	BORSING GmbH	GERMANY
36	BELLELI S.P.A	ITALY
37	FBM HUDSON ITALIANA S.p.A	ITALY
38	GE POWER (NUOVO PIGNONE SPA)	ITALY
39	ROLLE S.P.A. (11 TO 60 kg/cm2 pr.)	ITALY
40	WALTER TOSTO SpA	ITALY
41	HITACHI ZOSEN	JAPAN
42	KOBE STEEL LIMITED	JAPAN

43	MITSUBISHI HEAVY INDUSTRIES LTD.	JAPAN
44	MITSUI ENGINEERING & SHIPBUILDING CO. LTD	JAPAN
45	DOOSAN MECATEC CO. LTD.	KOREA
46	HANJUNG DCM CO. LTD.	KOREA
47	HANTECH LIMITED	KOREA
48	KOREA HEAVY INDUSTRIES & CONSTN. CO. LTD	KOREA
49	MECANICA DE LA PENA S.A.	SPAIN
50	BEAIRD INDUSTERIES LOUISIANA	U.S.A
51	CHEM PROCESS SYSTEM PVT. LTD. (CS/SS upto 30 kg/cm^2g only)	INDIA
52	CICB-CHEMICON PVT. LTD. (upto 30 kg/cm^2 only (CS only))	INDIA
53	ESSAR HEAVY ENGINEERING SERVICES	INDIA
54	FAB-TECH WORKS & CONSTRUCTIONS PRIVATE LIMITED (CS/SS/LTCS)	INDIA
55	GMM PFAULER LIMITED (CS/SS only)	INDIA
56	INDCON PROJECTS & EQUIPMENT LIMITED (for CS/LTCS/SS only upto 30 kg/cm^2g)	INDIA
57	MEENAKSHI ASSOCIATED (P) LTD. (CS/LTCS/SS upto 30 kg/cm^2g)	INDIA
58	NUBERG ENGINEERING LIMITED (CS/SS upto 30 kg/cm^2g)	INDIA
59	PHILS HEAVY ENGINEERING PVT. LTD. (upto 30 kg/cm^2g)	INDIA
60	R.D. ENGINEERS (INDIA) PVT. LTD. (upto 30 kg/cm^2g)	INDIA
61	RELIANCE FABRICATIONS PVT. LTD. (CS/SS upto 30 kg/cm^2g)	INDIA
62	SPETECH PLANT EQUIPMENT PVT. LTD. (CS upto 30 kg/cm^2g)	INDIA
63	TECHNO PROCESS EQUIPMENTS (I) LTD. (CS/AS/SS upto 30 kg/cm^2g (AS only for P3 Material))	INDIA
64	NEWTON ENGINEERING AND CHEMICAL LTD.(upto 36 kg/cm^2g)	INDIA
65	UNIQUE CHEMOPLANT EQUIPMENTS (CS/SS only upto 30 kg/cm^2g)	INDIA
66	UNIVERSAL HEAT EXCHANGERS LIMITED (CS/SS/LTCS upto 30 kg/cm^2g)	INDIA
67	VIJYA TANKS & VESSELS LIMITED (CS/SS and LAS Upto 37 kg/cm^2g only)	INDIA

68	VIJYA TANKS & VESSELS LIMITED (KANDLA)(CS/SS upto 30 kg/cm^2g only)	INDIA
69	AERO ENGINEERS (CS only)	INDIA
70	AVADH INDUSTRIES (Upto 34 kg/cm2g), CS only	INDIA
71	GEMINI ENGI-FAB PVT. LTD. (Upto 40 Kg/cm2g)	INDIA
72	JINDAL STEEL & POWER LTD. (MACHINERY DIVISION) (CS only)	INDIA
73	PRAJ INDUSTRIES LIMITED (CS/SS ONLY)	INDIA
74	TECHNOPROCESS EQUIPMENT INDIA PVT.LTD (NON IBR)	INDIA
75	THE KCP LIMITED	INDIA
76	ALPEC CO. LTD. (CS & AS only)	KOREA
77	SUNGJIN GEOTEC CO., LTD. (CS and SS only)	KOREA

SHOP FABRICATED TANKS & NONCODED VESSELS		
1.	ALTECH INFRASTRUCTURE (INDIA) PVT. LTD.	INDIA
2.	ARTSON ENGINEERING LIMITD	INDIA
3.	BAKSHI CHEMPHARMA EQUIPMENTS PVT. LTD.	INDIA
4.	ESSAR HEAVY ENGINEERING SERVICES	INDIA
5.	FLOWLINK INDUSTRIES PVT. LTD. (CS/SS only)	INDIA
6.	G R ENGINEERING PRIVATE LIMITED	INDIA
7.	GANSONS LTD.	INDIA
8.	GAYATRI TANKS & VESSELS	INDIA
9.	GEMINI ENGI-FAB PVT. LTD.	INDIA
10.	GENERAL MECH & PROCESS EQUIPT. (P) LTD.	INDIA
11.	GODREJ & BOYCE MFG. CO. LTD.	INDIA
12.	GRANDPRIX ENGINEERING PVT. LTD	INDIA
13.	INDIA TUBE MILLS & METAL INDUSTRIES LTD.	INDIA
14.	INDUS ENGG. COMPANY	INDIA
15.	ISHAN EQUIPMENTS PVT. LTD. (CS/SS only)	INDIA

16.	KINETICS TECHNOLOGY INDIA LTD.	INDIA
17.	LAXMI ENGINEERING INDUSTRIES (BHOPAL) PRIVATE LIMITD (CS/SS only)	INDIA
18.	LLOYDS STEEL INDUSTRIES LIMITED	INDIA
19.	MABEL ENGINEERS PVT. LTD.	INDIA
20.	MULTI-MAX ENGINEERING WORKS PVT. LTD.	INDIA
21.	NEWTON ENGG. & CHEMICALS LTD.	INDIA
22.	NIVITA ENGINEERING WORKS	INDIA
23.	NOVATECH PROJECT INDIA (P) LTD.	INDIA
24.	ORIENTAL MANUFACTURERS PRIVATE LIMITED (CS/SS only)	INDIA
25.	PRECISION EQUIPMENTS (CHENNAI) PVT. LTD.	INDIA
26.	PRECISION TANKS & VESSEL	INDIA
27.	PROJECT TECHNOLOGISTS PVT. LTD.	INDIA
28.	R.D. ENGINEERS (INDIA) PVT. LTD.	INDIA
29.	RAJ ENGG. CO.	INDIA
30.	RELIANCE FABRICATIONS PVT. LTD.	INDIA
31.	SHARP TANKS & STRUCTURALS PVT. LTD.	INDIA
32.	TAS ENGINEERING CO. (P) LIMITED	INDIA
33.	TATA CHEMICALS LTD.	INDIA
34.	UNITOP ENGINEERS PVT. LTD. (Max shell Dia 4.65m. Vol 140m3)	INDIA
35.	VIJAY TANKS & VESSELS LIMITED	INDIA
36.	VIP J INDUSTRIAL ENTERPRISES PVT. LTD.	INDIA
37.	RELIABLE FABRICATION & ENGINEERING INDUSTRIES	INDIA
38.	TITANIUM TANTALUM PRODUCTS LTD.	INDIA
39.	VIJAY TANKS & VESSELS LTD. (KANDLA)	INDIA
40.	OSWAL INFRASTRUCTURE LIMITED	INDIA
41.	BTL EPC LIMITED (CS Only)	INDIA
DEMISTERS		
1	EVERGREEN INDUSTRIES	INDIA
2	GRAND PRIX ENGINEERING PVT. LTD.	INDIA
3	HAVER STANDARD INDIA PVT. LTD. (Demister pads with grids)	INDIA

4	HEIN LEHMANN (I) LTD.	INDIA
5	MISTER – MESH WIRE PRODUCTS	INDIA
6	COSTACURTA VICO S.P.A	ITALY
7	GLITSH ITALIANA, SPA	ITALY
8	KNITMESH LTD.	U.K.
9	KEVIN ENTERPRISES PVT. LIMITED	INDIA
STORAGE TANKS (Site Fabricated)		
1.	ARTSON ENGINEERING LIMITD	INDIA
2.	BAKSHI CHEMPHARMA EQUIPMENTS PVT. LTD.	INDIA
3.	BRIDGE & ROOF CO.	INDIA
4.	EXPO GAS CONTAINERS LTD.	INDIA
5.	FACT EINGINEERING WORKS	INDIA
6.	GANSONS LTD.	INDIA
7.	GODREJ & BOYCE MFG. CO. LTD.	INDIA
8.	INDIA TUBE MILLS & METAL INDUSTRIES LTD.	INDIA
9.	INDUS PROJECTS LTD. (FORMERLY INDUS ENGG.)	INDIA
10.	LARSEN & TOUBRO LTD.	INDIA
11.	LLOYDS STEEL INDUSTRIES LIMITED	INDIA
12.	MABEL ENGINEERS PRIVATE LIMITED	INDIA
13.	MARS DESIGN PVT. LTD.	INDIA
14.	NEWTON ENGG. & CHEMICALS LTD.	INDIA
15.	NOVATECH PROJECTS INDIA (P) LTD.	INDIA
16.	PRECISION TANKS & VESSELS	INDIA
17.	PROJECT TECHNOLOGISTS PVT. LTD.	INDIA
18.	RAJ ENGG. CO.	INDIA
19.	SHARP TANKS & STRUCTURALS PVT. LTD.	INDIA
20.	SPS ENGINEERING LIMITED	INDIA
21.	TAS ENGINEERING CO. (P) LIMITED	INDIA
22.	TATA CHEMICALS LTD.	INDIA
23.	VIJAY TANKS & VESSELS LIMITED	INDIA
24.	FABTECH PROJECTS & ENGINEERS LTD. (For CS only)	INDIA
25.	TECHNO PROCESS EQUIPMENTS (INDIA) PVT. LTD.	INDIA
26.	FABTECH WORKS AND CONSTRUCTION PVT. LTD.	NDIA

Note: Bidder/Contractor shall evaluate and decide present financial, performance credential and Shop loading conditions of the vendors.

Any addition to vendor list shall be reviewed and approved by Owner subject to submission of back-up credentials with proven & reliable record of performance for similar or comparable plant design capacity by contractor.

D. PIPING

	CS WELDED PIPES TO API 5L SPIRAL LONG. WELDED	
1	HEAVY METAL PIPE CENTRE (UPTO 24" (UPTO SCHXXS)	INDIA
2	JINDAL PIPES LTD. (2" TO 14")	INDIA
3	JOTINDRA STEEL & TUBES LTD. (½" TO 14")	INDIA
4	KALPESH TUBE(INDIA), (TRADER)	INDIA
5	LALIT PIPES & PIPES LTD.. (16" to 64" thickness upto 20mm)	INDIA
6	MUKAT PIPES LTD.	INDIA
7	P.K.FORGE & FITTING INDUSTRIES	INDIA
8	PRATIBHA INDUSTRIES LTD. (16" to 24" thickness 6mm to 14.27mm)	INDIA
9	RATNAMANI METALS & TUBES LTD.	INDIA
10	SAGAR STEEL CORPORATION (TRADER)	INDIA
11	SAIL	INDIA
12	SURINDRA ENGINEERING CO. PVT. LTD.	INDIA
13	SURYA ROSHINI LTD (GR. A 3" TO 4", GR. B, 6" TO 14")	INDIA
14	THE BENGAL MILL STORES SUPPLY CO.(TRADER)	INDIA
15	WELSPUN GUJARAT STAHL ROHREN LIMITED (FOR ANJAR AND DAHEJ PLANTS) (UPTO 72" 50 MM THK FOR DAHEJ PLANT AND UPTO 100" 30 MM THK. FOR ANJAR PLANT.)	INDIA
16	PHOCEENNE	FRANCE
17	ETS TROUVAY & CAUVIN	FRANCE
18	MANNESMANN HANDEL AG	GERMANY
19	THYSSEN-KRUPP STAHLUNION GMBH	GERMANY
20	DALMINE SPA	ITALY
21	RACCORTUBI SRL	ITALY
22	KOSEI SANGYO LTD	JAPAN
23	MARUBENI ITOCHU STEEL	JAPAN
24	MITSUBISHI CORPORATION	JAPAN
25	NIPPON KOKAN	JAPAN
26	NIPPON STEEL CORPORATION	JAPAN
27	NISHITANI & CO. LTD.	JAPAN
28	NISSHO IWAI CORPORATION	JAPAN
29	OKURA & CO. LTD.	JAPAN
30	SOJITZ CORPORATION	JAPAN
31	SUMITOMO METAL INDUSTRIES LTD.	JAPAN

32	HYUNDAI CORPORATION	KOREA
33	BRITISH STEEL CORPORATION	U.K.
34	CORUS TUBES LIMITED	U.K.
35	SAW PIPES USA, INC	U.S.A
	CS/AS LTCS SEAMLESS PIPES	
1	BHEL	INDIA
2	CHETAN STEELS (Upto 12", SCH80)	INDIA
3	HEAVY METAL & TUBES (Upto 8", thickness upto 18.26mm)	INDIA
4	HEAVY METAL PIPE CENTRE (UPTO 24" (UPTO SCHXXS)	INDIA
5	INDIAN TUBE CO. (TATA DEV. OF TUBES & PIPES)	INDIA
6	ISMT LIMITED	INDIA
7	JINDAL SAW LTD.	INDIA
8	MAHARASHTRA SEAMLESS LTD.	INDIA
9	P.K.FORGE & FITTING INDUSTRIES	INDIA
10	RATNADEEP METAL & TUBES PVT. LTD.	INDIA
11	SAINEST TUBES PVT. LTD. (½ " NB TO 3" UPTO SCH. 160 (ASTM A 106 GR. B, A333 GR. 1 & 6 & A335 GR. P11))	INDIA
12	PHOCEENNE	FRANCE
13	ETS TROUVAY & CAUVIN	FRANCE
14	MANNESMANN HANDEL AG	GERMANY
15	HORST KURVERS GMBH	GERMANY
16	DALMINE SPA	ITALY
17	GAM RACCORDI S.P.A	ITALY
18	IBF SEAMLESS PIPES SPA	ITALY
19	RACCORTUBI SRL	ITALY
20	MARUBENI ITOCHU STEEL	JAPAN
21	MITSUBISHI CORPORATION	JAPAN
22	NIPPON STEEL CORPORATION	JAPAN
23	NISHITANI & CO. LTD.	JAPAN
24	NISSHO IWAI CORPORATION	JAPAN
25	OKURA & CO. LTD.	JAPAN
26	SOJITZ CORPORATION	JAPAN
27	SUMITOMO METAL INDUSTRIES LTD.	JAPAN
28	HYUNDAI CORPORATION	KOREA
29	AB SANDVIK STEEL	SWEDEN

30	VOMAL INTERNATIONAL LIMITED	U.K.
31	CORUS TUBES LIMITED	U.K.
32	BRITISH STEEL CORPORATION	U.K.
	SS SEAMLESS/ WELDED PIPES	
1	APEX TUBES	INDIA
2	BHANDARI FOILS & TUBES LIMITED (SEAMLESS UPTO 4" (SCH. 80) & WELDED UPTO 20" (THK. <= 8	INDIA
3	CHOKSI TUBE COMPANY LTD.	INDIA
4	CHETAN STEELS (UPTO 6” SCH. 40)	INDIA
5	HEAVY METAL & TUBES (UPTO 8" (THICKNESS UPTO 18.26 MM))	INDIA
6	HEAVY METAL PIPE CENTRE (UPTO 8" (UPTO SCH80S) (PDIL APPROVED MANUFACTURER'S MAKE ONLY))	INDIA
7	JINDAL SAW LTD.	INDIA
8	KRYSTAL STEEL MANUFACTURING PVT. LTD. (UPTO 2" (MATERIAL UPTO GRADE SS 321))	INDIA
9	MARDALE PIPES PLUS LTD.	INDIA
10	MODERN TUBE INDUSTRIES LTD. (Upto 2" (upto SS Grade 321))	INDIA
11	NUCLEAR FUEL COMPLEX	INDIA
12	P.K.FORGE & FITTING INDUSTRIES	INDIA
13	PRAKASH STEELAGE LTD. (Seamless: upto 12” & Welded: upto 24”)	INDIA
14	QUALITY STAINLESS PVT. LTD.	INDIA
15	RAJENDRA MECHANICAL INDUSTRIES LTD.	INDIA
16	RATNAMANI METALS & TUBES LTD.	INDIA
17	RATNADEEP METAL & TUBES PVT. LTD. (SMLS. 6” , WELDED 2”)	INDIA
18	SANDVIK ASIA PVT. LTD. (¾" TO 2" (THK: UPTO 8.74 MM))	INDIA
19	SANGHVI METALS (TRADER)	INDIA
20	SCORODITE STAINLESS (INDIA) PVT. LTD. (UPTO 2" (UPTO SS GRADE 321))	INDIA
21	SUBHLAXMI METALS & TUBES PVT. LTD. (Seamless: upto 2” & Welded: upto 8”)	INDIA
22	SURAJ STAINLESS LIMITED	INDIA
23	THE BENGAL MILL STORES SUPPLY CO.(TRADER)	INDIA
24	ZHEJIANG JIULI STAINLESS STEEL PIPE CO. LTD.	CHINA
25	ETS TROUVAY & CAUVIN	FRANCE
26	PHOCEENNE	FRANCE
27	H. BUTTING GMBH & CO. (SEAMLESS : UPTO 30" (UPTO 16MM THK)	GERMANY

	& WELDED: UPTO 72" (UPTO 64MM)	
28	HORST KURVERS GMBH	GERMANY
29	MANNESMANN HANDEL AG	GERMANY
30	THYSSEN-KRUPP STAHLUNION GMBH	GERMANY
31	DALMINE SPA	ITALY
32	GAM RACCORDI S.P.A	ITALY
33	IBF SEAMLESS PIPES SPA	ITALY
34	RACCORTUBI SRL	ITALY
35	MARUBENI ITOCHU STEEL	JAPAN
36	MITSUBISHI CORPORATION	JAPAN
37	NIPPON STEEL CORPORATION	JAPAN
38	NISHITANI & CO. LTD.	JAPAN
39	NISSHO IWAI CORPORATION	JAPAN
40	OKURA & CO. LTD.	JAPAN
41	SOJITZ CORPORATION	JAPAN
42	SUMITOMO METAL INDUSTRIES LTD.	JAPAN
43	AB SANDVIK STEEL	SWEDEN
44	T.T.I. – TUBACEX TUBOS INOXIDABLES, S.A.	SPAIN
45	SOSTA BV (UPTO 72" (THICKNESS UPTO 25.4 MM))	NETHERLAND
46	VOMAL INTERNATIONAL LIMITED	U.K.
47	CORUS TUBES LIMITED	U.K.
48	BRITISH STEEL CORPORATION	U.K.
49	HYUNDAI CORPORATION	KOREA
	SS SEAMLESS TUBES	
1	ANIL METAL CORPORATION	INDIA
2	APEX TUBES PVT. LIMITED (UPTO 50.8 MM OD (THICKNESS UPTO 4.00 MM))	INDIA
3	BHANDARI FOILS & TUBES LIMITED (UPTO 50MM OD)	INDIA
4	HEAVY METAL & TUBES (UPTO 8" (THICKNESS UPTO 18.26 MM))	INDIA
5	KRYSTAL STEEL MANUFACTURING PVT. LTD. (UPTO 50.8 MM OD (MATERIAL UPTO GRADE SS 321))	INDIA
6	MODERN TUBE INDUSTRIES LIMITED (UPTO 50.80 MM OD (UPTO SS GRADE 321))	INDIA
7	PRAKASH STEELAGE LTD. (Seamless: upto114 mm OD, Thickness upto 6 mm)	INDIA
8	RATNAMANI METALS & TUBES LTD.	INDIA
9	SANDVIK ASIA PVT. LTD. (OD UPTO 60.33 (THK: UPTO 8.74 MM))	INDIA

10	SCORODITE STAINLESS (INDIA) PVT.LTD. (UPTO 50.80 OD (UPTO SS GRADE 321))	INDIA
11	SURAJ STAINLESS LIMITED	INDIA
12	T.T.I.-TUBACEX TUBOS INOXIDABLES, S.A.(OD 15.8 MM TO 250.0 MM, WALL THK.1.0 MM)	SPAIN
	FITTINGS: CS/AS/SS SEAMLESS & FORGED	
1	AMFORGE INDUSTRIES	INDIA
2	ANIL METAL CORPORATION	INDIA
3	CHETAN STEELS (UPTO 6” SCH. 80)	INDIA
4	COMMERCIAL SUPPLYING AGENCY	INDIA
5	CSA FITTINGS (Forged ½” to 2”-upto 900#, Seamless: 2” to 8”- upto SCHXXS)	INDIA
6	EBY FASTENERS	INDIA
7	EBY INDUSTRIES	INDIA
8	FIT-TECH INDUSTRIES (Forged ½” to 1 1/2”-upto 900#, Seamless: 2” to 8”- upto SCHXXS)	INDIA
9	FLASH FORGE(P) LTD.(Forged upto 4”-upto 900#, Seamless/welded: up to 42”)	INDIA
10	GUJARAT INFRAPIPES PVT. LTD.	INDIA
11	KALPESH TUBE(INDIA),(TRADER) (UPTO A MAX ORDER VALUE RS.25.0 LAKH)	INDIA
12	M.S FITTINGS MANUFACTURING CO. PVT LTD.	INDIA
13	MARDALE PIPES PLUS LTD.	INDIA
14	NAVKAR FORGINGS & FITTINGS PVT. LTD	INDIA
15	NL HAZRA (upto SCH80)	INDIA
16	P.K TUBES & FITTINGS PVT. LTD.	INDIA
17	P.K FORGE & FITTING INDUSTRIES	INDIA
18	PARAS FITTINGS PVT. LTD. (Forged: CS ½” to 2” & CS Seamless: 2” to 8”- upto SCHXXS)	INDIA
19	PARMAR TECHNO FORGE (Elbow, Tee, Reducer- ½” to 12” & Cap upto 18”)	INDIA
20	PERFECT MARKETTING PVT. LTD.	INDIA
21	PETROCHEM INDUSTRIES (Seamless: Upto 16" (All Fittings) & upto 36" (caps) SCH : XXS /80S, Forged: upto 3”-6000#)	INDIA
22	RAJENDRA FORGE INDUSTRIES (CS: UPTO 12" SCH 40 & SS: 6" SCH 40S)	INDIA
23	S & G ENGINEERS (P) LTD.	INDIA
24	SAGAR STEEL CORPORATION (TRADER)	INDIA
25	SANGHVI METALS (TRADER)	INDIA

26	SAWAN ENGINEERS	INDIA
27	SHIVANANDA PIPE FITTINGS LTD.,	INDIA
28	STEWARTS AND LLOYDS OF INDIA LIMITED	INDIA
29	TEEKAY TUBES PRIVATE LIMITED	INDIA
30	THE BENGAL MILL STORES SUPPLY CO.(TRADER)	INDIA
31	TOPAZ PIPING INDUSTRIES	INDIA
32	TUBE BEND (CALCUTTA) PVT. LTD. (CS FITTINGS ONLY)	INDIA
33	TUBE PRODUCTS INCORPORATE	INDIA
34	ZOLOTO INDUSTRIES (upto 6” (only CS Galv.))	INDIA
35	PHOCEENNE	FRANCE
36	ETS TROUVAY & CAUVIN	FRANCE
37	VALLOUREC	FRANCE
38	SEIKMANN ANLAGEN-TECHNIK GMBH.	GERMANY
39	TPS-TECHNITUBE ROHRENWERKE GMBH	GERMANY
40	MANNESMANN HANDEL AG	GERMANY
41	HORST KURVERS GMBH	GERMANY
42	PETROL RACCORD S.P.A. (Seamless: 1” to 42” (Elbow) & 1” to 56” Tee/Reducer/Cap))	ITALY
43	DALMINE SPA	ITALY
44	GAM RACCORDI S.P.A	ITALY
45	IBF SEAMLESS PIPES SPA	ITALY
46	IND MECCANICA BASSI LUIGI & C. SPA	ITALY
47	MANTOVANI SPA	ITALY
48	RACCORTUBI SRL	ITALY
49	TECHNO FORGE SPA	ITALY
58	MARUBENI ITOCHU STEEL	JAPAN
51	NIPPON KOKAN	JAPAN
52	NISHITANI & CO. LTD.	JAPAN
53	NISSHO IWAI CORPORATION	JAPAN
54	OKURA & CO. LTD.	JAPAN
55	SOJITZ CORPORATION	JAPAN
56	SUMITOMO METAL INDUSTRIES LTD.	JAPAN
57	HAITIMA CORPORATION	TAIWAN
58	CORUS TUBES LIMITED	U.K.
59	BRITISH STEEL CORPORATION	U.K.
60	EUROTUBE LIMITED	U.K.
61	VOMAL INTERNATIONAL LIMITED	U.K.

62	BONNEY FORGE	U.S.A.
	FORGED FLANGES	
1	AJAY FORGING PVT. LTD	INDIA
2	AMFORGE INDUSTRIES	INDIA
3	ANANDMAYEE FORGINGS PVT. LTD.	INDIA
4	C D ENGINEERING	INDIA
5	CHAUDHARY HAMMER WORKS (P) LTD.	INDIA
6	CHETAN STEELS (UPTO 6", 150#)	INDIA
7	`ECHJAY INDUSTRIES LTD	INDIA
8	FERROUS ALLOYS FORGING PVT. LTD	INDIA
9	GOOD LUCK ENGINEERING CO. (½"-12" (UPTO 2500#), 14"-16" (UPTO 900#), 18"-32" (UPTO 600#), 34"-48" (UPTO 300#),	INDIA
10	J.K FORGINGS	INDIA
11	KUNJ FORGINGS PVT. LTD.(MATERIAL CS/SS/AS) (upto 60" (upto 300#) & upto 12" (upto 2500#))	INDIA
12	MAHESH INDUSTRIES (Upto 8" -150#, material ASTM A105 only)	INDIA
13	P.K TUBES & FITTINGS PVT. LTD. (Upto 24"(upto1500#) & Upto 12"(upto2500#) Spectacle Blind and Spacer & Blinds only)	INDIA
14	PARAMOUNT FORGE (CS,AS & SS : ½" TO 42" (UPTO 600#), ½" TO 24" (UPTO 900#, ½ " TO 16" (UPTO 1500#), ½" TO 12" (UPTO 2500#)).	INDIA
15	PERFECT MARKETING (P) LTD.	INDIA
16	PUNJAB STEEL	INDIA
17	R D FORGE (A UNIT OF R D CHEMICALS PVT LTD) (Upto 54" (150#), 42" (upto 600#), 20" (upto 1500#) & 12" (2500#))	INDIA
18	RAJENDRA FORGE INDUSTRIES (CS & SS : UPTO 12", 300#)	INDIA
19	S & G ENGINEERS (P) LTD.	INDIA
20	SANGHVI FORGINGS & ENGINEERING LTD	INDIA
21	SANGHVI METALS (TRADER)	INDIA
22	SAWAN ENGINEERS	INDIA
23	TECHNO FORGE LTD. (UPTO 42" (UPTO 300#), UPTO 24" (600#), UPTO 20" (900#), UPTO 16" (1500#),	INDIA
24	TUBE BEND (CALCUTTA) PVT LTD	INDIA
25	PHOCEENNE	FRANCE
26	ETS TROUVAY & CAUVIN	FRANCE
27	HORST KURVERS GMBH	GERMANY
28	I.S. INTERNATIONAL	ITALY
29	MANTOVANI SPA	ITALY
30	OFFICINE NICOLA GALPERTI & FIGLIO S.P.A	ITALY
31	RACCORTUBI SRL	ITALY

32	NICHINAN SANGYO CO. LTD.,	JAPAN
33	NISHITANI & CO. LTD.	JAPAN
34	SOJITZ CORPORATION	JAPAN
35	VOMAL INTERNATIONAL LIMITED	U.K.
	GATE/ GLOBE/ CHECK VALVES CS/SS/AS < 900 LBS	
1	AV VALVES LTD. (CAST UPTO 42" ,150#) 28" 300#, 24" (600#) & FORGE UPTO 2" (800#)	INDIA
2	ADVANCE VALVES (2"-80" (Upto 600#) Dual Plate Check Valves only)	INDIA
3	ASSOCIATED TOOLINGS (I) PVT. LTD.	INDIA
4	AUDCO INDIA LIMITED (L&T VALVES DIVN.)	INDIA
5	AUTOCAP INDUSTRIES (1/2" to 2" 800# (only CS & SS)	INDIA
6	BELL- O-SEAL VALVES LTD.(FOR ZERO LEAKAGE , HAZARDOUS FLUIDS.)	INDIA
7	BHEL (VALVES DIVISION)	INDIA
8	BRIGHTECH VALVES AND CONTROLS PVT. LTD. (Upto 8" x 300#)	INDIA
9	CHEMTECH INDUSTRIAL VALVES PVT. LTD.	INDIA
10	CRAWLEY & RAY (FOUNDERS & ENGINEERS) PVT. LTD. (<=300#, (only CS))	INDIA
11	DATRE CORPORATION LTD. (Upto 300#, 2" to 8" (Gate), 2" to 6" (Globe & Check Valves))	INDIA
12	DEWRANCE MACNEILL & CO. LTD.	INDIA
13	ECONO VALVES PVT. LTD.	INDIA
14	EXPERT ENGINEERING ENTERPRISES	INDIA
15	FLOCON SYSTEMS PVT. LTD. (CS upto 6" – 1500#)	INDIA
16	FLOVEL VALVES PVT. LTD.(SINGLE DISC , DULA PLATE & NOZZLE CHECK VALVES ONLY : UPTO 48" (150#) & 24 (UPTO 600#)	INDIA
17	FLUIDTECH EQUIPMENT PVT. LTD. (CAST # CS & SS 2" TO 12" 150# & 2 " TO 8" 300 # AND FORGED (CS AND SS) ½" TO 2" (800#)	INDIA
18	FORWARD ALLOYS & CASTINGS (UPTO 14")	INDIA
19	GURU INDUSTRIAL VALVES PVT. LTD. (Cast CS only: upto 24"(150#), 20"(300#), 10" (600#) & Forged : upto 2" (800#)	INDIA
20	HAWA ENGINEERS LTD. (Gate Valves: upto 40"(150#), upto 26" (300#), upto 24" (600#), upto 2" (800#); Globe Valves: upto 20"(150#), upto 16" (300#), upto 12" (600#), upto 2" (800#), Check Valves: upto 36"(150#), upto 24" (300#), upto 16" (600#), upto 2" (800#) (Dual Plate: 36" (150#)	INDIA
21	HAWA VALVES INDIA PVT. LTD. (CS upto 6", 150#)	INDIA
22	HI-TECH VALVES PVT. LTD. (CS,<=800 #, SIZE ½-2, <=300# FOR	INDIA

	SIZE 2-6")	
23	INTERVALVE INDIA LTD. (CAST UPTO 24" (UPTO 300#) & UPTO 12" 600# , FORGED UPTO 2" (800#))	INDIA
24	JC VALVES & CONTROLS INDIA PVT. LTD. (CAST UPTO 48" (150#) & 24" (UPTO 600#) & FORGED UPTO 2" (800#))	INDIA
25	KIRLOSKAR BROTHERS LTD.(CS UPTO 12" , 300#)	INDIA
26	KSB PUMPS LIMITED (VALVES DIVN)	INDIA
27	LARSEN & TOUBRO LIMITED (1/2" TO 24")	INDIA
28	LEADER VALVES LTD. (Casting<=20"-600#, 300-150#, Forging<=2"-800#)	INDIA
29	M.H. VALVES PVT. LTD. (1/2" to 1 1/2"-800#, 2" to 6"-600#)	INDIA
30	MICON ENGINEERS (HUBLI) [PVT. LTD.(Cast: Upto 12" (150# & 300#), 6" (600#) & Forged: upto 2" (800#))	INDIA
31	MICROFINISH VALVES LTD.	INDIA
32	NSSL LTD. (UPTO 80" (150#), 56" UPTO 600# & FORGED UPTO 2" (800 #))	INDIA
33	NITON VALVES INDUSTRIES PVT. LTD.	INDIA
34	OSWAL IND. LTD. (UPTO 48" (150#), 32" (300#) & 24" (600#)	INDIA
35	S & M INDUSTRIAL VALVES LTD. (CS Gate & Globe Valves 2" – 24" <=300#)	INDIA
36	SHALIMAR VALVES PVT. LTD. (Cast Upto 24" (Upto 600#), Forged: ½" to 1 ½" (800#))	INDIA
37	SHREERAJ INDUSTRIES (CS upto 150#)	INDIA
38	STEEL STRONGVALVES (I) PVT. LTD. (Upto 42")	INDIA
39	VENUS PUMP & ENGINEERING WORKS.	INDIA
40	VIBA FLUID CONTROL	INDIA
41	WEIR BDK VALVES (A UNIT OF WEIR INDIA PVT. LTD.) (Cast UPTO 36" (150#); 24" (300#); 12" (600#) & Forged: Upto 2" (800#))	INDIA
42	ZED VALVES CO. PVT. LTD. (Upto 14" (600#))	INDIA
43	ZOLOTO INDUSTRIES. (40 MM TO 200 MM(ONLY CS & SS))	INDIA
44	VELAN INC. (UPTO 48" , 600#)	CANADA
45	BOTELI VALVE GROUP CO. LTD.(Cast Upto 56" (150#), 36" (300#), 24" (600#) & Forged: Upto2" (800#))	CHINA
46	ZHEJIANG JIEHUA VALVE CO. LTD.	CHINA
47	PEMTO VALVE	GERMANY
48	CESARE BONETTI SPA (Cast Upto 42" (Upto 300#), 24" (600#) Forged: ½" to 1 ½" (800#))	ITALY
49	FASANI S.P.A.	ITALY
50	FRIULCO SPA (UPTO 48" (150#), 32" (Upto 600#)	ITALY
51	GTC ITALIA, S.R.L.	ITALY

52	MANTOVANI SpA	ITALY
53	OMB S.P.A.	ITALY
54	PETROL VALVES S.R.L.	ITALY
55	MATSURA H. P MACHINE WORKS CO.LTD.	JAPAN
56	NISHITANI & CO. LTD.	JAPAN
57	SOJITZ CORPORATION	JAPAN
58	REDPOINT ALLOYS BV	NETHERLAND
59	WALTHAN & WEIR	SPAIN
60	POYAM VALVES (AMPO S.CCP.) (Size upto 60” (Rating upto 800#)	SPAIN
61	BABCOCK BORSIG ESPANA , S.A	SPAIN
62	SUFA LIMITED	U.A.E.
63	BEL VALVES	U.K.
	GATE/ GLOBE/ CHECK VALVES CS/SS/AS > =900 LBS	
1	A V VALVES LIMITED (Cast Upto 24” (900# & 1500#), 8” (2500#) Forged: Upto 2” (2500#))	INDIA
2	ADVANCE VALVES (2”-36” (900#) 2”-24” (1500#), 2”-12(2500#) Forged: Upto 2” (2500#)) FOR DUAL PLATE CHECK VALVES)	INDIA
3	ASSOCIATED TOOLINGS (I) PVT. LTD. (½” TO 2” (900# & 1500#))	INDIA
4	AUDCO INDIA LIMITED (L&T VALVES DIVN.)	INDIA
5	BHEL (VALVES DIVISION)	INDIA
6	FLOVEL VALVES PVT. LTD. (Dual Plate Check Valves: Upto 24” (900#)	INDIA
	HAWA ENGINEERS LTD. (Gate Valves: upto 20”(900#), upto 10” (1500# & 2500#); Globe Valves: upto 8”(900# & 1500#), upto 1” (2500#); Check Valves: upto 10”(900#), upto 6” (1500#), upto 1” (2500#)	INDIA
7	HAWA VALVES INDIA PVT. LTD. (Forged upto 2”, 1500#)	INDIA
8	INTERVALVES INDIA LTD.(Forged: Upto 2” (1500#))	INDIA
9	JC VALVES & CONTROLS INDIA PVT. LTD. (CAST UPTO 12” (1500#),10” (2500#) & FORGED UPTO 2” (2500#))	INDIA
10	KSB PUMPS LIMITED (VALVES DIVN)	INDIA
11	LARSEN & TOUBRO LIMITED (1/2" TO 2")	INDIA
12	LEADER VALVES LIMITED (1500# & 2500# UPTO 12", FORGING UPTO 2" 2500#)	INDIA
13	METROPOLITAN INDUSTRIES (SIZE=200mm, rating=2500 lb)	INDIA
14	MICON ENGINEERS (HUBLI) PVT. LTD. (FORGED: UPTO 2" (1500#))	INDIA
15	NSSL LIMITED. (CAST: Upto 36"(900#), 24” (upto 2500#) & FORGED: Upto 2” (Upto 2500#))	INDIA
16	OSWAL INDUSTRIES LTD. (Upto 12” (900# & 1500#))	INDIA

17	SHALIMAR VALVES PVT.LTD.(CAST: UPTO 20"(900#), FORGED: ½" TO 1 ½" (1500#))	INDIA
18	WEIR BDK VALVES (A UNIT OF WEIR INDIA PVT. LTD.) (Cast UPTO 12" (upto 2500#) & Forged: Upto 2" (1500#), 1" (2500#))	INDIA
19	VELAN INC. (UPTO 24" (Rating upto 2500#))	CANADA
20	BOTELI VALVE GROUP CO. LTD.(Cast Upto 16" (Upto 1500#), 12" (2500#) & Forged: Upto 2" (1500# & 2500#))	CHINA
21	ZHEJIANG JIEHUA VALVE CO. LTD.	CHINA
22	BFE BONNEY FORGE VALVE LICENSEE	ITALY
23	CESARE BONETTI SPA (Upto 24" (Upto 2500#)	ITALY
24	FASANI S.P.A.	ITALY
25	FRIULCO SPA (UPTO 32" (900#); 24" (1500#); 14" (2500#))	ITALY
26	GTC ITALIA S.R.L.	ITALY
27	OMB S.P.A.	ITALY
28	PETROL VALVES S.R.L.	ITALY
29	VALVITALIA SPA	ITALY
30	MATSURA H. P MACHINE WORKS CO.LTD.	JAPAN
31	NISHITANI & CO. LTD.	JAPAN
32	BABCOCK BORSIG ESPANA, S.A.	SPAIN
33	POYAM VALVES, (AMPO S. COOP.) (SIZE UPTO 30" (RATING UPTO 2500#))	SPAIN
34	SUFA LIMITED	U.A.E.
35	BEL VALVES	U.K.
	BALL VALVES (SOFT SEATED)	
1	A V VALVES LIMITED (Upto 12" (Upto 600#))	INDIA
2	AIRA EURO AUTOMATION PVT. LTD. (Upto 6", Rating 150# & 300#),	INDIA
3	AQUA VALVES PVT. LTD.	INDIA
4	BRIGHTECH VALVES & CONTROLS PVT. LTD. (4" x 150# for CS, AS & SS material)	INDIA
5	CHEMTECH INDUSTRIAL VALVES PVT. LTD.	INDIA
6	CRAWLEY & RAY (FOUNDER & ENGINEERS) PVT. LTD. (DN25)	INDIA
7	DELVAL FLOW CONTROLS PVT. LTD. (Upto 12" (Upto 900#))	INDIA
8	FLOCON SYSTEMS PVT. LTD. (CS upto 6", 150#)	INDIA
9	FLOW CONTROL	INDIA
10	FLOWCHEM INDUSTRIES (UPTO 300# and upto 10")	INDIA
11	FLUIDTECH EQUIPMENT PVT. LTD(UPTO 4" (300#))	INDIA
12	FORWARD ALLOYS AND CASTINGS (Upto 900#)	INDIA
13	GURU INDUSTRIAL VALVES PVT. LTD. (Cast CS only: Upto 12"	INDIA

	(Upto 300#), 4" (Upto 900#) & Forged: Upto 2" (800#))	
14	HAWA ENGINEERS LTD. (Upto 16" (150# & 300#), Upto 12" (600# & 900#))	INDIA
15	INTERVALVE INDIA LTD. (Forged: Upto 2" (800#), Cast: Upto 12" (Upto 300#))	INDIA
16	JC VALVES & CONTROLS INDIA PVT. LTD. (CAST UPTO 28" (upto 600#),12" (900# , 1500#) & 10" (2500#))	INDIA
17	KSB PUMPS LTD. (VALVES DIVN.) (CS upto 100DN, 20 bar)	INDIA
18	LEADER VALVES LTD. (Casting upto 600#, 6" & forging upto 800#, 2")	INDIA
19	MICON ENGINEERS (HUBLI) PVT. LTD. (Cast: Upto 6" (150# & 300#) & Forged: Upto 2" (800#)	INDIA
20	MICROFINISH VALVES (P) LTD.	INDIA
21	NSSL LTD. (Upto 12" (150# & 300#))	INDIA
22	OSWAL IND. LTD. (Upto 24" (150#, 300# & 600#))	INDIA
23	SHALIMAR VALVES PVT. LTD. (Upto 18" (600#) Material: CS/AS/SS)	INDIA
24	VIBA FLUID CONTROL (Upto 300#)	INDIA
25	VIRGO ENGINEERS LTD. (Upto 16" (upto 600#))	INDIA
26	WEIR BDK VALVES (Cast: Upto 30" (150# & 300#), 20" (600#), 16" (900#), 12" (1500#) & Forged: Upto 2" (800#))	INDIA
27	XOMOX SANMAR LTD.(FISHER XOMOX)	INDIA
28	BHDT GMBH	AUSTRIA
29	BOTELI VALVE GROUP CO. LTD. (Upto 32" (150# & 300#), 30" (600#), 24" (900#)	CHINA
30	ZHEJIANG JIEHUA VALVE CO. LTD.	CHINA
31	VELAN INC.(UPTO 16", 600#)	CANADA
32	ETS TROUVAY & CAUVIN	FRANCE
33	PERRIN GMBH (2500#, SIZE UPTO 24")	GERMANY
34	FRIULCO SPA (UPTO 48" (150# & 300#); 20" (upto 1500#); 12" (2500#))	ITALY
35	CESARE BONETTI SPA (Cast: Upto 4" (150#) & Forged: Upto 1" (800#) Floating only)	ITALY
36	GTC ITALIA S.R.L	ITALY
37	MANTOVANUI SPA	ITALY
38	PIBIVESSE SRL (UPTO 48" , 600#)	ITALY
39	PETROL VALVES S.R.L	ITALY
40	METSO AUTOMATION	SINGAPORE
41	POYAM VALVES (AMPO S. COOP.) (Size upto 42" (Rating upto 2500#))	SPAIN
42	HATIMA CORPORATION	TAIWAN

	BALL VALVES (METAL SEATED)	
1	AIRA EURO AUTOMATION PVT. LTD. (Upto 6", Rating 150# & 300#),	INDIA
2	BRIGHTECH VALVES & CONTROLS PVT. LTD. (4" x 150# for CS, AS & SS material)	INDIA
3	DELVAL FLOW CONTROLS PVT. LTD. (Upto 12" (Upto 900#))	INDIA
4	GURU INDUSTRIAL VALVES PVT. LTD. (Cast CS only: Upto 12" (Upto 300#), 4" (Upto 900#) & Forged: Upto 2" (800#))	INDIA
5	HAWA ENGINEERS LTD. (Upto 16" (150# & 300#), Upto 12" (600# & 900#))	INDIA
6	INTERVALVE INDIA LTD.(UPTO 12" , 150#).	INDIA
7	JC VALVES & CONTROLS INDIA PVT. LTD. (CAST UPTO 28" (upto 600#),12" (upto 1500#), 10" (2500#))	INDIA
8	MICON ENGINEERS (HUBLI) PVT. LTD. (Cast: Upto 6" (150# & 300#) & Forged: Upto 2" (800#)	INDIA
9	MICROFINISH VALVES (P) LTD.	INDIA
10	NSSL LIMITED (Upto 12" NB, (150# & 300#))	INDIA
11	OSWAL INDUSTRIES LTD. (UPTO 24" (150#, 300#, & 600#))	INDIA
12	VIRGO ENGINEERS LTD. (UPTO16" (UPTO 600#))	INDIA
13	WEIR BDK VALVES (A UNIT OF WEIR INDIA PVT. LTD.) (Cast: Upto 30" (150# & 300#); 20" (600#), 16" (900#), 12" (1500#) & Forged: Upto 2" (800#)	INDIA
14	VELAN INC. (SIZE UPTO 16" (Rating Upto 600#))	CANADA
15	BOTELI VALVE GROUP CO. LTD. (Upto 32" (150# & 300#), 30" (600#), 24" (900#)	CHINA
16	ALFA VALVOLE SRL	ITALY
17	CESARE BONETTI SPA (UPTO 24" (150#) & 4" (UPTO 1500#) TRUNNION MOUNTED ONLY)	ITALY
18	GE POWER (NUOVO PIGNONE SPA)	ITALY
19	GTC ITALIA, S.R.L.	ITALY
20	PETROL VALVES S.R.L	ITALY
21	PIBIVIESSE (48", 600#)	ITALY
22	VALVITALIA SPA	ITALY
23	PERRIN GMBH (SIZE UPTO 24" (RATING UPTO 2500#))	GERMANY
24	RED POINT ALLOYS BV	NETHERLAND
25	FRIULCO SPA (UPTO 48" (150# & 300#); 20" (UPTO 1500#); 12" (2500#))	ITALY
26	POYAM VALVES, (AMPO S. COOP.) (SIZE UPTO 42" (RATING UPTO 2500#))	SPAIN
27	METSO AUTOMATION	SINGAPORE

28	ORBIT VALVES PLC	SINGAPORE
	BUTTERFLY VALVES	
1	A V VALVES LIMITED (UPTO 48" (150#))	INDIA
2	ADVANCE VALVES (RUBBER LINED AND METAL SEATED)	INDIA
3	AIRA EURO AUTOMATION PVT. LTD. (Upto 48", Rating upto 300#)	INDIA
4	AUDCO INDIA LIMITED (L&T VALVES DIVN.)	INDIA
5	BDK PROCESS CONTROL PVT LTD. (UPTO 1600MM)	INDIA
6	CHEMTECH INDUSTRIAL VALVES PVT LTD	INDIA
7	CRAWLEY & RAY (FOUNDER & ENGINEERS) PVT. LTD. (40mm-1000mm)	INDIA
8	DELVAL FLOW CONTROLS PVT. LTD. (Upto 24" (Upto 300#))	INDIA
9	FLOCON SYSTEMS PVT. LTD. (CS upto 12", 150#)	INDIA
10	FLUIDTECH EQUIPMENT PVT. LTD. (CS upto 12" (300#))	INDIA
11	FOURESS ENGINEERING (I) LTD.	INDIA
12	HAWA ENGINEERS LTD. (2" to 48"(PN10/PN16/150#/300#))	INDIA
13	HAWA VALVES INDIA PVT. LTD. (CS UPTO 6", 150#)	INDIA
14	HI-TECH BUTTERFLY VALVES INDIA PVT. LTD (<300#,<30"(TEFLON/RUBBER) ,<72"(METAL))	INDIA
15	INSTRUMENTATION LTD. (PALAKKAD)	INDIA
16	INTERVALVE INDIA LTD. (Upto 72" (150#) & Upto 16" (300#))	INDIA
17	JC VALVES & CONTROLS INDIA PVT. LTD. (Upto 20" (150#) & 10" (300#))	INDIA
18	L&T LTD (1/2" TO 24")	INDIA
19	LEADER VALVES LTD.(150#, upto 16")	INDIA
20	MATHER & PLATT (INDIA) LTD. A SUBSIDIARY OF WILO SE GERMAN (UPTO DN 1600,PN10, Double flange type)	INDIA
21	METROPOLITAN INDUSTRIES (SIZE=2000mm)	INDIA
22	MICON ENGINEERS (HUBLI) [PVT. LTD.(Upto 24" (PN10 & PN16))	INDIA
23	VENUS PUMP & ENGINEERING WORKS (upto 600NB, 150#)	INDIA
24	VIRGO ENGINEERS LTD. ((Triple offset only): 3" to 24", Upto 600# (CS/SS))	INDIA
25	WEIR BDK VALVES (A UNIT OF WEIR INDIA PVT. LTD.) (Upto 56" (Upto 250#), 24" (300#))	INDIA
26	XOMOX SANMAR LIMITED (FISHER XOMOX)	INDIA
27	TOMOE VALVE CO. LTD. (Upto 48"(150# & 300#), Upto 24"(600#, 900# & 1500#))	JAPAN
28	BHDT GMBH	AUSTRIA
29	VELAN INC. (Size upto 48"(Rating upto 600#)	CANADA
30	BOTELI VALVE GROUP CO. LTD. (Upto 36" (150# & 300#)	CHINA

31	ZHEJIANG JIEHUA VALVE CO. LTD.	CHINA
32	GRISS SAPAG INDUSTRIAL VALVES	FRANCE
33	ADAMS ARMATUREN	GERMANY
34	GTC ITALIA, S.R.L.	ITALY
35	HAITIMA CORPORATION	TAIWAN
36	WEIR VALVES & CONTROLS DIVISION.	U.K
37	LEEDS VALVE LTD	U.K
38	CURTIS WRIGHT FLOW CONTROL CORPOARATION	U.S.A.
39	LEAR SIEGLER MEAS. CTRLS. CORP	U.S.A.
40	TYCO INTERNATIONAL INC.,U.S.A.	U.S.A.
41	EMERSON PROCESS MGT	U.S.A.
42	SPX VALVES & CONTROLS	U.S.A.
43	XOMOS (CRANE CO.)	U.S.A.
	PLUG VALVES (NON LUBRICATED)	
1	A V VALVES LIMITED (UPTO 48" (150#))	INDIA
2	AUDCO INDIA LTD (L&T VALVES DIVN.)	INDIA
3	AZ ARMATUREN GMBH (1/2” TO 20”(150#, 300# & 600#), Matl. CS, AS &SS)	INDIA
4	BDK PROCESS CONTROL PVT LTD.	INDIA
5	CHEMTECH INDUSTRIAL VALVES PVT LTD	INDIA
6	CRAWLEY & RAY (FOUNDERS & ENGINEERS) PVT. LTD (DN 200)	INDIA
7	FLUIDTECH EQUIPMENT PVT. LTD. (Upto 4” (300#))	INDIA
8	GURU INDUSTRIAL VALVES PVT. LTD. (Cast CS only: Upto 12” (Upto 300#), Upto 4” (Upto 900#)) & Forged: Upto 2” (800#))	INDIA
9	HAWA ENGINEERS LTD. (1/2” TO 8” (150#))	INDIA
10	JC VALVES & CONTROLS INDIA PVT. LTD. (Upto 12” (Upto 300#))	INDIA
11	L&T LTD (1/2" TO 24")	INDIA
12	LEADER VALVES LIMITED (Upto 6” (Upto 300#))	INDIA
13	WEIR BDK VALVES (A UNIT OF WEIR INDIA PVT. LTD.) (UPTO 16"(150#), 12" (300#), 3" (600#))	INDIA
14	XOMOX SANMAR LIMITED (FISHER XOMOX)	INDIA
15	ZHEJIANG JIEHUA VALVE CO. LTD.	CHINA
16	O.M.S. SALERI DI SALERI P & FIGLI S.M.C.	ITALY
17	POYAM VALVES, (AMPO S. COOP.) (UPTO 30" (UPTO 900#) FOR LIFT PLUG VALVES ONLY.)	SPAIN
	FLAT GASKETS	
1	FERROLITE JOININGS (P) LTD.	INDIA
2	GASKETS (INDIA) PVT. LTD	INDIA

3	GOODRICH GASKET PVT. LTD. (UPTO 24")	INDIA
4	HINDUSTAN ASBESTOS & ALLIED PRODUCTS	INDIA
5	HINDUSTAN COMPOSITE LTD.	INDIA
6	HINDUSTAN FERREDO LTD.	INDIA
7	IGP ENGINEERS LIMITED	INDIA
8	MADRAS INDUSTRIAL PRODUCTS(UPTO 48")	INDIA
9	MECHANICAL PACKING INDUSTRIES LTD.	INDIA
10	PACKING & JOINTINGS (P) LTD.	INDIA
11	PERFECT MARKETING (P) LTD,	INDIA
12	PRASHANT ENGG STORES	INDIA
13	REIN TALBROS PVT. LTD.	INDIA
14	SPIRALSEAL GASKETS PVT. LTD. (CAF & Teflon)	INDIA
15	STARFLEX SEALING INDIA PVT. LTD.	INDIA
16	THE BENGAL MILL STORES SUPPLY CO. (TRADER)	INDIA
17	UNIQUE INDUSTRIAL PACKINGS PVT. LTD.	INDIA
	SPIRALLY WOUND GASKETS	
1	GASKETS (INDIA) PVT. LTD	INDIA
2	GOODRICH GASKET PVT. LTD.	INDIA
3	IGP ENGINEERS LIMITED	INDIA
4	MADRAS INDUSTRIAL PRODUCTS	INDIA
5	PACKINGS & JOINTINGS PVT. LTD	INDIA
6	PERFECT MARKETING (P) LTD,	INDIA
7	PRASHANT ENGG STORES	INDIA
8	SPIRASEAL GASKETS PVT. LTD.	INDIA
9	STARFLEX SEALING INDIA PVT. LTD.	INDIA
10	THE BENGAL MILL STORES SUPPLY CO. (TRADER)	INDIA
11	UNIQUE INDUSTRIAL PACKINGS PVT.LTD. (UPTO 42"(600#) & UPTO 24" (2500#))	INDIA
12	ZHEJIANG JIEHUA VALVE CO. LTD.	INDIA
	EXPANSION JOINTS & BELLOWS	
1	CORI ENGINEERS PVT. LTD.	INDIA
2	D.WREN & CO. (For Rubber & Fabric)	INDIA
3	FLEXATHERM EXPANLLOW PVT. LTD. (Circular: Upto 240", Rectangular No bar for size, (Upto 600#))	INDIA
4	FLEXICAN BELLOWS & HOSES PVT. LTD	INDIA
5	FLUIDYNE ENGG. (I) PVT. LTD	INDIA
6	KELD ELLENTOFT INDIA PVT. LTD	INDIA

7	LONESTAR INDUSTRIES	INDIA
8	MB METALLIC BELLOWS (INDIA) PVT. LTD	INDIA
9	PRASHANT ENGG. STORES	INDIA
10	STANDARD PRECISION BELLOWS	INDIA
11	TUBOFLEX	GERMANY
12	FLEXIDER S.P.A.	ITALY
	STRAINERS (PERMANENT INCLUDING Y-TYPE)	
1	CHEMTECH INDUSTRIAL VALVES PVT. LTD	INDIA
2	FLAIR STRAINERS & FILTERS (SIZE UPTO 42" (RATING UPTO 1500#))	INDIA
3	GRAND PRIX ENGINEERING PVT. LTD. (UPTO 60" PIPELINE, UPTO ANSI 1500#)	INDIA
4	GREAVES LIMITED	INDIA
5	GUJARAT OTOFILT	INDIA
6	HAWA ENGINEERS LTD. (1/2” to 24”(150# / 300#)	INDIA
7	KWIKFLO FILTERS PVT. LTD.	INDIA
8	LEADER VALVES LTD. (upto 300# & upto 12” size)	INDIA
9	MULTITEX FILTERATION ENGINEERS LTD	INDIA
10	MOD FABRICATORS	INDIA
11	ZOLOTO INDUSTRIES (15MM TO 100MM)	INDIA
12	BOTELI VALVE GROUP CO. LTD. (Y - TYPE ONLY: 14" (150#) & 3" (300# & 600#))	CHINA
	STEAM TRAPS	
1	GREAVES LTD.	INDIA
2	PENNANT ENGINEERING PVT. LTD.	INDIA
3	VIRGO ENGINEERS LTD. (1/2” to 4” (upto 600#) (CS/SS))	INDIA
4	YARWAY CORPORATION	INDIA
5	ZOLOTO INDUSTRIES (15 mm to 25 mm)	INDIA
6	GESTRA AG	GERMANY
7	ARMSTRONG INTERNATIONAL INC.	U.S.A
8	OGONTZ CORPORATION	U.S.A
9	TYCO INTERNATIONAL INC.,U.S.A.	U.S.A
	SPRING SUPPORTS	
1	MYRICS PIPING SYSTEM PVT.LTD.	INDIA
2	PIPE SUPPORTS INDIA PVT. LTD.	INDIA
3	PIPING & ENERGY PRODUCTS (P) LTD.	INDIA
4	SARATHI ENGG. ENTERPRISES PVT. LTD.	INDIA
5	SPRING SUPPORTS MFG. CO.	INDIA

6	FLEXIDER S.P.A.	ITALY
	FASTENERS	
1	AEP COMPANY	INDIA
2	CAPITAL INDUSTRIES	INDIA
3	CONSOLE ENGG. & FASTNERS INDUSTRIES	INDIA
4	EBY FASTNERS	INDIA
5	FIT TIGHT NUTS & BOLTS LTD.	INDIA
6	FIX FIT FASTENERS MFG. PVT. LTD.	INDIA
7	INDUSTRIAL ENGINEERING CORPORATION (SIZE UPTO 4" (M100))	INDIA
8	MEGA ENGINEERING PRIVATE LIMITED (½" TO 3" MATERIAL: CS/AS/SS)	INDIA
9	METRO MECHANICAL PVT.LTD.	INDIA
10	NAGBHUSHANAM INDUSTRIES	INDIA
11	NIREKA ENGG. CO. PVT. LTD.	INDIA
12	PACIFIC FORGING & FASTENERS PVT. LTD. (M 10 TO M125)	INDIA
13	PERFECT MARKETING (P) LTD,	INDIA
14	PIONEER NUTS & BOLTS PVT. LTD.	INDIA
15	PRECISION AUTO ENGINEERS	INDIA
16	PRECISION ENGINEERING INDUSTRIES	INDIA
17	PTD FASTNERS PVT. LTD.	INDIA
18	SANGHVI METALS (TRADER)	INDIA
19	SUNDARAM FASTENERS LIMITED	INDIA
20	UDHERA FASTENERS	INDIA
	FIRE FIGHTING SYSTEM	
1	AGNICE FIRE PROTECTION LTD.	INDIA
2	BHARTIYA CACCIALANZA FIRE SYSTEMS LTD	INDIA
3	BLUE STAR LTD.	INDIA
4	DE'S TECHNICO	INDIA
5	DE'S TECHNICO PVT. LTD.	INDIA
6	FUTECH CONSULTANTS PVT. LTD.	INDIA
7	GENERAL MECHANICAL WORKS	INDIA
8	HD FIRE PROTECTION COMPANY	INDIA
9	LAL ENTERPRISES	INDIA
10	MATHER & PLATT (INDIA) LTD. (A Subsidiary of WILO SE German)	INDIA
11	MX SYSTEMS INTERNATIONAL PVT. LTD.	INDIA
12	NEWFIRE ENGINEERS SERVICES	INDIA

13	PRAGATI ENGG. (PVT.) LTD.	INDIA
14	PYROTEK INDUSTRIES (INDIA) PVT. LTD.	INDIA
15	RADIANT FIRE PROTECTION ENGINEERS	INDIA
16	STEELAGE INDUSTRIES LTD.	INDIA
17	TECHNOFAB ENGG.	INDIA
18	TRI-PARULEX FIRE PROTECTION SYSTEMS	INDIA
19	UNITECH MACHINES LTD	INDIA
20	VIJAY FIRE PROTECTION SYSTEM LTD.	INDIA
	HOSE PIPE (METALLIC) & CAM LOCK COUPLING	
1	AEROFLEX INDUSTRIES LIMITED (Size 6mm to 250mm dia. (SS Corrg. Flex. Hose with Braid, Braid & Assembly)	INDIA
2	CHHATARIA RUBBER CHEMICALS INDUSTRIES	INDIA
3	D. WREN & CO.	INDIA
4	FLEXATHERM EXPANLLOW PVT. LTD. (1/2” to 6”)	INDIA
5	GAYATRI INDUSTRIES	INDIA
6	GAYATRI INDUSTRIAL CORPORATION (UPTO 6” ID)	INDIA
7	HELIFEX HYDRAULICS & ENGG CO. LTD.	INDIA
8	SENIOR INDIA PVT. LTD.	INDIA
	HOSE PIPE (NON-METALLIC) & CAM LOCK COUPLING	
1	CHHATARIA RUBBER CHEMICALS INDUSTRIES	INDIA
2	D. WREN & CO.	INDIA
3	GAYATRI INDUSTRIES	INDIA
4	GAYATRI INDUSTRIAL CORPORATION (UPTO 8” ID)	INDIA
5	HELIFEX HYDRAULICS & ENGG CO. LTD.	INDIA
6	PADMINI INDUSTRIES LIMITED	INDIA
7	PYROTEK INDUSTRIES (INDIA) PVT. LTD.	INDIA
8	SENIOR INDIA PVT. LTD.	INDIA

NOTE:

1. Any item for which vendor list is not enclosed, bidder has to furnish a list of their proposed vendors along with their references for supply of similar type of items with their proven track record. Vendor for these items shall be finalized during execution/detail engineering stage.
2. Any addition to vendor list of listed item shall be reviewed and approved by Owner/PMC, subject to submission of proper justification/reason and back-up credentials with proven & reliable record of performance for similar items on case to case basis.

E. ELECTRICAL

UPS System		
1.	VERTIV Energy Private Limited" (formally known as Emerson Network Power (India) Pvt. Ltd)	India
2.	GE Power Controls India Pvt. Ltd	India
3.	AEG Telefunken AG.	Germany
4.	Asea Brown Boveri	Sweden
5.	General Electric Co.	U.S.A.
6.	Westinghouse Electric Corporation	U.S.A.
7.	PILLER [PCI LTD	GERMANY INDIA
8.	GUTOR	GERMANY
Transformers – 11 kV & Below		
1.	GE T&D India Limited (Formerly known as Alstom T&D Ltd)	India
2.	ABB Power Products and System India Ltd	India
3.	CG Power and Industrial Solution Limited (Formerly known as Crompton Greaves Ltd)	India
4.	Siemens Ltd.	India
5.	Toshiba Transmission & Distribution System India Pvt Ltd	India
6.	Bharat Bijlee Ltd	India
7.	Kirloskar Electric Company Ltd.	India
8.	Voltamp Transformers Ltd.	India
Auxiliary Supply Transformers		
1.	Esennar Transformers (P) Ltd.	India
2.	Gujarat Plug-In Devices Pvt. Ltd. (Upto 300 KVA)	India
3.	IMP Power Ltd.	India
4.	Indcoil Transformers Pvt. Ltd.	India
5.	Kalpa Electrical Pvt. Ltd.	India
6.	Mehru Electricals (Formerly Automatic Electric Limited)	India
7.	Shephard Transformers Ltd.	India
8.	Vardhman Electro-mech Pvt. Ltd.	India
Neutral Earthing Resistor		
1.	Elecmech Corporation	India

2.	Lotus Powergear Pvt Ltd	India
3.	Resitech Electricals Private Limited	India
4.	RSI Switchgear Private Ltd.	India
5.	S R Narkhede Engineering Pvt. Ltd.	India
HV Switchboard (11 kV & 3.3 kV)		
1.	ABB India Limited	India
2.	Crompton Greaves Ltd	India
3.	Siemens Ltd	India
4.	BHEL (Electrical Machines Divn.)	India
5.	Schneider Electric	India
415 V SWITCH BOARD(PCC/MCC/PMCC)		
1.	Alstom Limited (Areva T & D)	India
2.	GE Power Controls India Pvt. Ltd.	India
3.	Larsen & Toubro Ltd.(El.Products Divn)	India
4.	Siemens Ltd.	India
5.	Schneider	India
Floor Mounting Type Distribution Boards		
1.	Associated Switchgears & Projects Ltd.	India
2.	C & S Electric Ltd	India
3.	Elecmech Corporation	India
4.	GE Power Controls India Pvt. Ltd.	India
5.	Intrelec	India
6.	Jakson Engineers Ltd	India
7.	Larsen & Toubro Ltd.(El.Products Divn)	India
8.	Lotus Powergear Pvt Ltd	India
9.	Siemens Ltd.	India
10.	Spaceage Switchgears Limited	India
11.	Tricolite Electrical Industries Pvt. Ltd.	India
12.	United Electric Co. (Delhi) Pvt. Ltd	India
13.	Venus Controls & Switchgear (P) Ltd.	India
14.	Schneider	India
Wall Mounting Type Distribution Boards		
1.	Anand Power Limited	India
2.	Associated Switchgears & Projects Ltd.	India
3.	C & S Electric Ltd	India
4.	Cosmic Power Systems Pvt. Ltd.	India
5.	Elecmech Corporation	India
6.	GE Power Controls India Pvt. Ltd.	India
7.	Intrelec	India

8.	Larsen & Toubro Ltd.(El.Products Divn)	India
9.	Lotus Powergear Pvt Ltd	India
10.	Siemens Ltd.	India
11.	Spaceage Switchgears Limited	India
12.	Tricolite Electrical Industries Pvt. Ltd.	India
13.	Trident Switchgears Pvt. Ltd. (Upto 3200 A)	India
14.	United Electric Co. (Delhi) Pvt. Ltd	India
15.	Venus Controls & Switchgear (P) Ltd.	India
16.	Schneider Electric	India
Control & Relay Panel		
1.	Alstom Limited (Areva T&D)	India
2.	ABB.	India
3.	Elecmech Corporation	India
4.	Larsen & Toubro Ltd. (El. Products Divn)	India
5.	Siemens Ltd.	India
6.	Schneider Electric	India
Protective Relays (other than BMR)		
1.	Alstom Limited (Areva T & D)	India
2.	ABB.	India
3.	Schneider – MICOM Model	India
4.	SEL – Schweitzer Engineering Laboratories	India
5.	Woodward	India
6.	Siemens Ltd.- SIPROTEC Model	India
Vacuum Circuit Breakers (VCB)		
1.	Alstom Limited (Areva T & D)	India
2.	ABB	India
3.	BHEL (Electrical Machines Divn.)	India
4.	Siemens Ltd.	India
5.	Schneider Electric	India
Air Circuit Breakers (ACB)		
1.	GE Power Controls India Pvt. Ltd.	India
2.	Larsen & Toubro Ltd.(El.Products Divn)	India
3.	Siemens Ltd.	India
4.	ABB	India
5.	Schneider Electric	India
Moulded Case Circuit Breakers (MCCB)		

1.	Crompton Greaves Ltd.	India
2.	GE Power Controls India Pvt. Ltd.	India
3.	Larsen & Toubro Ltd.(El.Products Divn)	India
4.	Siemens Ltd.	India
5.	ABB	India
6.	Schneider Electric	India
Miniature Circuit Breakers (MCB) / RCBO		
1.	Indo Asian Fusegear Ltd	India
2.	Legrand India Ltd	India
3.	S & S Power Switchgear Ltd	India
4.	Standard Electricals Limited	India
5.	Siemens Ltd.	India
6.	ABB	India
7.	Schneider Electric	India
ELCB		
1.	GE Power Controls India Pvt. Ltd.	India
2.	Havells India Ltd.	India
3.	Indo Asian Fusegear Ltd	India
4.	Legrand India Ltd	India
5.	S & S Power Switchgear Ltd	India
6.	Siemens Ltd.	India
7.	Standard Electricals Limited	India
8.	ABB	India
9.	Schneider Electric	India
Low Voltage Industrial Switches/Isolators		
1.	ABB	India
2.	GE Power Controls India Pvt. Ltd.	India
3.	Havells India Ltd.	India
4.	Kaycee Industries Ltd	India
5.	Larsen & Toubro Ltd.(El.Products Divn)	India
6.	Siemens Ltd.	India
7.	Schneider Electric	India
Current Transformers (11 kV & 3.3 kV)		
1.	Anant Powertech	India
2.	ABB	India
3.	Kalpa Electrical Private Limited	India
4.	Mehru Electricals (Formerly Automatic Electric Limited)	India

5.	Perfect Sales Corporation	India
6.	Silkans	India
7.	Kappa	India
8.	Pragati	India
Potential Transformer (11 kV & 3.3 kV)		
1.	Anant Powertech	India
2.	ABB	India
3.	Kalpa Electrical Private Limited	India
4.	Mehru Electricals (Formerly Automatic Electric Limited)	India
5.	Perfect Sales Corporation	India
Current Transformers (415V)		
1.	Alstom Limited (Areva T & D)	
2.	Anant Powertech	India
3.	Indcoil Transformers Pvt. Ltd.	India
4.	Kappa Electricals	India
5.	Mehru Electricals (Formerly Automatic Electric Limited)	India
6.	Perfect Sales Corporation	India
7.	Siemens Ltd.	India
8.	Silkans	India
9.	Pragati	India
10.	Automatic Electric	India
11.	Rishabh	India
Potential Transformers (415V)		
1.	Alstom Limited (Areva T & D)	India
2.	Indcoil Transformers Pvt. Ltd.	India
3.	Kalpa Electrical Private Limited	India
4.	Kappa Electricals	India
5.	Larsen & Toubro Ltd.(El. Products Divn)	India
6.	Mehru Electricals (Formerly Automatic Electric Limited)	India
7.	Perfect Sales Corporation	India
8.	Siemens Ltd.	India
Meters		
1.	Alstom Limited (Areva T & D)	India
2.	IMP Power Ltd.	India
3.	M.B. Control & Sytstems Pvt. Ltd. (Only For Multifunctional Meter)	India
4.	Meco Instruments	India
5.	Mehru Electricals (Formerly Automatic Electric	India

	Limited)	
6.	Rishabh Instruments Pvt. Ltd.	India
7.	Seahorse Industries Ltd.	India
Multi Function Meter (MFM)		
1	Secure meter Limited	India
2	SEMS	India
3	Larsen & Toubro Ltd.	India
4	SATEC	India
5	Alstom Limited (Areva T & D)	India
6	Siemens Ltd.	India
7	Asea Brown Boveri Ltd.	India
8	Schneider Electric	India
Bus Ducts (11 kV & 3.3 kV)		
1.	Best & Crompton Engg. Co.	India
2.	C & S Electric Ltd.	India
3.	Crompton Greaves Ltd.	India
4.	Intrelec	India
5.	Powergear Limited	India
6.	Spaceage Switchgears Limited	India
7.	United Electric Co. (Delhi) Pvt. Ltd.	India
Bus Duct (415 V)		
1.	Associated Switchgears & Projects Ltd.	India
2.	Best & Crompton Engg. Co.	India
3.	C & S Electric Ltd.	India
4.	Intrelec	India
5.	Lotus Powergear Pvt Ltd	India
6.	Spaceage Switchgears Limited	India
7.	United Electric Co. (Delhi) Pvt. Ltd.	India
8.	Venus Controls & Switchgear (P) Ltd.	India
9.	Globe Electrical Industries (MV bus duct)	India
10.	Powergear Ltd.	India
Induction Motors – HV (11kV & 3.3 kV) (Safe/Hazardous Area)		
1.	BHEL (Electrical Machines Divn.)	India
2.	Jeumont Industrie	France
3.	Fuji Electric Systems Co. Ltd	Japan
4.	Mitsubishi Corporation	Japan
5.	Toshiba Corporation	Japan
6.	Toshiba Mitsubishi Electric Industrial Systems Corporation (Excluding Flame-proof motors of frame size more than 900)	Japan
7.	Peebles Electrical Machines	UK
8.	Siemens	India / Germany

9.	ABB	Finland/Switzerland/India
10.	Jeumont Electric India Private Limited	India
Induction Motors – LV (415 V) (Safe Area)		
1.	ABB	India
2.	Bharat Bijlee Ltd	India
3.	Crompton Greaves Ltd	India
4.	Kirloskar Electric Company Ltd	India
5.	Siemens Ltd	India
6.	Jeumont Industrie	France
7.	Siemens AG, Germany	Germany
8.	Fuji Electric Systems Co. Ltd.	Japan
9.	Mitsubishi Corporation	Japan
10.	Toshiba Corporation	Japan
11.	Asea Brown Boveri	Sweden
12.	General Electric Co.	USA
Induction Motors – LV (415 V) (Hazardous Area)		
1.	ABB	India
2.	Bharat Bijlee Ltd	India
3.	Crompton Greaves Ltd	India
4.	Kirloskar Electric Company Ltd	India
5.	Siemens Ltd	India
6.	Jeumont Industrie	France
7.	Siemens AG, Germany	Germany
8.	Fuji Electric Systems Co. Ltd.	Japan
9.	Mitsubishi Corporation	Japan
10.	Toshiba Corporation	Japan
11.	Asea Brown Boveri	Sweden
12.	General Electric Co.	USA
Industrial Type Sw. Socket & Plug		
1.	Baliga Lighting Equipments Limited	India
2.	Chloride Power Systems and Solutions Ltd. (formerly CALDYNE)	India
3.	Crompton Greaves Ltd	India
4.	Cyclo Electric Devices & Services Co.	India
5.	Ex-protecta	India
6.	FCG Flameproof Control Gears Pvt. Ltd. (Formerly CEAG Flame	India
7.	FCG Power Industries Ltd	India
8.	Flameproof Equipments Pvt. Ltd.	India
9.	Legrand India Ltd	India
10.	Legrand S.A.	France
11.	BBC-Brown Boveri & Cie AG	Germany

12.	R Stahl Schaltgerate Gmbh	Germany
13.	Weidmuller Ltd.	Germany
14.	CORTEM S.p.A.	Italy
Street/Flood Lighting Fixtures		
1.	Bajaj Electricals Limited	India
2.	Crompton Greaves Ltd	India
3.	Havells India Ltd.	India
4.	Philips India Ltd.	India
5.	Surya Roshni Ltd.	India
6.	Wipro Lighting	India
Hose Proof Industrial Lighting Fixtures		
1.	Bajaj Electricals Limited	India
2.	Crompton Greaves Ltd.	India
3.	Philips India Ltd.	India
4.	Surya Roshni Ltd.	India
5.	Wipro Lighting	India
Air Obstruction Lights (Neon Type)		
1.	Bajaj Electricals Limited	India
2.	Elecab Poysha	India
3.	Wipro Lighting	India
Lighting Poles		
1.	Bharti Exports	India
2.	Metalite Industries	India
3.	Premier Power Products (Calcutta) Pvt. Ltd.	India
4.	Sadhana Engineering Corporation	India
5.	Surya Roshni Ltd.	India
Explosion Proof Lighting Fixtures		
1.	Baliga Lighting Equipments Limited	India
2.	Crompton Greaves Ltd	India
3.	Ex-Protecta	
4.	FCG Flameproof Control Gears Pvt. Ltd. (Formerly CEAG Flame)	India
5.	FCG Power Industries Ltd	India
6.	Flameproof Equipments Pvt. Ltd.	India
7.	Flexpro Electricals Pvt. Ltd.	India
Battery Charger		
1.	Amco Power Systems Limited	India
2.	Chloride Power Systems and Solutions Ltd. (formerly CALDYNE)	India

3.	Chhabi Electricals Pvt. Ltd.	India
4.	HBL Nife Power Systems Ltd.	India
5.	Universal Industrial Products	India
Battery (Ni-Cd)		
1.	AMCO Power Systems Ltd.	India
2.	HBL Nife Power Systems Ltd.	India
3.	Fuji Electric Systems Co. Ltd.	Japan
4.	Hitachi Limited	Japan
HT Power Cables		
1.	Cable Corpn. of India Limited	India
2.	KEC International Ltd. (Formerly RPG Cables Limited	India
3.	KEI Industries Limited (Upto 33 kV)	India
4.	Ravin Cables Limited	India
5.	Torrent Cables Ltd.	India
6.	Universal Cables Ltd.	India
7.	Uniflex	India
8.	Polycab	India
LT Power Cables		
1.	Cable Corpn. of India Limited	India
2.	Cords Cable Industries Ltd	India
3.	Delton Cables Ltd	India
4.	Finolex Cables Ltd	India
5.	KEC International Ltd. (Formerly RPG Cables Limited	India
6.	KEI Industries Limited	India
7.	Plaza Cable Industries Limited	India
8.	Ravin Cables Limited	India
9.	Torrent Cables Ltd	India
10.	Universal Cables Ltd.	India
11.	Polycab	India
LT Control Cables (1.1 kV)		
1.	Cable Corpn. of India Limited	India
2.	Cords Cable Industries Ltd	India
3.	Delton Cables Ltd	India
4.	Finolex Cables Ltd	India
5.	KEC International Ltd. (Formerly RPG Cables Limited	India
6.	KEI Industries Limited	India
7.	Plaza Cable Industries Limited	India
8.	Radiant Cables Pvt. Limited	

9.	Ravin Cables Limited	India
10.	Torrent Cables Ltd	India
11.	Universal Cables Ltd.	India
12.	Miracle cables	India
13.	Polycab	India
Cables For Earthing		
1.	Advance Cable Technologies (P) Ltd.	India
2.	Delton Cables Ltd	India
3.	Finolex Cables Ltd	India
4.	Gupta Electric & Machinery Stores (GEMSCAB)	India
5.	J K Cables Limited	India
6.	Netco Cable Industries (Pvt.) Ltd.	India
7.	Prestige Cable Industries	India
8.	Shyam Cables Industries	India
9.	Special Cables Pvt. Ltd.	India
10.	T C Communication Pvt Ltd	India
11.	Universal Cables Ltd.	India
Cable Jointing Kits		
1.	Raychem RPG Ltd.	India
Pre-Fabricated Al-Cable Trays		
1.	Globe Electrical Industries	India
2.	Hindustan Vidyut Products	India
3.	Indiana Engg Works Pvt Ltd	India
4.	Indmark Formtech Pvt. Ltd.	India
5.	Jamna Metal Company	India
6.	Kanade Anand Udyog Pvt. Ltd.	India
7.	Maheshwari Electrical Mfrs. (P) Ltd.	India
8.	Metalite Industries	India
9.	Parekh Engineering Company	India
10.	Premier Power Products (Calcutta) Pvt. Ltd.	India
11.	Rukmani Electricals & Components Pvt Ltd	India
12.	Sadhana Engineering Corporation	India
13.	Sree Atreya Enterprises	India
14.	Stealite Engg Co	India
Pre-Fabricated G.I. Cable Trays		
1.	Globe Electrical Industries	India
2.	Indiana Engg Works Pvt Ltd	India
3.	Jamna Metal Company	India
4.	Maheshwari Electrical Mfrs. (P) Ltd.	India

5.	Premier Power Products (Calcutta) Pvt. Ltd.	India
6.	Rukmani Electricals & Components Pvt Ltd	India
Hose Proof Local Control Station		
1.	Baliga Lighting Equipments Limited	India
2.	Bhartia Industries Ltd. (Divn. Bch)	India
3.	C & S Electric Ltd.	India
4.	Ex-Protecta	
5.	FCG Flameproof Control Gears Pvt. Ltd. (Formerly CEAG Flame)	India
6.	FCG Power Industries Ltd.	India
7.	Flameproof Equipments Pvt. Limited	India
8.	Hotline Switchgear & Controls	India
9.	Power Engg Co	India
Flameproof Items (Switch, Switch Socket, Plugs, Isolators, Junction Box, Local Control Station, Distribution Board)		
1.	Baliga Lighting Equipments Ltd.	India
2.	Ex-Protecta	India
3.	FCG Flameproof Control Gears Pvt. Ltd.(Formerly CEAG Flame)	India
4.	FCG Power Industries Ltd	India
5.	Flameproof Equipments Pvt. Ltd.	India
6.	Flexpro Electricals Pvt. Ltd.	India
7.	Legrand S.A.	France
8.	AEG Telefunken AG	Germany
9.	BBC-Brown Boveri & CIE AG	Germany
10.	R Stahl Schaltgerate GMBH	Germany
11.	Siemens AG, Germany	Germany
12.	Weidmuller Ltd.	Germany
13.	Cortem S.p.A.	Italy
14.	Fuji Electric Systems Co. Ltd.	Japan
15.	Togami Electric Mfg. Company	Japan
16.	Toshiba Corporation	Japan
17.	Asea Brown Boveri	Sweden
18.	Crouse-Hinds (Europe) Ltd.	U.K.
19.	GEC Industrial Control Ltd.	U.K.
20.	M&C Switchgear	U.K.
Hose proof Junction Boxes		
1.	Baliga Lighting Equipments Limited	India
2.	Bhartia Industries Ltd. (Divn. Bch)	India
3.	Ex-protecta	India
4.	FCG Flameproof Control Gears Pvt. Ltd.	India

	(Formerly CEAG Flame)	
5.	Flameproof Equipments Pvt. Ltd.	India
6.	FCG Power Industries Ltd	India
Limit Switches / Belt Monitoring Switches		
1.	A G System Controls	India
2.	AG Mechanical Enterprises (P) Ltd.	India
3.	Balaji Electricals	India
4.	Bhartia Industries Ltd. (Divn. Bch)	India
5.	Jayashree Electrodevices Pvt. Ltd.	India
6.	Protocontrol Instruments (I) Pvt. Ltd.	India
7.	R.K. Electrical Engg. Works	India
Limit Switches (Flameproof Type)		
1.	Baliga Lighting Equipments Limited	India
2.	Ex-protecta	India
3.	FCG Flameproof Control Gears Pvt. Ltd. (Formerly CEAG Flame)	India
4.	Flameproof Equipments Pvt. Ltd.	India
5.	FCG Power Industries Ltd	India
6.	Protocontrol Instruments (I) Pvt. Ltd.	India
Horn/Hooter/Klaxon		
1.	Baliga Lighting Equipments Limited	India
2.	Flameproof Equipments Pvt. Ltd.	India
3.	Worthmax Engineers	India
Variable Speed Motor Package (HV Motors)		
1.	Asea Brown Boveri Ltd.	Finland
2.	BHEL (Electrical Machines Divn.)	India
3.	Danfoss Industries Pvt. Ltd. (Upto 1400 KW)	India
4.	Alsthom Atlantique	France
5.	Siemens AG	Germany
6.	Ansaldo Robicon	Italy
7.	Fuji Electric Systems Co. Ltd.	Japan
8.	Toshiba Mitsubishi Electric Industrial Systems Corporation	Japan
9.	GEC Industrial Control Ltd.	UK
Variable Speed Motor Package (LV Motors)		
1.	Amtech Electronics (India) Ltd.	India
2.	Asea Brown Boveri Ltd.	Finland
3.	BHEL (Electrical Machines Divn.)	India
4.	Crompton Greaves Ltd.	India
5.	Danfoss Industries Pvt. Ltd.	India
6.	Larsen & Toubro Ltd. (El. Products Divn)	India

7.	Kirloskar Electric Company Ltd.	India
8.	Rockwell Automatic India Ltd.	India
9.	Siemens Ltd.	India
10.	Alsthom Atlantique	France
11.	Siemens AG	Germany
12.	Ansaldo Robicon	Italy
13.	Fuji Electric Systems Co. Ltd.	Japan
14.	Toshiba Mitsubishi Electric Industrial Systems Corporation	Japan
15.	GEC Industrial Control Ltd.	UK
Capacitors		
1.	BHEL (Electrical Machines Divn.)	India
2.	Crompton Greaves Ltd.	India
3.	Kapsales Electricals Ltd.	India
4.	Shreem Capacitors Pvt. Ltd.	India
5.	Universal Cables Ltd.	India
6.	ABB	India
Earthing & Lightning Protection Material – (Al) Wire/Strip		
1.	Anand Electric Trading Co.	India
2.	C & S Electric Ltd.	India
3.	Indmark Formtech Pvt. Ltd.	India
4.	Jayant Metal Mfg. Co.	India
5.	Premier Power Products (Calcutta) Pvt. Ltd.	India
6.	Jamna Metal Company	India
7.	Mahavir Industrial Corporation	India
8.	Metropolitan Industries	India
9.	Sai Galvanisers & Fabricators Pvt Ltd	India
Earthing & Lightning Protection Material – (GI) Wire/Strip		
1.	Anand Electric Trading Co.	India
2.	Controls & Switchgear Co. Ltd.	India
3.	Jayant Metal Mfg. Co.	India
4.	Indmark Formtech Pvt. Ltd.	India
5.	Premier Power Products (Calcutta) Pvt. Ltd.	India
6.	Jamna Metal Co.	India
7.	Mahavir Industrial Corporation	India
8.	Metropolitan Industries	India
9.	Sai Galvanisers & Fabricators Pvt Ltd	India
10.	Bharti Exports	India
11.	Metalite Industries	India
12.	Rukmani Electricals & Components Pvt Ltd	India
13.	Sadhana Engineering Corporation	India

14.	Stealite Engg Co	India
GI Pipes & Conduits		
1.	Bharti Exports	India
2.	Indian Tube Co. (Tata Div. of Tubes & Pipes)	India
3.	Jindal Pipes Ltd.	India
4.	Meghjyot Enterprises	India
5.	Rukmani Electricals & Components Pvt Ltd	India
6.	Steelcraft	India
Industrial Cable Gland		
1.	Baliga Lighting Equipments Limited	India
2.	Comet Brass Products	India
3.	Comet Industries	India
4.	Dowell's Electricals	India
5.	Electromac Industries	India
6.	FCG Flameproof Control Gears Pvt. Ltd. (Formerly CEAG Flame	India
7.	Gland-Mech. Industries	India
8.	Industrial products Equipment	India
9.	Power Engg Co	India
10.	Quality & Precision Indl. Equipment	India
11.	S J Metal Industries (Jainson)	India
Cable Lugs		
1.	Dowell's Electricals	India
2.	Forward Engg Industries	India
3.	KSE Electrical Pvt. Ltd.	India
4.	MG Electrica	Indai
5.	Power Engg Co	India
6.	S J Metal Industries (Jainson)	India
7.	Usha Martin Industries Ltd. (Ismal Divn)	India
Flameproof Cable Gland		
1.	Baliga Lighting Equipments Limited	India
2.	Comet Brass Products	India
3.	Comet Industries	India
4.	Dowell's Electricals	India
5.	Electromac Industries	India
6.	Ex-Protecta	
7.	FCG Flameproof Control Gears Pvt. Ltd. (Formerly CEAG Flame)	India
8.	FCG Power Industries Ltd	India
9.	Flameproof Equipments Pvt. Ltd.	India
10.	Flexpro Electricals Pvt. Ltd.	India
11.	Industrial Products Equipment	India
12.	Kaysons Techno Equipments Pvt. Ltd.	India
13.	Power Engg Co	India
14.	Prompt Engineering Works	India

15.	Sudhir Switchgears Pvt. Ltd.	India
Explosion Proof Exhaust Fan		
1.	Alstom Limited (Areva T & D)	India
2.	Crompton Greaves Ltd	India
3.	FCG Flameproof Control Gears Pvt. Ltd. (Formerly CEAG Flame)	India
4.	Flameproof Equipments Pvt. Ltd.	India

Fuse		
1.	Larsen & Toubro Ltd. (El. Products Divn.)	India
2.	Siemens Ltd.	India
3.	Alstom Power	India
4.	Havells India Ltd.	India

Contactor / Relay /		
1.	Larsen & Toubro Ltd. (El. Products Divn.)	India
2.	Siemens Ltd.	India

Timer		
1.	ABB	India
2.	Alstom Power	India
3.	Bhartia Cutler Hammer	India
4.	Siemens Ltd	India

Control Switches		
1.	Alstom Power	India
2.	Siemens Ltd.	India
3.	Kaycee	India
4.	Larsen & Toubro Ltd. (El. Products Divn.)	India

Push Buttons		
1.	Alstom Power	India
2.	Larsen & Toubro Ltd. (El. Products Divn.)	India
3.	Siemens Ltd.	India
4.	Tecnik	India
5.	Tulsi	India

Signal Lamps		
1.	Alstom Power	India
2.	Binoy	India
3.	Larsen & Toubro Ltd. (El. Products Divn.)	India
4.	Siemens Ltd.	India
5.	Tulsi	India

Terminal Blocks		
1.	Connectwell	India
2.	Elmex	India
3.	Larsen & Toubro Ltd. (El. Products Divn.)	India
4.	Siemens Ltd.	India

High Masts		
1.	Bajaj Electricals Limited	India
2.	Philips India Ltd.	India

Programmable Logic Controller		
1.	Rockwell Automation India Pvt. Ltd.	India
2.	Siemens Ltd.	India
3.	ABB	India
Optical Fiber Cable		
1.	Finolex	India
2.	DLink	India
3.	Molex	India
4.	Lucent	India
5.	Ericson	India
6.	Sterlite	India
7.	HFCL	India
8.	OPTEL	India
9.		
Transducer		
1.	Crompton	UK
2.	Elster (ABB)	India
HDPE Pipe		
1.	Astral	India
2.	Reliance Industries ‘RELPIPE	India
3.	APOLLO	India
4.	Cliamx Synthesis	India

GEARED MOTORS		
1.	Greaves Cotton & Co.Ltd	India
2.	Kirloskar Electric Company Ltd	India
3.	New Allenberry Works	India
4.	Nord Drivesystem Pvt.Ltd	India
5.	Power Build Ltd	India
6.	Sew Eurodrive India Private Ltd	India
ELECTROMAGNET		
1.	Electromag	India
2.	Power Build	India

3.	Sterling Controls	India
4.	Storm Kraft Controls	India

F. INSTRUMENTATION

Sl.No	Vendor's Name	Country
Gas Analysers (IR, Thermal Conductivity, Paramagnetic)		
1.	ABB Ltd (BU – Analytical &Adv)	India
2.	Chemtrols Industries Limited (Maihak Make)	India
3.	Emerson Process Management (I) Pvt. Ltd	India
4.	Endress+ Hauser (India) pvt. Ltd.	India
5	Yokagawa	India
6	Ametek ,INC	U.S.A
7	Emerson Process Mgt Singapore Ltd.	Singapore
8	MaihakAktiengesellschraft	Germany
9	M.S.A International	U.S.A
10	Siemens AG	Germany
Sodium Analyser		
1.	ABB	
2.	HACH	
3.	THERMOFISHER	
4.	WALTRON	
5.	AWA	
Chlorine Analyser		
1.	ABB	INDIA
2.	HACH	FRANCE
3.	KROHNE	U.K
4.	E&H	
5	WALTRON	
6	THERMOFISHER	
Turbidity Analyser		
1.	HACH	
2.	YOKOGAWA	JAPAN
SDI Analyser		
1.	RODI	USA
pH, conductivity & ORP Analyser		
1.	ABB India Limited	India
2.	BELA INSTRUMENTS (For Knick, GmbH make), Mumbai(For ConductivityAnalyser)	India
3	Chemtrols Industries Limited	India
4	Emerson Process Management (I) Pvt. Ltd	India
5	Endress+ Hauser (India) pvt. Ltd. (Liquid Analyser)	India
6	Forbes polymetron Pvt. Ltd.	India
7	POTENCE CONTROLS (for GLI International make), Mumbai.(For ConductivityAnalyser)	India
8	Yokogawa India Ltd.	India
9	Emerson Process Mgt Singapore Ltd.	Singapore
10	Foxbro Far East PTE Ltd.	Singapore

11	Hach Company	U.S.A
12	Yokogawa Electric Corporation	Japan
13	Zellweger SA	France
Trace Analyser/ Ion Selective		
1.	ABB India Limited	India
2	Chemtrols Industries Limited	India
3	Forbes PolymetronPvt. Ltd	India
4	Bran &Luebbe Ltd	U.K
5	Hach company	U.S.A
6	Zellweger SA	France
PC / SERVERS		
1.	DELL	INDIA
Fire alarm System		
1.	HONEYWELL	INDIA
2	SIEMENS	INDIA
SO_X/ NO_X Analyser		
1.	ABB India Ltd.	India
2.	Chemtrols Industries Limited	India
3.	Emerson Process Management (I) Pvt. Ltd	India
4.	Yokogawa India Ltd.	India
5.	Emerson Process Management Singapore Ltd	Singapore
6.	Horiba Ltd.	Japan
7.	Lear Siegler Meas. Controls Corp.	U.S.A
8.	M.S.A International	U.S.A
9.	Sick AG	Germany
10.	Siemens AG	Germany
11.	Thermo Environment Instruments Inc	U.S.A
12	Yokogawa Electric Corporation	Japan
Mass Spectrometer		
1.	ABB India Ltd.	India
2.	Orbital Science Corporation	U.S.A
3.	VG Gas Analysis Systems	U.K.
Gas Chromatograph		
1.	ABB India Limited	India
2.	Emerson Process Management (I) Pvt. Ltd.	India
3	Applied Automation Inc	Singapore
4	ABB Process Analytics	U.K
5.	Foxbaro Far East Pte Ltd	Singapore
6.	Siemens	Germany
7	Yokogawa India Ltd.	India
Flue Gas Analyser (ZrO_2 type)		
1.	ABB Ltd (BU – Analytical &Adv)	India
2.	Chemtrol (For MAIHAK Only)	India
3.	Emerson Process Management (I) Pvt. Ltd	India
4.	Endress+Hauser	India
5	Yokogawa India Ltd.	India
6	Ametek Inc	U.S.A
7.	GE Panametrics	Ireland
H_2S/ Total Sulphur Analysers		
1.	ABB India Ltd.	India
2.	Barton Instrument Systems Limited	U.K

System House Analysers		
1.	ABB Ltd (BU – Analytical &Adv)	India
2.	Adage Automation Pvt. Ltd.	India
3.	Analyser Instrument Co.Pvt. Ltd.	India
4.	Chemtrols Industries Limited	India
5.	Emerson Process Management (I) Pvt. Ltd	India
6.	Yokogawa India Ltd.	India
7.	Intech	Italy
Density Analysers		
1.	Chemtrols Industries Limited	India
2.	Emerson Process Management (I) Pvt. Ltd (coriolis type)	India
3.	Bopp & Reuther MesstechnikGmbh (coriolis type)	Germany
4	Solartron Mobrey	U.K
Moisture Analysers		
1.	Chemtrols Industries Limited	India
2.	AmetekInc	U.S.A
3	GE Panametrics	Italy
Gas & Fire Detection System		
1.	Andrew Yule & Company Ltd. (Fire)	India
2.	Chemtrols Industries Limited	India
3.	Honeywell Automation India Limited (Gas)	India
4.	J B Boda And Brothers Pvt. Ltd. (Gas Make-International Sensor Technology)	India
5.	Pollution Protection System Mumbai Pvt Ltd (Gas)	India
6.	General Monitors (Gas)	U.K
7	Teledyne Fluid Systems (Gas)	Thailand
Air Quality Monitoring System		
1	Chemtrol Industries Ltd.	India
Sample Handling System		
1.	Analyser Instrument Co.Pvt. Ltd.	India
Flow Element: Orifice/ Venturi/ Flow Nozzle		
1.	Baliga Lighting (only Orifice)	India
2.	Chemtrol Industries Ltd.	India
3.	Delta Engineering, Pune	India
4.	Eureka Industrial Equipments Pvt. Ltd.	India
5	FORBES MARSHALL	India
6	Flowtech Instruments (Orifice/Venturi)	India
7	General Instruments Consortium	India
8.	Instrumentation Ltd.	India
9.	Micro Precision Products Private Ltd.	India
10.	Micro India Flow Elements Pvt. Ltd.	India
11	Minco(India) Flow Instruments Pvt. Ltd.	India
12	Unicontrols Instrument Pvt. Ltd.	India
13	Bopp & Reuther Messtechnik GMBH	Geramny
14	Daniel Measurement & Control	USA
15	ISA Controls Limited	U.K
16	Technomatic SPA	Italy
Pitot Tube/ Annubar		
1.	ABB India Limited	India
2.	Control Engineers	India
3.	Emerson Process Management (I) Pvt. Ltd.	India

4	Micro Precision Products Private Ltd.	India
5.	Unicontrols Instruments Pvt. Ltd.	India
6.	Daniel Measurement & Control	U.S.A
7.	ISA Controls Limited	U.K
8	Technomatic Spa	Italy
Rotameters		
1.	ABB india Ltd.	India
2.	Chemtrols Industries Ltd.	India
3.	Delta Control	India
4.	Eureka Industrial Equipments Pvt. Ltd.	India
5	Flowtech Instruments services	India
6.	Instrumentation Engineers Pvt. Ltd.	India
7.	Krohne Marshall Pvt. Ltd.	India
8.	Placka Instruments & Controls Pvt. Ltd. (Purge Rotameter Only)	India
9.	Rota Instrumentation	India
10	Yokogawa	India
11	Rota Yokogawa Gmbh& Co. Kg	Germany
12	Tokyo Keiso Co.Ltd.	Japan
13	Azbil Corporation	Japan
14	Emerson Process Mgt	U.S.A
15	Krohne	Germany
Mass Flow Meter (Coriolis Type)		
1.	ABB India Limited	India
2	Chemtrol Industries Ltd	India
3.	Emerson Process Management (I) Pvt. Ltd.	India
5	Endress + Hauser	India
6.	SIEMENS Ltd.	India
7.	Yokogawa	India
8.	Bopp & Reuther Messtechik GMBH	Germany
7	Krohne	Germany
8	Schlumberger resource management Ltd.	U.S.A
Turbine Flowmeter		
1.	ABB India Ltd.	India
2.	Chemtrol Industries Ltd	India
3.	Krohne	India
4.	Yokogawa	India
5.	Azbil Corporation	Japan
6.	Bopp & Reuther Messtechnik Gmbh	Germany
7.	Barton Instrument System Ltd.	U.K.
8.	Emerson Process Mgt	U.K.
9.	Emerson Process Mgt.	U.S.A
10.	Instromet International N.V.	Holland
11.	Itochu Corporation	Japan
12.	Oval Asea Pacific Pte Ltd.	Singapore
13.	Rockwell International Corporation	U.S.A
Vortex meter		
1.	ABB India Ltd.	India
2.	Emerson Process Management (I) Pvt. Ltd.	India
3.	Krohne Marshall Pvt. Ltd.	India
4	Siemens Ltd.	India

5.	Yokogawa Limited	India
6	Bopp & Reuther MesstechnikGmbh	Germany
7.	Endress + Hauser	Germany
8..	Itochu Corporation	Japan
9.	Krohne	Germany
10.	Schlumberger resource management Ltd.	U.S.A
PD Meter		
1.	Chemtrols Industries Ltd.	India
2.	Rock Flow Meters (i) Pvt. Ltd.	India
3.	Bopp & Reuther MesstechnikGmbh	Germany
4.	Emerson Process Managment	U.S.A
5.	Oval Asea Pacific Pte Ltd.	Singapore
6.	Schlumberger resource management Ltd.	U.S.A
Magnetic Flow meter		
1.	ABB India Ltd.	India
2.	Chemtrol Industries Ltd	India
3.	Emerson Process Management (I) Pvt. Ltd.	India
4.	Endress + Hauser (India) Pvt. Ltd.	India
5.	Krohne Marshall Pvt. Ltd.	India
6	Siemens Ltd.	India
7	SBEM Pvt. Ltd.	India
8	Yokogawa	India
9.	Azbil Corporation	Japan
10.	Bopp & Reuther MesstechnikGmbh	Germany
11	Krohne	Germany
Insertion Type Flow Meter		
1	Emerson Process Management (I) Pvt. Ltd.	India
2	Siemens Ltd.	India
Ultrasonic Flow Meter		
1	Chemtrol Industries Ltd	India
2.	Endress + Hauser (India) Pvt. Ltd.	India
3.	Emerson Process Management	India
4	Siemens Ltd.	India
5	Yokogawa	india
Orifice Meter		
1	Chemtrol Industries Ltd	India
Metering Skid		
1.	Chemtrol Industries Ltd.	India
Pressure Gauges		
1.	Ashcroft India(P) Ltd. (standard normal type)	India
2.	A.N. Instruments Pvt. Ltd.	India
3.	Baumer Technologies India Pvt . Ltd	India
4.	Forbes Marshall	India
5.	General Instruments Consortium,	India
6.	H.Guru Industries	India
7.	Peejee Engg. Works	India
8.	Precision Industries Ltd. (standard normal type)	India
9.	Premium Instrument & Controls Ltd.	India
10.	Manometer (India) Pvt. Ltd.	India
11.	Walchand Nagar Industries Ltd.	India
12.	Wika	India

13.	Budenberg Gauge Co. Ltd	U.K
14.	Dresser Europe S.A	Germany
15.	Nagano keiki Seisakusho	Japan
16.	Rueger Sa	Switzerland
17	Spriano Spa	Italy
18	WikaAlexenderWiegardGmbh& Co.	Germany
Local D/P Indicators		
1.	Precision Mass Products Pvt. Ltd	India
2.	Switzer Instrument Co.	India
3	Wika	India
4	Barton Instrument Systems Limited	U.K
5	Delta Controls Ltd.	U.K
Pressure & D/P Transmitters		
1.	ABB India Ltd.	India
2.	Emerson Process Management (I) Pvt. Ltd.	India
3.	Endress + Hauser (India) Pvt.Ltd.	India
4.	Honeywell Automation India Limited	India
5	Siemens Ltd.	India
6.	Yokogawa Limited	India
7.	Azbil Corporation	Japan
8.	Emerson Process Mgt Singapore Ltd	Singapore
9.	Honeywell Inc.	U.S.A
10	Moore Products Company	U.S.A
11	Siemens Ag, Germany	Germany
12	Smar Singapore Pte. Ltd.	Singapore
13	VEGA Grieshaber KG	Germany
14	Yokogawa Electric Corporation	Japan
Pressure & D/P Switches Including Vol. Seal		
1.	Endress + Hauser(India) Pvt. Ltd.	India
2.	Indfos Industries Ltd. (Except Vol.Seal)	India
3.	Kaustubha Udyog (Except Vol.Seal)	India
4.	Precision Mass Products Pvt. Ltd	India
5.	Switzer Instrument Co. (Except Vol.Seal)	India
6.	Azbil Corporation	Japan
7	Delta Controls Ltd.	U.K
8	Nagano Keiki Seisakusho	Japan
9	SOR Inc.	U.S.A
10	United Electric Controls Co.	U.S.A
Transparent/ Reflex / Bicolor Mag.Level Gauges		
1.	ABB India Ltd.	India
2.	Bliss Anand Private Ltd.	India
3.	Chemtrols Samil(India) Pvt Ltd.	India
4.	Flowtech Instruments services	India
5.	LEVCON INSTRUMENTS PVT. LTD.	INDIA
6	Nisan Scientific Process Equipments Pvt. Ltd	India
7.	Pune Techtrol Pvt. Ltd. (=<300#)	India
8	Technomatic (India) Pvt. Ltd.	India
9.	V-Automat Instruments Pvt. Ltd. (upto 300#)	India
10	Clark-Reliance Corp.	U.S.A
11	CesareBonetti	Italy
12	Jerugson Gauge & Valve Co.	U.S.A

13	Nihon Klingage Co. Ltd.	Japan
14	Richard Klinger Ag	Austria
15	Technomatic Spa	Italy
Level Switches (Float & Displacer Type)		
1.	ABB India Ltd.	India
2.	Bliss Anand Private Ltd.	India
3.	Chemtrols Samil(India) Pvt Ltd.	India
4.	Pune Techtrol Pvt. Ltd.	India
5.	SBEM Pvt. Ltd.	India
6.	Siemens Ltd.	India
7.	V.Automat & Instruments (P) Ltd.	India
8.	ISA Controls Limited	U.K.
9	KDG. MOBREY Ltd.	U.K.
10	Magnetrol International N.V	Belgium
11	SOR Inc.	U.S.A
12.	Vega Grieshaber KG	Germany
Displacer Type Level Transmitters		
1.	Chemtrols Industries Limited (Eckdart Make Electronics)	India
2.	Dresser Valve India Pvt Ltd (Rating <= 600#)	India
3.	Dresser Masoneilan	France
4.	Foxboro EckardtGmbh	Germany
5.	Magnetrol International N.V. (Lvdt)	Belgium
6.	Parcol Spa (Pneumatic Transmission Only)	Italy
Tank Level Instruments		
1.	ABB India Limited	India
2.	Emerson Process Management (i) Pvt. Ltd.	India
3.	Pune Techtrol Pvt. Ltd.	India
4.	Siemens Ltd. (Radar level Transmitter, guided wave Radar)	India
5.	SBEM Pvt. Ltd.	India
6	EnrafSingaporePte. Ltd.	Singapore
7.	Endress + Hauser Gmbh& Co., (Non-Contact & Servo)	Germany
8.	Krohne (Non-Contact Type)	Germany
9.	L& J Technologies	U.S.A
10.	Toyo Keiso Co. Ltd.	Japan
Ultrasonic Level Transmitter		
1.	Forbes Marshell	India
2.	Siemens Ltd.	India
3	Vega Grieshaber KG	Germany
Tank Farm Management		
1.	Endress + Hauser (India) Pvt. Ltd. (Servo,Radar)	India
Guided wave Rdar		
1.	Endress + Hauser (India) Pvt. Ltd	India
2.	Forbes Marshell	India
3	Magnetrol	India
4	Vega Grieshaber KG	Germany
Temperature Elements (Thermocouple, Rtd)		
1.	Altop Industries Ltd.	India
2.	ABB India Ltd.	India
3.	Detriv Instrumentation & Electronics Ltd.	India
4.	Electrical & Electronics Ltd.	India
5.	Eleind Engineering Pvt. Ltd.	India

6.	Endress + Hauser (India) Pvt. Ltd.	India
7..	Exotherms Instruments	India
8.	General Instruments Consortium	India
9.	Goa Instruments Industries Ltd.	India
10.	Industrial Instrumentation	India
11.	Precision Mass Products Pvt. Ltd.	India
12.	Pyro Electric Instruments Goa Pvt. Ltd.	India
13.	Tempsens Instruments (I) Pvt. Ltd.	India
14	Thermal Instruments India Pvt. Ltd.	India
15	Unicontrols Instruments Pvt. Ltd.	India
16	Azbil Corporation	Japan
17	Okazaki Manufacturing Co.	Japan
18	Sensycon	Germany
19	Thermo Electric Co.Ltd.	Holland
20	W.C.Heraeus GMBH	Germany
Bimetallic Thermometer		
1.	A N Instruments Pvt. Ltd.	India
2.	Ashcroft India(P) Ltd.	India
3.	Baumer Technologies India Pvt. Ltd.	India
4.	General Instruments Consortium	India
5.	Goa Instruments Industries Ltd	India
6.	H.Guru Industries	India
7	Krohne Marshall Pvt. Ltd.	India
8	Precision Mass Products Pvt. Ltd.	India
9	Nagano Keiki Seisakusho	Japan
10	Rueger SA	Swizerland
11	Technomatic SPA	Italy
12	Trend Instrument Inc.	U.S.A
Vibration Fork type Level Switches		
1.	ABB India Ltd.	India
2.	Protocontrol Instruments (I) Pvt. Ltd. (non-critical)	India
3.	Endress + Hauser	Germany
4.	SOR Inc.	U.S.A
Dial Thermometer (Hg In Steel/Glass)		
1.	A N Instruments Pvt. Ltd.	India
2.	Ashcroft India(P) Ltd.	India
3.	Baumer Technologies India Pvt. Ltd.	India
4.	General Instruments Consortium,	India
5.	Goa Instruments Industries Ltd	India
6.	H.Guru Industries	India
7.	Precision Mass Products Pvt. Ltd	India
8.	Pejee Engg Works	India
9.	Walchand Nagar Industries Ltd.	India
Radiation Pyrometer		
1.	Tempsens Instruments Pvt. Ltd.	India
2.	C.C.R Technico	Italy
3.	Chino Corpn.	Japan
4.	Land Infrared	U.K.
5.	Siemens AG	Germany
6.	Wahal Instruments	U.S.A
Temperature Transmitters		

1.	ABB India Limited	India
2.	Emerson Process	India
3.	Endress+ Hauser (India) Pvt. Ltd.	India
4.	Siemens Ltd.	India
5	Yokogawa	India
Gate/Plug Valves		
1.	Audco India Limited(L&T Valves Divn.)	India
2.	BHEL(Valves Division)	India
3.	Chemtrols Engineering Limited (Plug Valves)	India
4.	Flowserve India Control Pvt. Ltd.(Plug Valve upto 12”300# upto 6” 600#)	India
5.	Ksb Pumps Limited (Valves Divn)	India
6	NU Tech Controls (MOV Gate :1/2” to 8” 2500#, 10” to 14”,300#)	India
7.	Samsons Contols Pvt. Ltd. (Upto 34”, 300#)	India
8.	Valve Tech Industries (Mov -8” upto 2500#)	India
9.	Velan Inc.	Canada
10	Weir Bdk Vlaves	India
11	Bel Valves	Japan
12	CesareBonetti	Italy
13	Fasani S.P.A	Italy
14	MalbranqueS.A.	France
15	Matsura H. P Machine works co. Ltd.	Japan
16	Petrol Valves S.R.L	Italy
Globe / Angle Valves		
1.	AST S.P.A (Upto 8”900#)	India
2	Chemtrol Industries Ltd.	India
3	Circor Flow Technologies India Pvt. Ltd.	India
4	Dresser Valve India Pvt. Ltd.(Rating =<600#,size ¾” to 6”)	India
	Emerson Process Management India Ltd	India
5	Emet Controls Pvt. Ltd.(Globe Valve up to 4”,300# angle valve upto 1-1/2”,2500#)	India
6	Flowserve india control pvt. Ltd. (globe valve upto 30” 600# upto 24” 900#, upto 16” 2500# upto 4” 4500#)	India
7	Koso fluids controls pvt. Ltd. (globe valves: upto 8” 2500# 10 to 18” 300# angle valves upto 8” 300#)	India
8	Instrumentation Ltd. (Palakkad)	India
9.	Mil Controls Limited	India
10.	NU Tech Controls	India
11	Pneucon valves Pvt. Ltd. (upto 6” 300#) noncritical)	India
12	Samson Control Pvt Ltd(upto 6’’ &=<600#)	India
13	Tecnik valves pvt Ltd. (air & water service upto 4” 150#)	India
14	Valve-Tech Inducstries (non-critical)	India
15	Azbil Corporation (=< 2500#)	Japan
16	Arca Regler GMBH	Germany
17	Dresser Masoneilan	France
18	Flowserve (=<2500#)	U.S.A
19.	Fisher Xomox (=< 2500#)	Singapore
20.	Parcol Spa	Italy
21	Nippon Fisher Co. Ltd. (=<2500#)	Japan
22	Severn Glocon (1 to 12” 600#)	U.K.

Ball Valves		
1.	Tyco Valves & Controls (I) Ltd (=< 150 #)	India
2.	Virgo Engineers Ltd. (=<600# With Maccair Actuators)	India
3.	Anand teknow aids engineering india limited (upto 6",600# (ON-OFF)	India
4.	Bray Controls India Pvt. Ltd.(upto 4",300#)	India
5.	Emerson	India
6	EMET controls pvt. Ltd.(upto 8",150# for air service)	India
7	Fisher Xomox Sanmar	India
8	Flowserve India controls Pvt. Ltd. (upto 16" 600#)	India
9	Intervalve ponnawalla limited (uptp 10",150#)	India
10	Koso Fluid Controls pvt. Ltd. (upto 8 " ,2500# ,10" to 18" 900#)	India
11	NU Tech Controls (14",600# for non-critical purpose)	India
12	Pentair Valves and controls India Pvt. Ltd. (<=150#)	India
13	Pneucon valves pvt. Ltd. (upto 6",150# non-critical)	India
14	Samson Control Pvt Ltd(upto 24'' &=<1500#)	India
15	Valve tech industries ltd. (18",150# non critical)	India
16	Weir Bdk Vlaves (upto 16",150#)	India
17	G.T.C. Italia S.R.L(=<300#)	Italy
18	Metso Automation (=<2500#)	Singapore
19	Orbit Valves PLC (=<2500#)	Singapore
20	Petrol Valves S.R.L	Italy
21	PERRIN Gmbh (size ½" to 12",& rating 150# to 2500#,size 14"to 18", rating 150# to 1500# ,size 20"to 24" rating 150# & 300#)	Germany
22	Pibiviesse S.P.A. (Rating Upto 2500 #)	Italy
23	Rotex manufacturers & Engineers Pvt. Ltd. (upto 6" 600#, 6" to 10" 150#)	India
24	Velan Inc. (ball valves on/off size: ¼" to 6" (rating upto 2500#) size 8"to 16" (rating upto 900#) size 18" to 30 " (rating upto 300#)	Canada
Butterfly Valves		
1	Advance valves pvt. Ltd.(size 2"to 24" upto 600#)	India
2	Bray controls india pvt. Ltd. (upto 300#)	India
3	Dresser Masonelian Valves	India
4	Emet controls pvt. Ltd. (upto 4",900#, 6",150# to 16",150# double eccentric)	India
5	Flowserve india control pvt. Ltd. (upto 30",300# upto 12" 600#)	India
6	Fisher	India
7	Intervalve ponnawaala ltd. (2" to 48",150#)	India
8	Instrumentation Ltd. (Palakkad) (=< 300#)	India
9	Koso fluid controls (pvt.) ltd. (=< 150#)	India
10	Nu tech controls (16",300# for non-critical services)	India
11.	Pneucon valves pvt. Ltd. (upto 8",150# non critical)	India
12.	Samson controls pvt. Ltd.	India
13	Tyco Valves & Controls (I) Ltd (=< 150 #)	India
14	Valve tech industries (non-critical services)	India
15	Virgo Engineers Ltd. (=<300#)	India
16	Weird BDK valves (upto 16",300#0	India
17	Bray Controls(=<300#)	U.S.A

18	Keystone (Upto 2500#)	Singapore
19	Leeds valve ltd.	UK
20	Korea Unicom Valve Co. Ltd.	Korea
21	Parcol Spa (=< 2500# Urea Service Also)	Italy
22	Pentair Valves and controls India Pvt. Ltd. (<=150#)	
23	Metso Automation (Upto 2500#)	Singapore
24	Orton S.r.l. (upto 2500#)	
PRDS & SPRAY NOZZLE,VENT VALVES upto 2500#		
1.	ARCA (Forbes Marshal) (Mech. Spray nozzle type desuperheater only)	India
2.	Chemtrols Industries Ltd. (PRDS Combine &Split)	India
3.	Circor Flow Technolgies India Pvt. Ltd. (1” to 20”,upto 150#, 1 to 10” upto 1500#, 1”to 8”,upto 2500#)	India
4	Control components INC	India
5	FisherControls	India
6.	Samson Controls Pvt. Ltd. (upto 6”,150#)	India
7.	CCI Valve Technology AB	Sweden
8	SPX Valves & Controls (COPES-VULCAN LTD.)	U.S.A
Electric Actuator		
1.	Biffi Italia S.R.L	Italy
2.	Limitorque, U.S.A	U.S.A
3.	Rotork Control (Deutschland) Gmbh	Germany
4.	Auma, Usa	U.S.A
Air Filter cum Pressure Regulator		
1.	ABB India Limited	India
2.	Divya Control Elements Pvt. Ltd.	India
3.	Dresser	India
4.	Emerson Process Managenment	india
5.	Mil Controls Limited	India
6.	Placka Instruments & Controls Pvt. Ltd.	India
7.	Shavo Norgren(India) Pvt Ltd.	India
8.	Schrader Duncan Ltd. (1/4” to 2” port size)	India
Valve Actuator (Pneumatic/Rotary)		
1.	Bray Control India Pvt. Ltd.	India
2.	EL-O-Matic India Pvt. Ltd.	India
3	Rotex Manufacturers & Engineers Pvt Ltd	India
4	Schrader Ducan Ltd.	India
Self actuated pressure control valve		
1	FisherControls	India
2	Nirmal Industrial controls private limited (size ½” to 6 “ & rating : < =300#)	India
3	Nu tech Controls (upto 10”,600#)	India
4	Pneucon Valves Pvt.Ltd. (upto 4”,150#)	India
5	Samsons Controls Pvt. Ltd. (upto 2”,150#)	India
Electropneumatic Positioner		
1.	FisherControls	India
2	Siemens Ltd.	India
Desuperheaters		
1.	Circor Flow Technologies India Pvt. Ltd (upto 24”,300# upto 28”,150#, multinozzle 3” to 4”,upto 2500#)	India
2.	Chemtrols	India

3	CCI	India
4	EMET Controls Pvt. Ltd.(Desuperheating Control Valves 1-1/2", 600# * 3",2500#)	India
5	Fisher	India
6	Tyco	India
Pressure reducing Station		
1.	Circor Flow Technologies India Pvt. Ltd (1" to 20",upto 150# ,1 "to 10", upto1500#,1"to 8 " upto 2500#))	India
Pressure Regulator		
1.	Chemtrol Industries Ltd.	India
Safety Valves & Thermal Relief Valves Upto 2500#		
1.	AST S.P.A	India
2.	Bliss anand private limited (8" * 10" 300#, 6" * 8 " 600# ,4 * 6" 1500#)	India
3.	FaingerLeser Valves (P) Ltd. (Upto 600#, ½" To 6")	India
4.	Instrumentation Ltd. (Palakkad)	India
5.	Keystone	India
6	Pentair Sanmar Ltd.	India
7	Nu tech controls (upto 2",300# * 3",150#)	India
8	Valve Tech Industries	India
9	Weir Bdk Valves	India
10	BOPP & Reuther Messtechnic GMBH	Germany
11	Crossby valve & Engg. Company Ltd.	U.K
12	Dresser Industries Incorporated	U.S.A
13	Dresser Valve & Controls	Canada
14	Farris	U.K
15	Itochu Corporation	Japan
16	Parcol Spa (For Urea Service Also)	Italy
17	Sapag Gec Alsthom	France
18	Tai Milano S.P.A	Italy
19	Teledyne Fluid Systems	Thailand
Vaccum Breakers		
1.	Fainger Engineering	India
2.	Potego India Pvt. Ltd.	India
3.	Braunschweiger Flammenfilter	
4.	Itochu Corporation	Japan
5.	Parcol Spa	Italy
6.	Safety Systems UK Ltd.	U.K
7.	Tai Milano S.P.A	Italy
8.	Whessoe Varec Limited	U.K
Rupture Discs		
1.	Bs&B Safety Systems (India) Limited	India
2.	Fainger Engineering	India
3.	Tyco Sanmar	India
4.	Continental Controls Inc.	U.S.A
5.	Fike Europe	Belgium
6.	Sapag GEC Alsthom	France
7.	Teledyne Fluid Systems	Thailand
Pilot relief valves		
1.	AST S.P.A (inlet size upto 3", upto 1500#, outlet size upto 4", upto 300#,inlet size upto 4",upto 300# ,inlet size upto 6", upto	India

	150#,outlet size upto 8", upto 150#)	
2.	Bliss Anand Private Limited (Size 1"* 2" 2500#)	India
Low pressure relief valve		
1.	Protego India Pvt. Ltd. (less than 1 BAR with flame arrestor)	India
Flame arrestor		
1.	Protego India Pvt. Ltd	India
Control Panel		
1.	Electronics corporation of india ltd.	India
2.	Ex protecta	India
3.	Hulasi metals pvt. Ltd.	India
4.	Industrial control appliances (p) ltd.	India
5.	Jaisun & hutchisun control ltd.	India
6.	Prima automation (india) pvt. Ltd.	India
7.	Pyrotech electronics pvt. Ltd.	India
8	Tan swa technologies INC	India
9	United electric co (delhi) pvt. Ltd,	India
10	Yokogawa india limited	India
11	Instromet international N.V.	Holland
Programable Logic Controller- Package		
1.	ABB India Limited	India
2.	Emerson Process Management (I) Pvt. Ltd.	India
3.	Ge Fanuc Systems Prvitate Limited	India
4.	Honeywell Automation India Limited	India
5.	Rockwell Automation India Ltd.	India
6	Siemens Ltd.,	India
7.	Yokogawa	India
8	GE fanuc automation north America INC (fault tolerant TMR)	U.S.A
9	Hima paul Hiildebrandt Gmbh +Co KG (fail safe)	Germany
10	Marconi italiana (non fail safe)	Italy
11.	Omron corporation (Relay)	Japan
12	RTP Control system	U.S.A /India
13	Triconex (fault tolerant TMR)	Singapore
14	Triconex (Schenider)	Singapore
Distributed Control System		
1.	ABB India Limited	India
2.	Emerson process management India Pvt. ltd.	India
3.	Foxboro	India/Intl.
4.	Honeywell Automation India Limited	India
5.	Siemens Ltd.	India
6	Yokogawa Limited	India
7	Bailey controls company	U.S.A
8	Emerson process management Singapore ltd.	Singapore
9	Honeywell Inc.	U.S.A
10	Invensys	Holland
11	Siemens AG	Germany
12	Yokogawa Electric Corporation	Japan
ESD SHUT- DOWN SYSTEM		
1	HONEYWELL	
2	HIMA CONTROLS	
3	PAUL HILDEBRANDT (HIMA)	
4	RTP Control system	

5	Rockwell automation pvt. Ltd.	
6	SIEMENS AG	
7	TRICONEX / IMPROTEC	
8	YOKOGAWA	
Multiplexer / Remote I/O		
1.	Mtl Instrument Limited	India
2.	Pepperl + Fuch	India
3.	M.system Co. Ltd. (Remote I/O; Model No.R3)	Japan
4	M.T.L., U.K.	U.K
5	Pepperl + Fuchs Pte Ltd.	Singapore
6	Stahl-Und Apparatebau Hans LefferGmbh	Germany
Receiver Instruments (Indicator,Controller,Recorder)		
1.	ABB India Limited	India
2.	Chino-Laxsons (India) Limited (Only Recorder)	India
3.	Eurotherm Del India Limited	India
4.	Honeywell Automation India Limited	India
5.	Masibus Automation & Instrumenation Pvt.Ltd. (Receiver Instruments except recorder)	India
6.	Moore Controls Ltd.	India
7.	Yokogawa Limited	India
8	ChinoCorpn.	Japan
9.	Heraeus Electro-Nite International N.V.	Japan
10.	Honeywell Inc.	U.S.A
11	Siemens Ag, Germany	Germany
12	Yokogawa Electric Corporation	Japan
Alarm Annunciator		
1.	Industrial Instruments & Controls	India
2.	Shree Electronics	India
3.	M.T.L., U.K.	U.K
4.	Rochester Instrument Systems Ltd.	U.K
5.	Riley Panalarm	U.S.A
6.	Ronan Engg. Co.	U.S.A
Temperature Scanner		
1.	Industrial Instrumentation	India
2.	Protocontrol Instruments (I) Pvt. Ltd.	India
Cctv / Access System		
1.	Honeywell Automation India Limited	India
2.	Yokogawa Limited	India
Miscellenous Items (Rtu / ScadaEtc)		
1	ABB India Limited	India
2.	Rockwell Automation India Pvt. Ltd.	India
3.	Siemens Ltd. (Simatic WINcc)	India
Energy meter		
1.	M.system co. Ltd.(Model No. 53U)	India
Surge Protection Devices		
1.	Phoenix Contact (India) Pvt. Ltd.	India
Wiring Ducts		
1.	Trinity touch Pvt.Ltd.	India
DIN Rail		
1.	Trinity touch Pvt.Ltd.	India
Interface Module		

1.	Trinity touch Pvt.Ltd.	India
Cable connector		
1.	Phoenix contact (India) Pvt. Ltd.	India
Advance Process Control System		
1.	Yokogawa India Limited	India
Speed Indicator		
1.	Bentley NevedaLlc	U.S.A
2.	Jacquet	Switzerland
3.	Pepperl + Fuch	Germany
4.	Pepperl + Fuchs Pte Ltd.	Singapore
5.	Shinkawa Electric Co.	Japan
Burner Management System		
1.	Siemens (TMR/QMR)	
2.	Triconex (TMR/QMR)	
3.	Honeywell (TMR/QMR)	
4.	Yokogawa (TMR/QMR)	
5.	Rockwell Automation Pvt. Ltd. (TMR/QMR)	
Instrument Power & Control Cables		
1.	Associated Cables Ltd.	India
2.	Associated Flexibles & Wires Pvt. Ltd.	India
3.	Cords Cable Industries Ltd.	India
4.	Delton Cables Ltd	India
5.	Insucon Cables & Conductors (P) Ltd. (For Smaller Non-Critical Projects)	India
6.	J K Cables Limited	India
7.	Kei Industries Limited	India
8.	Leoni cable solutions	India
9.	Paramount Cable Corporation	India
10.	T C Communications Pvt Ltd	India
11.	Thermo Cables Limited	India
12.	Toshniwal Cables	India
13	Udey Pyro Cables Pvt Ltd	India
Extension & Compensating Cables		
1.	Associated Cables Ltd.	India
2.	Associated Flexibles & Wires Pvt. Ltd.	India
3.	Cords Cable Industries Ltd.	India
4.	Delton Cables Ltd	India
5.	General Instruments Consortium,	India
6.	J K Cables Limited	India
7.	Kei Industries Limited	India
8.	Paramount Cable Corporation	India
9.	ThermopadsPvt. Ltd.	India
10.	Toshniwal Cables	India
Cable Trays & Accessories (Al./Gi)		
1.	D-Y Engineers	India
2.	Globe Electrical Industries	India
3.	HOPPES	India
4.	Indiana Engg Works Pvt Ltd	India
5.	Metalite Industries	India
6.	Parekh Engineering Company	India
7	Sadhana Engineering Corporation	India

8	Steelite Engineering Limited	India
Multi Transit Inlet System		
1.	Hawke International	U.K
2.	MctBrattbergAktiebolag	Sweden
3.	RoxtecAb	Sweden
Junction Box & Cable Gland		
1.	Baliga Lighting Equipments Limited	India
2.	Ceag Flameproof Control Gears Pvt.Ltd.	India
3.	Ex-protecta	India
4.	Flameproof EquipmentsPvt. Ltd.	India
5.	Flexpro Electicals Pvt. Ltd.	India
6.	TAN SWA technologies Inc (Junction Box)	India
7.	Trinity Touch Pvt. Ltd. (Only cable Glands upto size 25M)	India
8	Stahl-Und Apparatebau Hans LefferGmbh	Germany
CS Seamless Pipes –As per Piping list		
1	Indian tube Co.(Tata Div of tubes & pipes)	India
2	ISMT limited	India
3	Maharasthra seamless limited	India
4	Dalmine SPA	Italy
5	ETS Trouvay & Cauvin	France
6	Horst kurvers Gmbh	Geramny
7	Hyundai Corporation	Korea
8	IBF seamless pipes SPA	Italy
9	Mannesmann Hnadel AG	Geramny
10	Marubeni Itochu Steel	Japan
11	Nippon steel corporation	Japan
12	Nissho IWAI Corporation	Japan
13	Okura & Co. Ltd.	Japan
14	Sojitz Corporation	Japan
15	Sumitomo metal industries Ltd.	Japan
16	Phoceenne	France
17	Vomal International Limited	UK
SS Seamless Pipes-As per piping list		
1	Choksi tube company limited	India
2	Maxim tubes company pvt. Ltd.	India
3	Nuclear fuel complex	India
4	Ratnamani metals & tubes limited	India
5	Remi edelstahl tubular ltd.	India
6	Dalmine SPA	Italy
7	Phoceenne	France
8	TPS technitube Rohrenwerke	Germany
9	T.T.I tubecex tubos inoxidables S.A. (1/2” NB SS pipe)	Spain
SS Tubes		
1.	Choksi Tube Company Ltd.	India
2.	Matim Tubes Company Pvt. Ltd.	India
3.	Nuclear Fuel Complex	India
4.	Ratnamani Metals & Tubes Limited	India
5.	Sandvik	India
6	Itochu Corporation (Rep.KubotaCorpn.)	Japan
7.	Nishitani& Co. Ltd.	Japan
8	Sumitomo Metal Industries Ltd.	Japan

Pipe Fittings		
1.	Eby industries	India
2.	Excel hydropneumatics pvt. Ltd.	India
3.	Micro precision products pvt. Ltd.	India
4	Precision engineering industries	India
5	Tecnomatic (india) pvt. Ltd.	India
6	Wesmec engineering pvt. Ltd.	India
7	Celleir	France
8	Cesare bonetti SPA	Italy
9	Dewrance & Co. Ltd.	U.K.
10	Hopkinsons Ltd.	U.K.
11	Siemens AG PGI	germany
12	Sumitomo metal industries ltd.	Japan
13	Thysen krupp stahlunion Gmbh	germany
14	Tecnomatic SPA	Italy

Instrument Miniature Valves		
1.	Audco India Limited(L&T Valves Divn.)	India
2.	Aura Inc	India
3.	Bhel (valves division)	India
4.	Chemtrol Industries Ltd	India
5.	Chemtrols Samil(India) Pvt Ltd	India
6.	Comfit & Valves Pvt. Ltd.	India
7.	Excel Hydro-Pneumatics Pvt Ltd,	India
8.	Excelsior Engg Works	India
9.	Hyd- Air Engineering works Lonavla	India
10.	Ksb Pumps Limited (Valves Divn)	India
11	Panam Engineers	India
12	Tecnomatic (India) Pvt. Ltd.	India
13	Anderson Greenwood & Co.	U.S.A
14	BFE boneey forge valve License	Italy
15	Celleir S.A.	France
16	Crane Company International Sales	U.S.A
17	Dewrance & Co. Ltd.	U.K.
18	Euromisure Cremona	Italy
19	Hopkinsons Ltd.	U.K.
20	Kosei Sanyog Ltd.	Japan
21	Swagelok company/creximco	U.S.A
22	Sumitomo metal industries ltd.	Japan
23	Technomatic SPA	Italy
24	Velan engineering Co. Limited	U.K.
25	Wesmec engineering pvt. Ltd	India
Purge rotameter		
1	Eureka industrial equipments Pvt. Ltd.	India
2	Instrumentation engineers pvt. Ltd.	India
3	Placka instruments & engineers pvt. ltd	India
AIR HEADER/ADPOT		
1	Wesmec engineering pvt. Ltd.	India
Condensate pot		
1	HYDROPNEUMATICS	India
2	MICRO-PRECISION PRODUCTS	India
3	TECHNOMATIC (I) P. LTD.	India

4	Wesmec engineering pvt. Ltd.	India
Valve manifolds		
1	Comfit & Valves Pvt. Ltd.	India
2	EXCEL HYDROPNEUMATICS PVT. LTD.	India
3	HYDER	India
4	INSTRUMENTATION LTD.	India
5	MICRO PRECISION	India
6	NORDIVAL (SWAGELOC)	
7	PARKER	India
8	TECHNOMATIC	India
9	Wesmec engineering pvt. Ltd.	India
Calibration equipment & services		
1	Tempsens instruments (i) pvt. Ltd.	India
2	Fluke	Singapore
3	Omega Engineering	US
Enclosures		
1	Trinity touch pvt. Ltd. (weatherproof size 80 * 80 mm)	India
Instrument contractor for inst. Construction /erection works		
1	Blue star	India
2	Bells control ltd.	India
3	Godrej & Boyce mfg. co. ltd	India
4.	ICB Contractor Pvt. Ltd.	India
5.	Jasubhai Industries	India
6.	Koso india pvt. Ltd. (kent introl control valve divn.)	India
7.	L&T (construction contracts Divn.)	India
8.	Miraj instrumentation service (upto 0.5 crores)	India
9.	Narayan engineering (< Rs. 5 lacs (small project))	India
10.	Pace process control pvt. Ltd.	India
11	Peron engg. Construction ltd.	India
12.	Protect control pvt. Ltd.	India
13	Technimont ICB ltd.	India

MAGNETIC NORTH
PLANT NORTH
WIND DIRECTION

VILLAGE DEOJHARNA

BOUNDARY WALL (EXIST.)

EXISTING RAIL TRACKS

GATE

GREEN BELT

EXIST. HT LINE

LINE No-1
LINE No-2
LINE No-3
LINE No-4
LINE No-5

PROPOSED TRACK HOPPER 250m LONG

LOADING/UNLOADING PLATFORM (660m x 30m)

BAGGING S/S 100M X 31M

BAGGING PLANT (4)

CONVEYOR FROM COAL MINES

CONVEYOR FROM RAILWAY SIDING

ELECTRICAL DISTRIBUTION SYSTEM & EDG [70 M x 240 M] [HOLD] NOTE-7 (17)

STEAM GENERATION PLANT [320 M x 240 M] (14)

SPACE FOR FURUTE

COOLING WATER SYSTEM FOR COAL GASIFICATION PLANT

COOLING WATER SYSTEM FOR UREA

COOLING WATER SYSTEM FOR AMMONIA

UREA PLANT

AMMONIA PLANT [100 M x 120 M]

AMMONIA STORAGE TANK [170 M x 100 M]

DM WATER PLANT [170 M x 80 M] (9)

HOLDING POND FOR ETP [27000 M2] (24)

FLARE STACK (15)

NEW BOUNDARY WALL

MATERIAL GATE (EXIST.)

MATERIAL GATE (NEW)

POLICE STATION

Future Sulphur Pastilation by Owner

SULFUR RECOVERY UNIT

Location to be defined by Owner

PURIFICATION UNIT

EDG (17)

SUBSTATION 66KL (33)

CONST. WATER STORAGE

FUEL OIL UNLOADING, STORAGE & FORWARDING AREA (7)

INST. AIR GENERATION UNIT (12)

(EXIST.UREA SILO) [192 M x 37.5 M] (20)

WATER TREATMENT PLANT [190 M x 100 M] (10)

ETP [110 M x 70 M] (11)

LABORATORY BLDG. (UREA &AMMONIA)

LABORATORY BLDG. (CGP)

FIRE WATER STORAGE & PUMP HOUSE (31) (100M x 50M) UREA PLANT EXIST.

WEIGH BRIDGE (16)

PUMP HOUSE

EXIST. HT LINE

RAW WATER STORAGE [280 M x 270 M] (22)

GASIFICATION UNIT

AIR SEPARATION UNIT

ASH /SLAG POND [70560 M2] [288 M x 245 M] (24)

SCREENING & CRUSHING BLDG.

SAMPLING STATION

CENTRAL STORE EXIST. (29)

EXT. MECHANICAL WORKSHOP (19)

ELECTRICAL WORK SHOPS

PLANT MAINT. OFFICE (30)

SHANKAR BHAGAVAN TEMPLE

HEAVY WATER PLANT EXIST

132-KV SWITCH YARD EXIST.

CANTEEN (25)

TECHANICAL BUILDING EXIST (8)

TIME OFFICE

TRAINING INSTITUTE

FIRE STATION EXIST.

TRAINING WORK SHOP

MAIN GATE

TO FACTORY

TOWNSHIP

BOUNDARY WALL

EXISTING BOUNDARY WALL

NEW BOUNDARY WALL

MAHANADI COALFIELDS Ltd. AREA

GREEN BELT

VILLAGE KARADAPALLI

N-2312910.151
E-308680.833

LEGEND

EXISTING FACILITIES	DESIGN FACILITIES OF COAL GASIFICATION PLANT	DESIGN FACILITIES OF AMMONIA-UREA PLANT	95.45	ROAD LEVEL
NEW RAILWAY TRACKS	DESIGN PIPE RACK OF COAL GASIFICATION PLANT	DESIGN PIPE RACK OF AMMONIA-UREA PLANT	95.30	DESIGN GROUND LEVEL (DHPL)
MAIN PLANT ROAD (SCOPE OF OWNER)	ROAD INSIDE BL. OF COAL GASIFICATION PLANT & AMMONIA-UREA PLANT	FACILITIES DESIGNED BY PDIL	95.45 / 95.60 (+0.150)	±0.000 ABSOLUTE LEVEL (FFL) +0.150 ABSOLUTE LEVEL (FFL)

FGL - FINISHED GROUND LEVEL
FFL - FINISHED FLOOR LEVEL
HPL - HIGHEST POINT OF PAVING

NOTE

1. THE PLOT PLAN IS DESIGNED ACCORDING TO: "PC0009-0000-0001-REV-5_PLOT_PLAN" & "PC150-0000-0205_R2 (LAND DEVELOPMENT) "WHICH IS PROVIDED BY PDIL.
2. THE INDICATED MAIN ROAD LEVELS ARE FROM "PC150-E109-201_R4 (LAYOUT OF PLANT ROAD AND TRUCK PARKING AREA)" WHICH IS PROVIDED BY PDIL.
3. ALL DIMENSIONS, COORDINATES AND LEVELS ARE IN METERS.

REV.	DESCRIPTION	DESIGN	CHECKD	APPROD	AUTHD	DATE
OF	UPDATE	L.O	L.SY	Z.R		2021.04.16
OE	UPDATE	L.O	L.SY	Z.R		2021.02.01
OD	UPDATE	L.O	Y.YF	Z.R		2020.07.10
OC	UPDATE	L.O	Y.YF	Z.R		2020.01.21
OB	UPDATE	L.O	Y.YF	Z.R		2020.01.08
OA	FIRST ISSUE	L.O	Y.YF	Z.R		2019.11.29

OWNER
Talcher Fertilizers Limited (TFL)

PMC
Projects & Development India Ltd (PDIL)

WUHUAN ENGINEERING CO., LTD.

Talcher Fertilizers Limited
Coal Gasification Plant, Talcher

GENERAL PLOT PLAN

General Plot plan & Transportation
BASIC ENGINEERING DESIGN

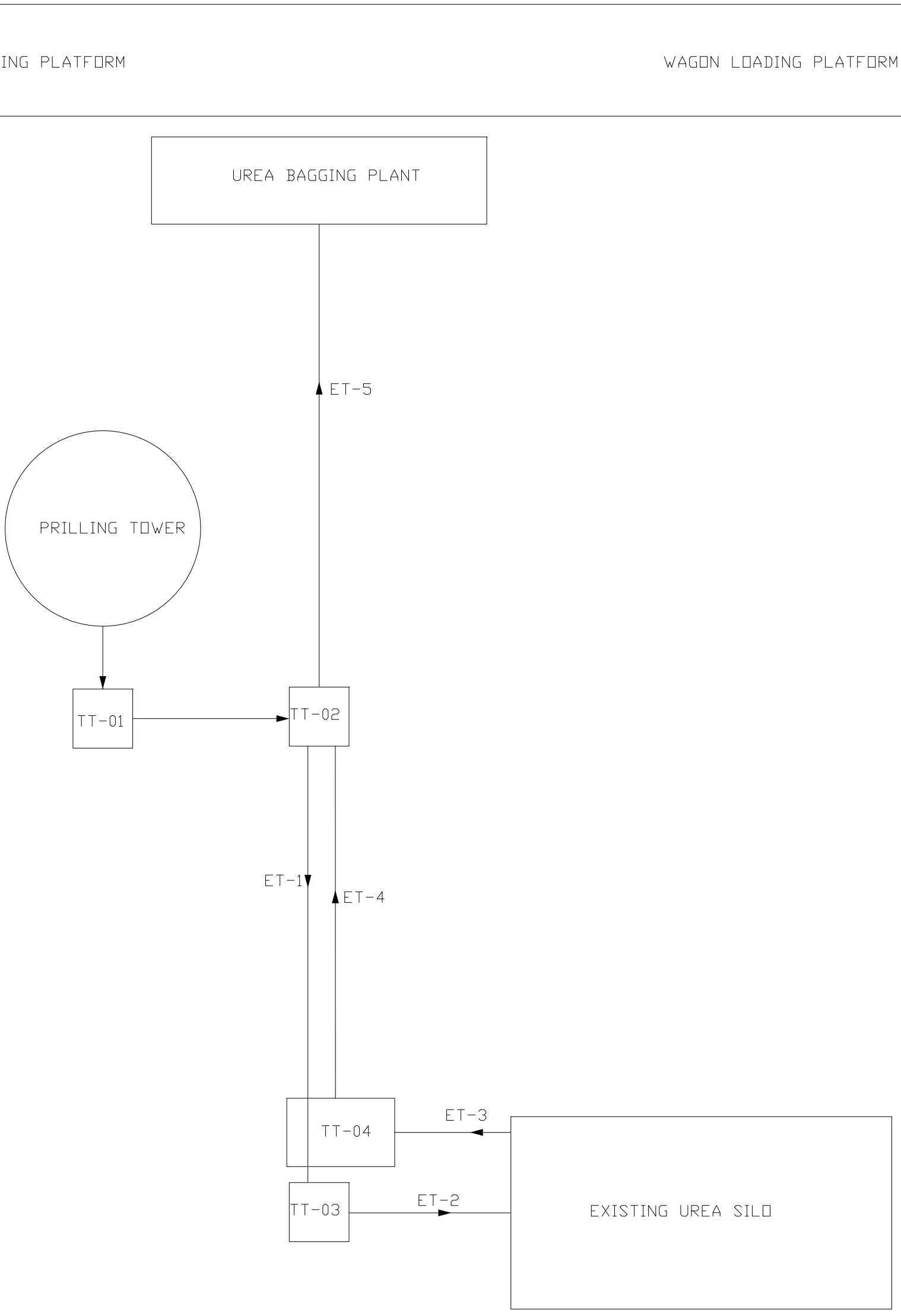
17125-331000-PL15 OF REV.

SPEC: PL AREA: - SCALE: 1:2000 SHT. 1 OF

पी डी आई एल
PDIL

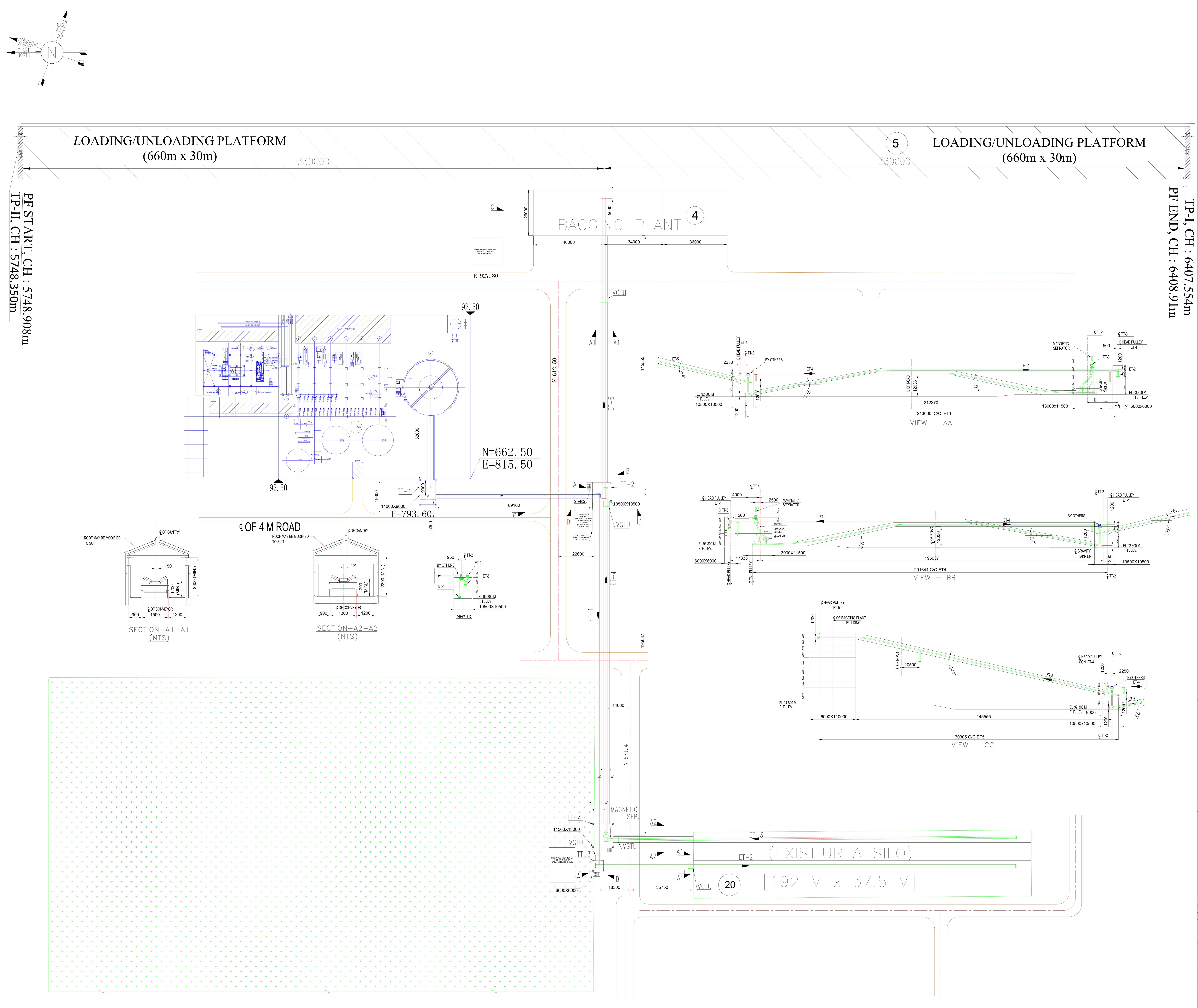
FLOW DIAGRAM
PRODUCT HANDLING SYSTEM
AMMONIA UREA PLANT,TFL-TALCHER

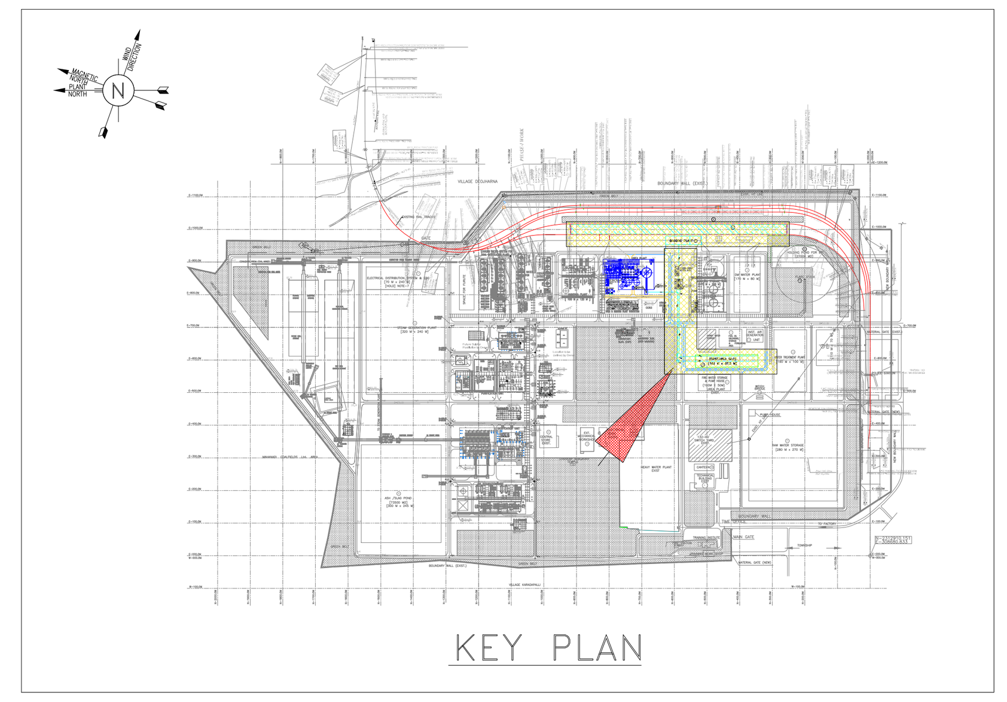
PC183-1300-0020	0
DRG. NO.	REV.
SHEET..1.OF..1..	



FLOW DIAGRAM

REV.	DATE	DESCRIPTION	PREPARED	REVIEWED	APPROVED
0	25.06.2021	ISSUED	EL	AM	PK





NOTES:–

1. ALL COORDINATES / ELEVATION ARE IN METERS & DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. FLOOR LEVEL
   a. FGL 92.000 M CORRESPONDS TO (RL) ***.***M ABOVE MSL. (TO BE CONFIRMED BY CIVIL)
   b. FFL / HPP LEVEL VARYING.
3. EQUIPMENT SIZES SHOWN ARE TENTATIVE, TO BE FINALIZED BY VENDOR / AFTER GETTING VENDOR INFORMATOIN.
4. ALL CUTOUT / OPENINGS & DIMENSION ARE TENTATIVE , TO BE FINALIZED BY VENDOR DURING DETAIL ENGINEERING .
5. ELEVATION (FGL / FFL) SHOWN ARE TENTATIVE , SHALL BE FINALIZED BY VENDOR DURING DETAIL ENGINEERING .

FOR TENDER PURPOSE ONLY.

REV	DATE	DESCRIPTION	PPD.	CKD.	APPD.
0	25.06.2021	UPDATED & ISSUED	EL	AM	PK
P	17.12.2020	ISSUED FOR COMMENTS	SATYA	EL	AM

CLIENT. M/s. TFL

CLIENT DOCUMENT NO. ---

PROJECT. AMMONIA UREA FERTILIZER PROJECT AT TALCHER

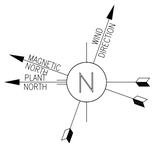
PROJ.NO	PLANT	SECTION	DEPT.
--	-	-	-

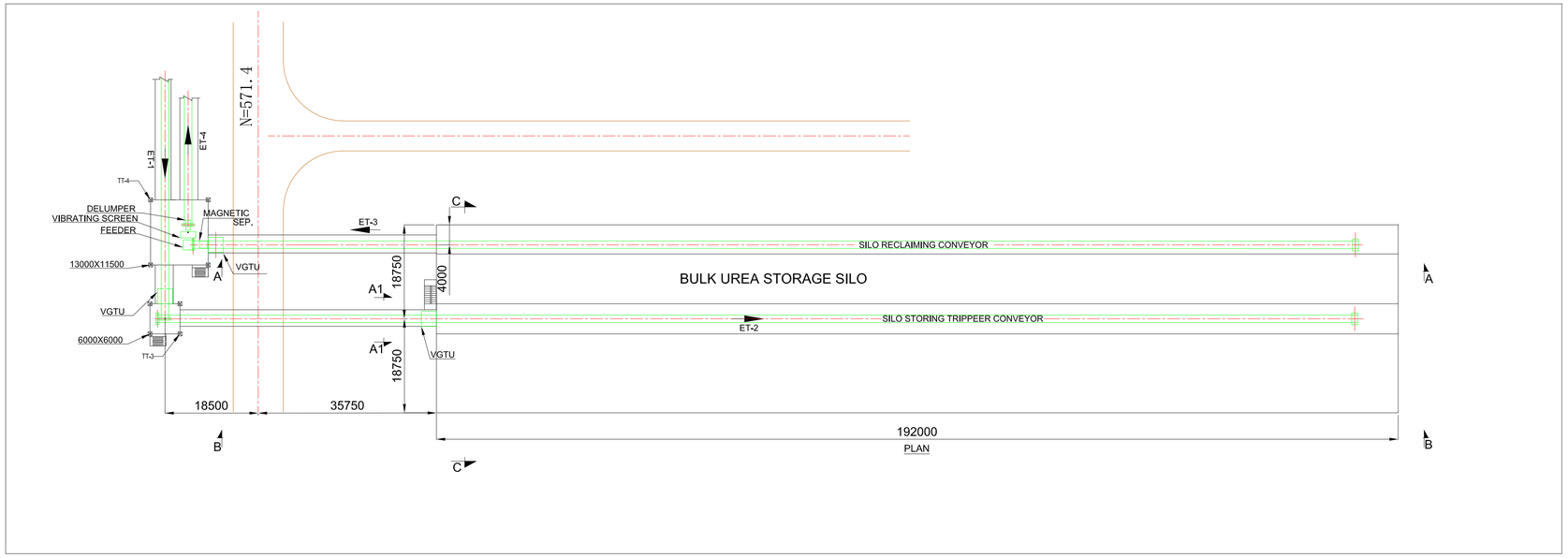
TITLE. PROPOSED LAYOUT OF PRODUCT (UREA) HANDLING SYSTEM

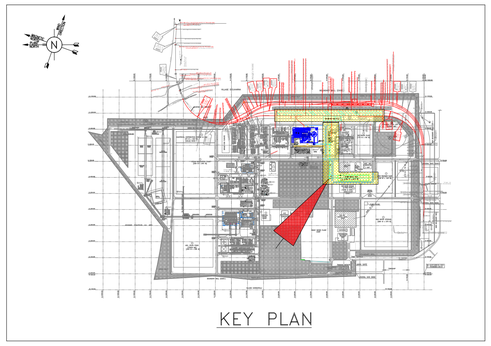
DWG.NO. PC183-1311-0001 REV. 0

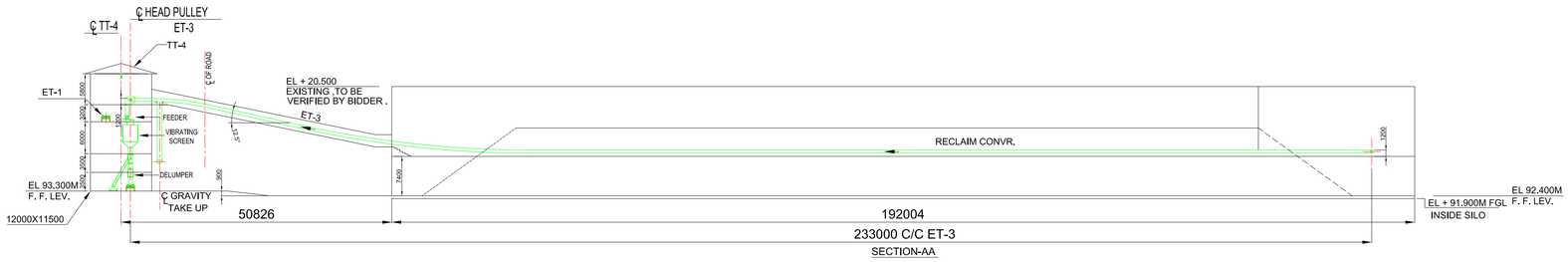
SCALE: 1 : 700 | SHEET: 1 OF 1 | DWG. SIZE. A0-SHEET 1189X841

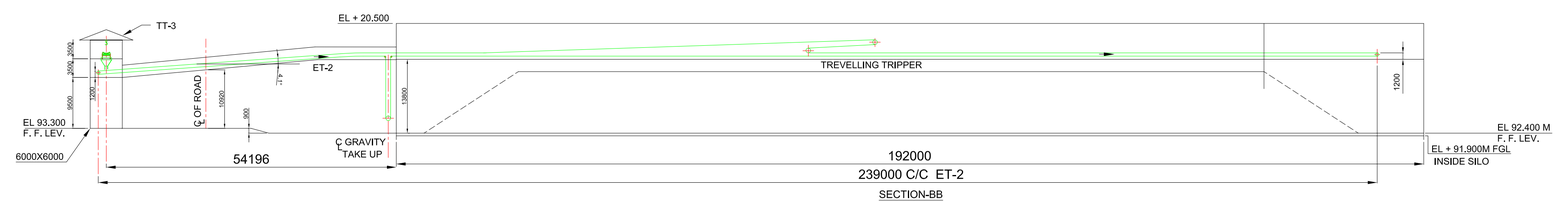
PROJECTS & DEVELOPMENT INDIA LTD., NOIDA

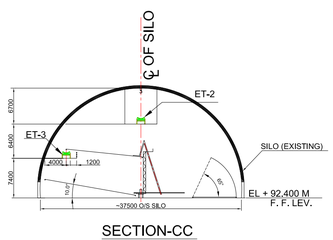


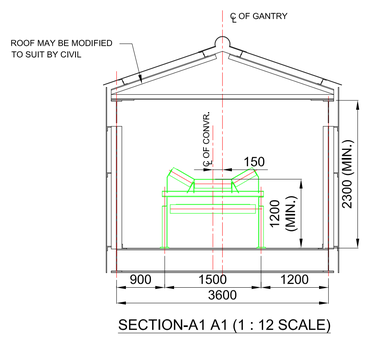












(DIMENSIONS SHOWN FOR SILO ARE TENTATIVE, CONTRACTOR TO VISIT SITE & FINALIZE)

NOTES:–

1. ALL COORDINATES/ELEVATION ARE IN METERS & DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. FLOOR LEVEL
   a. FGL 93.0000M CORRESPONDS TO (RL) ***.***ABOVE MSL. (TO BE CONFIRMED BY CIVIL)
   b. FFL/HPP LEVEL VARYING.
3. EQUIPMENT SIZES SHOWN ARE TENTATIVE, TO BE FINALIZED BY VENDOR.
4. ALL CUTOUT / OPENINGS & DIMENSIONS ARE TENTATIVE , TO BE FINALIZED BY VENDOR DURING DETAIL ENGINEERING .
5. ELEVATION (FGL / FFL) SHOWN ARE TENTATIVE , SHALL BE FINALIZED BY VENDOR DURING DETAIL ENGINEERING .

FOR TENDER PURPOSE ONLY.

REV	DATE	DESCRIPTION	PPD.	CKD.	APP'D.
0	25.06.2021	UPDATED & ISSUED	EL	AM	PK
P	17.12.2020	ISSUED FOR COMMENTS	SATYA	EL	AM

CLIENT. M/s. TFL — CLIENT DOCUMENT NO. ---

PROJECT. AMMONIA UREA FERTILIZER PROJECT AT TALCHER — PROJ.NO. -- | PLANT - | SECTION - | DEPT. -

TITLE. PROPOSED SCHEME FOR PRODUCT UREA SILO & SCREEN HOUSE — DWG.NO. PC183-1311-0002 | SCALE: 1 : 400 | DWG. AD-SHEET | SHEET: 1 OF 1 | SIZE. | 11894941

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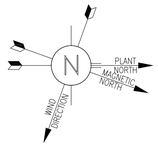
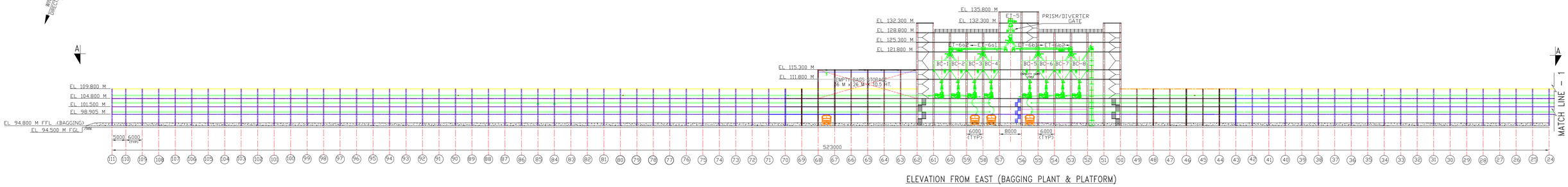
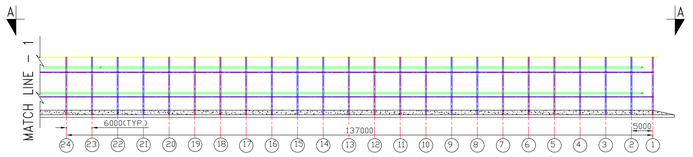
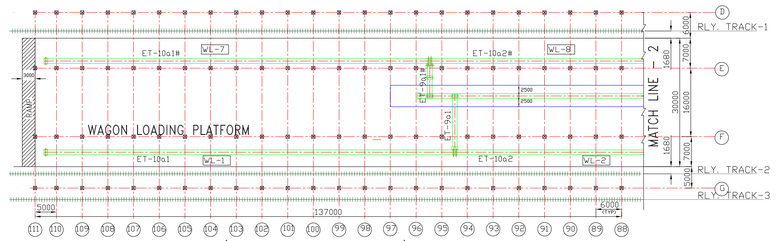




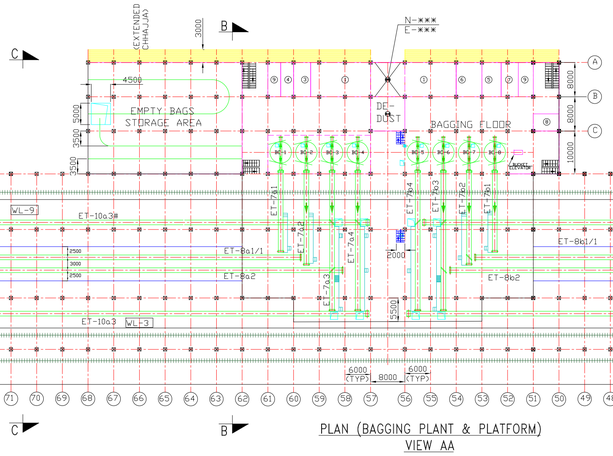
ELEVATION FROM EAST (BAGGING PLANT & PLATFORM)



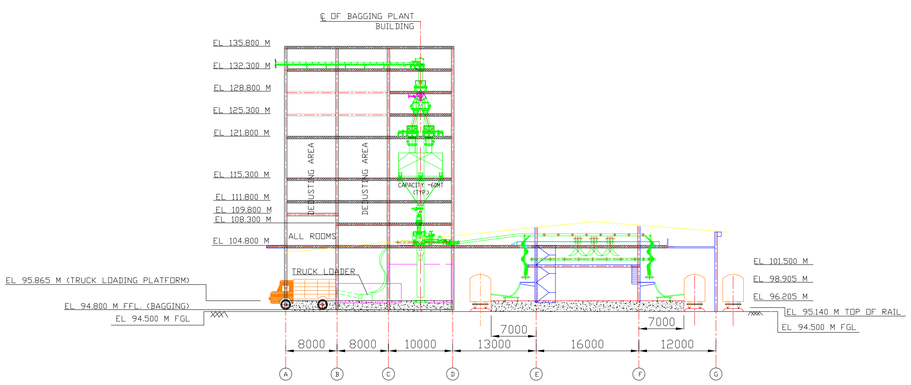
ELEVATION FROM EAST (BAGGING PLANT & PLATFORM)



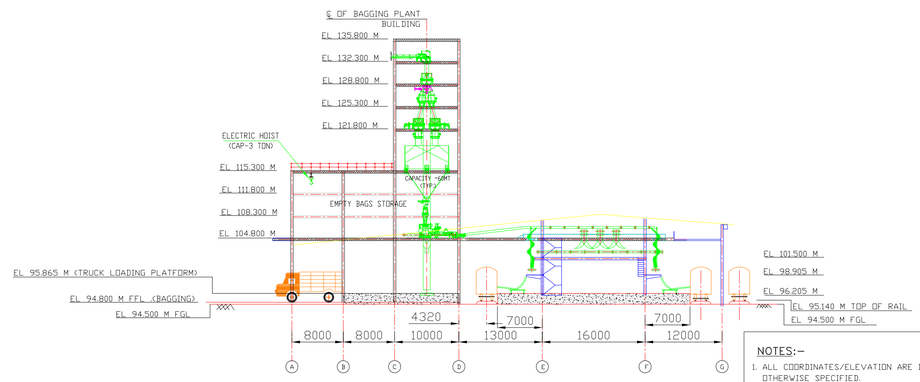
PLAN (BAGGING PLANT & PLATFORM)
VIEW AA



PLAN (BAGGING PLANT & PLATFORM)
VIEW AA



VIEW BB
(SCALE-1:50)



VIEW CC
(SCALE-1:50)

LEGENDS:–

- SLAB
- RCC TIE BEAM
- STRUCTURAL
- RAILWAY TRACK
- EQUIPMENT COLOUR
- SHED
- FACILITIES AREA
- OPENING/CUTOUTS

TABLE FOR FACILITY SPACE (TENTATIVE, TO BE FINALIZED DURING DETAIL ENGG.)

SL. NO	FACILITY DESCRIPTION	ROOM SIZE
1	CONTROL ROOM UPS WITH BATTERY BANK (1ST. FLOOR)	34M X 8M
2	M.C.C. ROOM & BATTERY CHARGER (GROUND FLOOR)	-
3	BAGGING INCHARGE ROOM (1ST. FLOOR)	4M X 8M
4	SHIFT INCHARGE ROOM (1ST. FLOOR)	3M X 8M
5	MECHANICAL MAINT.ROOM (1ST.FLOOR)	4.5M X 8M
6	ELECTRICAL & INST. MAINT. ROOM (1ST FLOOR)	6M X 8M
7	OPERATOR'S ROOM (1ST. FLOOR)	4M X 8M
8	RAILWAY OFFICE (1ST. FLOOR)	6M X 4M
9	UTILITY (WASH / TOILET) ROOM (1ST. FLOOR) (SOUTH)	3M X 8M
10	UTILITY (WASH / TOILET) ROOM (1ST. FLOOR) (NORTH)	3.5M X 8M
11	AIR COMPRESSOR AREA (GROUND FLOOR)	-

FOR TENDER PURPOSE ONLY.

NOTES:–

1. ALL COORDINATES/ELEVATION ARE IN METERS & DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. FLOOR LEVEL
   a. FGL 94.500 M CORRESPONDS TO (RL) ***.*** M ABOVE MSL. (TO BE CONFIRMED BY CIVIL)
   b. FFL/HPP LEVEL = 94.800M, FOR TRUCK LOADING AREA.
3. EQUIPMENT SIZES SHOWN ARE TENTATIVE, TO BE FINALIZED BY VENDOR / AFTER GETTING VENDOR INFORMATION.
4. ALL CUTOUT/OPENINGS ARE HOLD, UNLESS OTHERWISE SPECIFIED.

REV	DATE	DESCRIPTION	PPD.	CKD.	APPD.
0	25.06.2021	UPDATED & ISSUED	EL	AM	PK
P	17.12.2020	ISSUED FOR COMMENTS	SATYA	EL	AM

CLIENT. M/s. TFL

CLIENT DOCUMENT NO. ---

PROJECT. AMMONIA UREA FERTILIZER PROJECT AT TALCHER

PROJ. NO	PLANT	SECTION	DEPT
--	-	-	-

TITLE. PROPOSED SCHEME FOR UREA BAGGING PLANT

DWG.NO. PC183-1312-0001 (0)

SCALE: 1 : 500 | DWG. SIZE: A0-SHEET 1189X841

SHEET: 1 OF 3

PROJECTS & DEVELOPMENT INDIA LTD., NOIDA

SECTION-VII

SCHEDULE OF RATES