

NOTICE INVITING TENDER

FOR

**TENDER DOCUMENT FOR ELECTRICAL DISTRIBUTION SYSTEM
AT TALCHER FERTILIZERS LIMITED, ODISHA (INDIA) ON LSTK
AND SINGLE POINT RESPONSIBILITY BASIS.**

OPEN DOMESTIC COMPETITIVE BIDDING

(NIT NO : PNMM/PC-183/E- 4006/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)**

27.03.2021



	ELECTRICAL DISTRIBUTION SYSTEM ON A LUMP-SUM TURNKEY BASIS (LSTK) AT TALCHER FERTILIZERS LIMITED, ODISHA (INDIA) MASTER INDEX	PNMM/PC-183/E-4006 / NCB)	0	
		DOC. NO.	REV.	
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SECTION-I

INVITATION FOR BID (IFB)

SECTION-I
"INVITATION FOR BID (IFB)"

Ref No: PNMM/PC-183/E-4006 /NCB

Dated: 27.03.2021

To,

PROSPECTIVE BIDDERS

SUB: TENDER DOCUMENT FOR ELECTRICAL DISTRIBUTION SYSTEM 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 electrical distribution system on single point LSTK basis for its Coal gasification and 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, within the premises of Coal based Ammonia-Urea Complex of Fertilizer Corporation of India Limited (FCIL) 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 CONSULTANT 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	ELECTRICAL DISTRIBUTION SYSTEM AT TALCHER ON LSTK BASIS	
(B)	TENDER NO. & DATE	PNMM/PC-183/E-4006/NCB DATED 27.03.2021	
(B1)	TYPE OF TENDER	OPEN DOMESTIC COMPETITIVE BIDDING	
(C)	TYPE OF BIDDING SYSTEM	SINGLE BID SYSTEM	<input type="checkbox"/>
		TWO BID SYSTEM	<input checked="" type="checkbox"/>

(D)	TYPE OF TENDER	<table border="1"> <tr> <td>E-TENDER (CPP PORTAL)</td> <td><input checked="" type="checkbox"/></td> </tr> <tr> <td>MANUAL</td> <td><input type="checkbox"/></td> </tr> </table>	E-TENDER (CPP PORTAL)	<input checked="" type="checkbox"/>	MANUAL	<input type="checkbox"/>
E-TENDER (CPP PORTAL)	<input checked="" type="checkbox"/>					
MANUAL	<input type="checkbox"/>					
(E)	COMPLETION PERIOD	Please Refer Clause 20.0 of SPECIAL CONDITIONS OF CONTRACT .				
(F)	BID SECURITY /EARNEST MONEY DEPOSIT (EMD)	<table border="1"> <tr> <td>APPLICABLE</td> <td><input type="checkbox"/></td> </tr> <tr> <td>NOT APPLICABLE</td> <td><input checked="" type="checkbox"/></td> </tr> </table> <p>Bidders are required to submit declaration for Bid security as per attached Proforma (Refer clause no.16 of ITB)</p>	APPLICABLE	<input type="checkbox"/>	NOT APPLICABLE	<input checked="" type="checkbox"/>
APPLICABLE	<input type="checkbox"/>					
NOT APPLICABLE	<input checked="" type="checkbox"/>					
(G)	AVAILABILITY OF TENDER DOCUMENT ON WEBSITE(S)	GAIL (www.gailtenders.in) RCF Ltd. (www.rcfltd.com) CIL (www.coalindia.in) CPP Portal(https://eprocure.gov.in/eprocure/app) TFL (http://tflonline.co.in)				
(H)	LAST DATE OF RECEIPT OF BIDDER'S PRE-BID QUERIES	13.04.2021				
(I)	DATE, TIME OF PRE-BID MEETING (Through Video Conferencing)	16.04.2021 at 11:00 Hrs. (IST)				
(J)	BID SUBMISSION START DATE	12.05.2021 at 15:00 Hrs (IST)				
(K)	BID CLOSING DATE	26.05.2021 at 15:00 Hrs. (IST)				
(L)	BID OPENING DATE	27.05.2021 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	<p>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</p> <p>Kind Attention : Mr. Avijit Jharimunya DGM (PE) – Talcher JV</p> <p>Tel No. : +91 9837016692 E-mail : ajhari@gail.co.in</p>
(N)	Original Documents to be submitted at	<p>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)</p> <p>Kind Attention: Mr. P.R. Sahu, Addl. General Manager (M.M)</p> <p>Fax no. : +91-120-2529801 Tel no. : +91-120-2544063. E-mail : prsahu@pdilin.com</p>
(O)	Contact Person for Site visit	<p>M/s Talcher Fertilizers Ltd. (TFL), Administrative Building, Talcher, Post: Vikrampur, Dist: Angul, Pincode-759106, Odisha</p> <p>Kind Attention: Mr. Panchanan Halder, General Manager (PE)</p> <p>Tel No. : +91-9999692275 E-mail : phaldar@gail.co.in</p>

In case 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 depending upon Type of Tender as mentioned at Clause no. 2.0 (D) of IFB. The IFB is an integral and inseparable part of the bidding document.
- 4.0 Bidder to note that the provisions of EMD/ BID SECURITY wherever mentioned in the NIT document shall stand null & void. Bidders to only submit the declaration for Bid Security as per Format attached at (F-2)).
- 5.0 The following documents in addition to uploading the bid on 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
- iv) Original Letter of TPI as per Appendix-I at Section-II

- 6.0 Bidder(s) are advised to quote strictly as per terms and conditions of the tender documents and not to stipulate any deviations/exceptions.
- 7.0 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.
- 8.0 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.
- 9.0 Bidder(s) are advised to quote strictly as per terms and conditions of the tender documents and not to stipulate any deviations/exceptions.

The Tender Document calls for offers on single point "Sole Bidder" responsibility basis 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 above mentioned website(s) only as per Clause No. 2.0 (G) of IFB. Bidders are requested to visit the website regularly to keep themselves updated.
- 11.0 All the bidders who are willing to submit their bid are required to submit F-6 (Acknowledgement cum Consent letter) duly filled within 7 days from receipt of tender information.
- 12.0 The bidder shall submit the bid ONLINE through Central Public Procurement (CPP) Portal. Bids complete in all respects should be uploaded in the CPP portal on or before the Bid Due Date and time mentioned in at SI No. 2(K) above. Bids through Post/ Fax / E-mail /CD/ any other mode other than that specified in ITB will not be accepted
- 13.0 TFL/PDIL reserves the right to reject any or all the bids received at its discretion without assigning any reason whatsoever.

This is not an Order.

Thanking You,



(P.R. Sahu)

Add. 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-4006/NCB dated __.__.2021

Description : ELECTRICAL DISTRIBUTION SYSTEM AT TALCHER ON LSTK 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)
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(To be pasted on the envelope containing Physical Document i.e. Declaration for Bid Security, Power of Attorney & Integrity Pact)



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.

1.0 Technical Criteria:

- 1.1 The bidder must have completed one “**Similar work**“ having completed value not less than **INR 64.90 Crore** (including all applicable taxes & duties), during the last seven (07) years reckoned from the bid opening date.

“**Similar work**” shall mean the following:

Project management, Procurement, Supply, Erection, Testing & Commissioning including civil works of Electrical System/ substation , which consists of minimum One EHV Indoor Double Bus Gas Insulated Switchgear (GIS) Substation/ switchyard of at least Five (5) bays GIS circuit breakers of 220kV or above voltage level. The said “**Similar Work**” must have been in operation for atleast 1 (one) year from the date of Acceptance / Commissioning of the works

To meet the Technical Criteria 1.1 above, only single contract is acceptable. In case bidder has executed and completed composite works which includes any of the qualifying works(s) sated above, then value of such qualifying works out of the total value of composite works shall be considered for the purpose of qualification.

- 1.2 The bidder shall be an approved OEM as listed hereunder:

List of “Approved OEMs” for 220 KV Gas Insulated Switchgear (GIS):

- i) M/s ABB Power Products and Systems India Ltd.
- ii) M/s Siemens Ltd.
- iii) M/s GE T&D India Limited
- iv) M/s Hyosung T & D India Pvt. Ltd.
- v) M/s Toshiba Transmission & Distribution Systems India Pvt. Ltd.

In case bidder is NOT an approved OEM of GIS as listed above, the bidder must fulfil following criteria:

- a) The bidder must submit a MOU (Memorandum of Understanding) with one or more of approved OEM's as listed above.
- b) Further, bidder must also submit a legally enforceable undertaking (jointly with the GIS Manufacturer) to guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s)
- c) An undertaking by the OEM that in case their MOU partner becomes the successful bidder, then they shall furnish performance bank guarantee (as per prescribed format) for an amount equal to 0.6 % (zero point six) of the total contract price (excluding GST) within 30 days of issuance of FOA to TFL. This performance guarantee shall be in addition to the Contract Performance security to be submitted by the successful bidder.

Notes for 1.1 above:

- I. Job executed by a Bidder for its own plant/ project cannot be considered as experience for the purpose of meeting BEC of the tender. However, jobs executed 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 executed 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.

2.0 Financial Criteria:

- 2.1 The Annual Turnover in any one of the last three (03) preceding financial years i.e. FY 2019-20 / FY 2018-19 / FY 2017-18 or calendar years 2019/2018/2017 of the bidder should be at least **INR 38.94 Crore**.
- 2.2 Net Worth of the Company should be positive as per last audited financial year (F.Y 2019-20 or calendar year 2019).
- 2.3 The Bidder should have minimum working capital equal to **INR 7.78 Crore** as per last audited financial year (F.Y. 2019- 2020 or Calendar year 2019). 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 7.78 Crore**. The line of credit from bank shall be submitted strictly as per prescribed format.

Note (For 2.1, 2.2 and 2.3) Annual Turnover: In case of tenders having due date for submission of bid up to **30th September** of the relevant financial year, and if audited financial results of the immediate 3 preceding financial years are not available, the bidder has an option to submit the audited financial results of the 3 years immediately prior to that. Wherever the closing date of the bid is after **30th September** of the relevant financial year, bidder has to compulsorily submit the audited financial results for the immediate 3 preceding financial years.

Net Worth/Working Capital: In case of tenders having due date for submission of bid upto **30th September** of the relevant financial year, and if 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 as last financial year for Net worth & Working Capital calculation. Wherever the closing date of the bid is after **30th September** of the relevant financial year, Bidder has to compulsorily submit the audited financial results for the immediate preceding financial year.

3.0 General Note (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.
- 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. However, the Startups are exempted from submission of EMD. For availing the relaxation of EMD, bidder is required to submit requisite certificate towards Startup enterprise registration issued by Department of Industrial Policy and Promotion, Ministry of Commerce & Industry and the certificate should be 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."

5.0 Documents to be submitted for Compliance to BEC

(i) Technical Criteria of BEC:

To meet the criteria 1.1 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 reckoned from date of Acceptance / Commissioning of Works. Further, a certificate in respect of minimum one year successful operation of the Plant issued by the Owner/End user shall also be submitted.

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, Executed order value and date of completion. Further, a certificate in respect of minimum one year successful operation of the system issued by the Owner/End user shall also be submitted

To meet criteria of “Non-OEM” at Sl. no. 1.2, Bidder must submit copy(ies) of (a) MOU between bidder and concerned OEM of GIS for providing Design, Engineering, Supply, Erection/ Supervision of erection, and Commissioning of GIS System (b) Legally enforceable undertaking (jointly with the GIS Manufacturer) (c) Undertaking on letter head of OEM regarding submission of 2% Performance Bank Guarantee in case order is awarded to MOU partner (successful bidder).

(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/Calendar years (i.e. FY 2019-20 / FY 2018-19 / FY 2017-18 or calendar years 2019/2018/2017) whichever meets the annual turnover criteria.
- (b) To meet the criteria for Sr. No. 2.2, Bidder shall submit the last Audited Financial Statements (FY 2019-20 or calendar year 2019) alongwith “Details of Financial Capability of the Bidder” in prescribed format duly signed and stamped by Chartered Accountant.
- (c) To meet the criteria for Sr. No. 2.3, Bidder shall submit the last Audited Financial Statements (FY 2019-20 or calendar year 2019) along with (i) Bank’s Letter (if applicable) and (ii) “Details of Financial Capability of the Bidder” in prescribed format duly signed and stamped by Chartered Accountant along-with Bank’s letter for 2.3 (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 format.

For 5.0 (ii) above, the “Note for 2.1, 2.2 & 2.3” under 2.0 (Financial Criteria of BEC) shall apply.

6.0 Authentication of documents submitted against BEC

6.1 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 at Appendix-I):

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 Rhein land (India) Pvt. Ltd.
7. TÜV SÜD South Asia Pvt. Ltd.
8. TUV India Pvt. Ltd. (TÜV Nord Group)
9. Inter tek 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

All charges of the Third party for verification and certification shall be borne by the Bidder. TPIA will provide in addition a certificate towards verification and certification of documents pertaining to Technical BEC as per the prescribed format.

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

- 6.2 For authentication of document submitted in support of Financial Criteria of Bid Evaluation criteria (BEC), copy of audited annual financial statements submitted with bid shall be duly certified / attested by Notary Public with legible stamp. Further, bidder shall submit "Details of financial capability of Bidder" in prescribed format duly signed and stamped by a Chartered Accountant/ Certified Public Accountant (CPA).

Note: In case, bidder submits 'Details of financial capability of bidder' in prescribed format in support of financial criteria of BEC duly signed and stamped by its **Statutory Auditor**, authentication of audited financial statements as mentioned above may not be necessary.

B. EVALUATION METHODOLOGY

The works involve Design Engineering, Supply, Erection, Testing and commissioning on single point responsibility basis (LSTK) basis. Hence, the subject work is indivisible and complete works shall be awarded to bidder quoting lowest TOTAL LSTK PRICE inclusive of all applicable taxes & duties including GST.

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.....

SECTION-III

INSTRUCTION TO BIDDERS

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

SECTION-III

INSTRUCTION TO BIDDERS

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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 Tender document issued by Employer. Employer/Owner/TFL occurring herein under shall be considered synonymous.
- 1.2 SCOPE OF BID: The scope of work/ Services shall be as defined in Section-VI-3.0 of the Tender documents.
- 1.3 The successful bidder will be expected to complete the scope of Bid within the period stated in Special Conditions of Contract.
- 1.4 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, FCIL) or Public-Sector Project Management Consultant (like PDIL 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 or during the process of evaluation of bids. 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, FCIL.

If the Tender 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 their 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 Deleted.

2.7 Pursuant to qualification criteria set forth in the Tender 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 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.

3 **BIDS FROM "JOINT VENTURE"/"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 Bank charges all courier charges including taxes & duties etc. incurred thereof. 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 The 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] – TENDER DOCUMENTS

7 CONTENTS OF TENDER DOCUMENTS

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

- Section-I : Invitation for Bid [IFB]
- Section-II : Bid Evaluation Criteria [BEC] & Evaluation Methodology
- Section-III : Instructions to Bidders [ITB], Annexures, 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 Tender document.

- 7.2 The Bidder is expected to examine all instructions, forms, terms & conditions in the Tender documents. The "Request for Quotation [RFQ] and/or Invitation for Bid (IFB)" 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 Tender documents or submission of a Bid not substantially responsive to the Tender 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 Tender 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 at Clause No. 2.0 (G) of IFB and communicated to prospective bidders by e-mail.
- 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".

9 AMENDMENT OF TENDER DOCUMENTS

- 9.1 At any time prior to the 'Bid Due Date', Owner may, for any reason, whether at its own initiative or in response to a clarification requested by a prospective Bidder, modify the Tender documents by amendment / corrigendum.
- 9.2 Any corrigendum thus issued shall be integral part of the Tender Document and shall be hosted 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.
- 9.3 The Employer, if it considers necessary, may extend the date of submissions of Bid in order to allow the Bidders a reasonable time to furnish their most competitive bid taking into account the amendment / corrigendum issued thereof.

[C] – PREPARATION OF BIDS

10 LANGUAGE OF BID:

The bid prepared by the Bidder and all correspondence, 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 in a language other than English, the same should be accompanied by an English translation duly authenticated by the Chamber of Commerce of Bidders Country, 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 and the ready reckoner for bidders available in <https://eprocure.gov.in/eprocure/app>. Bids submitted manually shall be rejected.

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.
- (b) Duly attested documents in accordance with the "BID EVALUATION CRITERIA [BEC]" establishing the qualification.
- (c) 'Bidder's General Information', as per 'Form F-1'.
- (d) Copies of documents, as specified in tender document
- (e) As a confirmation that the prices are quoted in requisite format complying with the requirements copy of Schedule of Rate (SOR) with prices blanked out mentioning quoted / not quoted (as applicable) written against each item.
- (f) 'Letter of Authority' on the Letter Head, as per 'Form F-3'
- (g) 'Agreed Terms and Conditions', as per 'Form F-5'
- (h) 'Acknowledgement cum Consent Letter', as per 'Form F-6'
- (i) Copy of Power of Attorney as per 'F-13'/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) All forms and Formats including Annexures
- (l) 'Integrity Pact' as per 'Form F-15'
- (m) 'Indemnity Bond' as per 'Form F-16'
- (n) Checklist for Bid Evaluation Criteria (BEC) qualifying documents for bidder as per 'Form F-31

- (o) Declaration by bidder towards Minimum Local Content as per 'Form-I of Annexure-V'
- (p) Undertaking regarding Provisions for Procurement from a bidder which shares a land border with India as per 'Form 1 and Form-2 attached with Annexure VII
- (q) Tender Document along with all Amendments/Corrigendum/Addendum, if any, duly signed/ digitally signed by the Authorized Signatory.
- (r) Additional document specified in Bidding Data Sheet (BDS).
- (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.
2. Forms F-4 and F-14 are not to be filled up at this stage as these will be executed only with successful bidder. However, bidders to be participated in this tender shall produce an acknowledgement regarding acceptance of prescribed format without any deviations.

11.1.2 PART-II: Price Bid

- i) The Prices are to be submitted strictly as per the Schedule of Rate of the Tender documents. TFL/PDIL shall not be responsible for any failure on the part of the bidder to follow the instructions.
- ii) Bidders are advised NOT to mention Rebate/Discount separately, either in the SOR format or anywhere else in the offer. In case Bidder(s) intend to offer any Rebate/Discount, they should include the same in the item rate(s) itself under the "Schedule of Rates (SOR)" and indicate the discounted unit rate(s) only.
- iii) If any unconditional rebate has been offered in the quoted rate the same shall be considered in arriving at evaluated price. However no cognizance shall be taken for any conditional discount for the purpose of evaluation of the bids.

- iv) In case, it is observed that any of the bidder(s) has/have offered suo-moto Discount/Rebate after opening of unpriced bid but before opening of price bids such discount /rebate(s) shall not be considered for evaluation. However, in the event of the bidder emerging as the lowest evaluated bidder without considering the discount/rebate(s), then such discount/rebate(s) offered by the bidder shall be considered for Award of Work and the same will be conclusive and binding on the bidder.
- v) In the event as a result of techno-commercial discussions or pursuant to seeking clarifications / confirmations from bidders, while evaluating the un-priced part of the bid, any of the bidders submits a sealed envelope stating that it contains revised prices; such bidder(s) will be requested to withdraw the revised prices failing which the bid will not be considered for further evaluation.

11.2 Bidders must submit the original "Declaration for Bid Security , Power of Attorney, Integrity Pact and TPI letter as specified in the Tender Document to the address mentioned in IFB, in a sealed envelope, superscribing the details of Tender Document (i.e. tender number & tender for) within 7 days from the date of un-priced bid opening.

11.3 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 be uploaded in CPP portal.

12 SCHEDULE OF RATES / BID PRICES

12.1 Unless stated otherwise in the Tender documents, the Contract shall be for the whole works as described in Tender documents, based on the rates and prices submitted by the Bidder and accepted by the Employer.

12.2 Prices must be filled in format for "Schedule of Rates [SOR]"/"BOQ" enclosed as part of Tender document. If there is any variation in item description, unit or quantity vis-à-vis SOR format of Tender Document; 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 Tender 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 Tender 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. Applicable rate of **GST (CGST & SGST/ UTGST or IGST)** on the contract value shall be indicated in SOR under column for GST.

12.5 Prices quoted by the Bidder, shall remain firm and fixed and valid until completion of the Contract and will not be subject to variation on any account. Any new taxes & Duties, if imposed by the State/ Govt. of India after due date of bid submission but before the expiry of contract period, shall be reimbursed to the contractor on submission of documentary evidence for proof of payment to State/ Govt. Authorities and after ascertaining it's applicability with respect to the contract.

12.6 Further, Bidder shall also mention the **Service Accounting Codes (SAC) / Harmonized System of Nomenclature (HSN)** at the designated place in SOR.

13 GST (CGST & SGST/ UTGST or IGST)

13.1 Bidders are required to mention the GST Registration number in 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 Service Provider only. Service Provider providing taxable service shall issue tax 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 Service Provider with requisite details.

Payments to Service Provider 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 equivalent Central Government agency/ State Government agency brings to the notice of TFL that the Supplier of Goods / Services (Service Provider) 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 a 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 TFL will reimburse **GST (CGST & SGST/UTGST or IGST)** to the Contractor at actuals against submission of Tax Invoices as per format specified in rules/ regulation of GST, subject to any statutory variations, except variations arising due to change in turnover.

13.6 TFL will prefer to deal with registered contractors 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).

13.7 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.

13.8 RECONCILIATION BETWEEN GSTR 2A AND INPUT TAX CREDIT

Supplier shall ensure timely submission of correct e-Invoice(s)/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 Bidder 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 Bidder under this contract or under any other contract.

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 Bidder has not remitted the amount towards GST (CGST & SGST/UTGST or IGST) collected from TFL to the government exchequer, then, that Bidder shall be put under Holiday list of OWNER for period of six months as mentioned in Procedure for Evaluation of Performance of Vendors/ Suppliers/ Contractors/ Bidders. This action will be in addition to the right of recovery of financial implication arising on TFL.

- 13.9 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.

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 vendor 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 vendor and shall also be entitled to deduct / recover such GST along with all penalties / interest, if any, incurred by TFL.

- 13.12 The Contractor shall mention the particulars of Talcher Fertilizers Limited, (place specified in BDS) on the Invoice. Besides, if any other particulars of Talcher Fertilizers Limited are required to be mentioned, under GST rules/ regulations, the same shall also be mentioned on the Invoice.

13.13 GST, as quoted by the bidder, 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 GST or an erroneous GST, the bid evaluation for finalizing the L1 bidder will be done considering the quoted GST rate. 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 The CONTRACTOR confirms that it has included all taxes, duties, levies etc., as applicable at prevailing rates, in its SCHEDULE OF RATES. 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.

13.15 Wherever TDS under GST Laws has been deducted from the Tax invoices raised / payments made to the vendors, as per the provisions of the GST law / Rules, Vendors 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).

13.16 **Provision w.r.t. E- Invoicing requirement as per GST laws:** Contractor(s) 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 contractor 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 Contractor with requisite details.

If input tax credit is not available to TFL for any reason attributable to contractor (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 contract.

To ensure compliance, undertaking in requisite format is to be submitted by Contractor as per format enclosed at Form F-30 along with documents for release of payment.

- 13.17 **Provision w.r.t. TCS on Sale of Goods under section 206C(1H) of Income Tax Act (Applicable only in case of procurement of Goods):** As per section 206C(1H) of the Income Tax Act, 1961 inserted by Finance Act 2020, a seller (as defined under the said section), who receives any amount as consideration for sale of any goods to a buyer (as defined under the provision) of the value or aggregate of such value exceeding fifty lakh rupees in any previous year, shall levy at the time of sale, TCS for a sum equal to % as defined (Presently 0.1 per cent) of the sale consideration exceeding fifty lakh rupees (or limit as specified in the Act) and deposit the same with Government on receipt/collection of consideration from TFL.

TFL will avail TCS credit and adjust such TCS credit against its income tax liability on the basis of TCS certificate to be issued by seller to TFL.

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. A Bidder agreeing to the request will not be required or permitted to modify his Bid.

16 EARNEST MONEY DEPOSIT (DECLARATION FOR BID SECURITY)

- 16.1 Bid must be accompanied with Declaration for Bid Security, as per Form **(F-2)**. Bid not accompanied with Declaration for Bid Security or Declaration for Bid Security not in requisite format shall be liable for rejection.

- 16.2 Deleted

17 PRE-BID MEETING

- 17.1 The Bidder(s) or his designated representative are invited to attend a "Pre-Bid Meeting" which will be held through video conferencing only. The bidder shall send the list of representatives (not more than two) with their email IDs (on which meeting link will be sent) who wishes to attend the Pre Bid meeting to PDIL, at least two days before the scheduled Pre-bid 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 websites as mentioned at Clause No. 2.0 (G) of IFB. Any modification of the Contents of Tender 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 a 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 unamended 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 Digitally signed documents to be uploaded as detailed in addendum to ITB.

19 ZERO DEVIATION AND REJECTION CRITERIA

19.1 ZERO DEVIATION: Deviation to terms and conditions of "Tender documents" may lead to rejection of bid. TFL will accept bids based on terms & conditions of "Tender 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 Tender 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) Specifications & Scope of Work
- d) Schedule of Rates / Price Schedule / Price Basis
- e) Duration / Period of Contract/ Completion Period
- f) Payment Terms
- g) Period of Validity of Bid
- h) Integrity Pact
- i) Mutually Agreed Damages
- j) Overall ceiling on total liability
- k) Contract Performance Security
- l) Guarantee / Defect Liability Period
- m) Arbitration / Settlement of Dispute
- n) Governing laws, language & measures
- o) Force Majeure
- p) Undertaking forms, Form I & II of Annexure VII for provision for procurement from a bidder which shares a land border with India
- q) ***Bidder quoting less than 20% as minimum Local content (as per make in India PPLC policy)***

- r) 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 Suppliers and Contractors through RTGS / NEFT. The successful bidder should give the details of his bank account as per the E-Banking Mandate Form (F-12).

[D] – SUBMISSION OF BIDS

21 SUBMISSION, SEALING AND MARKING OF BIDS

- 21.1 Bids shall be submitted through e-tender mode on CPP portal (<https://eprocure.gov.in/eprocure/app>) in the manner specified elsewhere in tender document.
- 21.2 All the original/hard/physical copy of bids shall be addressed to the Consultant at address specified in IFB.
- 21.3 Bids submitted under the name of AGENT/ CONSULTANT/ REPRESENTATIVE /RETAINER/ ASSOCIATE etc. on behalf of a bidder/affiliate shall not be accepted.

22 DEADLINE FOR SUBMISSION OF BIDS

- 22.1 Bids must be submitted through e-tender mode on CPP portal not later than the date and time specified in the BDS (Bidding Data Sheet).
- 22.2 OWNER may, in exceptional circumstances and at its discretion, extend the deadline for submission of Bids (clause 9 of ITB refers). In which case all rights and obligations of OWNER 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 as mentioned in Clause No. 2.0(G) of IFB / communicated to the bidders.

23 LATE BIDS

CPP Portal (eprocure.gov.in) shall close immediately after the due date for submission of bid and no bids can be submitted thereafter unless the due date extended further. E-mail offers or offers submitted in physical/hard copy sent directly will not be considered and shall be rejected.

In case Bid bond/physical documents have been received but the bid itself has not been uploaded in CPP portal (<https://eprocure.gov.in/eprocure/app>), such bid bond/ physical documents shall be returned immediately to the address of sender appearing on the envelope.

24 MODIFICATION AND WITHDRAWAL OF BIDS

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

- 24.2 No bid shall be modified/ withdrawn after the Due Date & Time for Bid submission.
- 24.3 Any withdrawal/ modification/substitution of Bid in the interval between the Due Date & Time for Bid submission and the expiration of the period of bid validity specified by the Bidder in their Bid shall result in rejection of Bid.
- 21.4 The latest Bid submitted by the Bidder shall be considered for evaluation and all other Bid(s) shall be considered to be unconditionally withdrawn.
- 21.5 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, such bidders shall be debarred from participation in re-tendering of the same job(s)/item(s). Further, such bidder will be put on holiday for a period of six months after following the due procedure.

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.

[E] – BID OPENING AND EVALUATION

26 BID OPENING

26.1 Unpriced Bid Opening:

Due to COVID-19 situation, TFL/ PDIL will not be able to open unpriced bids in the presence of bidders' designated representatives. However, bidders can log onto CPP portal at the designated date & time to view the status of bids received.

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 are 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. Due to COVID-19 situation, TFL/ PDIL will not be able to open priced bids in the presence of bidders' designated representatives. However, bidders can log onto CPP portal at the designated date & time to view the status of price bids.

26.2.2 The price bids of those Bidders who were not found to be techno-commercially responsive shall not be opened. The Price bids for acceptable bidder shall be opened by OWNER/PMC.

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.
- 26.3.2 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. Information relating to the examination, clarification, evaluation & recommendation for award shall not be disclosed.
- 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 in this regard.

29 EXAMINATION OF BIDS AND DETERMINATION OF RESPONSIVENESS

- 29.1 The owner'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 Tender documents;
 - (b) Has been properly signed;
 - (c) Is substantially responsive to the requirements of the Tender 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 Tender 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.

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 DELETED.

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 Methodology mentioned under Section-II of Tender documents.

33 DELETED

34 PURCHASE PREFERENCE

Purchase preference to Central government public sector Undertaking, Local Content (PP-LC) bidders and Micro and Small Enterprises (MSEs) shall be allowed as per Government instructions in vogue.

[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 order/contract directly on the address from where Goods are produced / dispatched or Services are rendered. In case, bidder wants order/ 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.

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 OWNER 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 OWNER and successful Bidder (i.e. Contractor/Service Provider). 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. OWNER 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 The "Notification of Award" will constitute the formation of a Contract, until the Contract has been affected pursuant to signing of Contract as per "ITB: Clause-37". Upon the successful Bidder's / Contractor's furnishing of 'Contract Performance Security / Security Deposit', pursuant to "ITB: Clause-38",
- 36.3 The Order/ contract value mentioned above is subject to Mutually Agreed Damages clause.

37 SIGNING OF AGREEMENT

- 37.1 OWNER will award the Contract to the successful Bidder, who, within 'fifteen [15] days' of issuance of the same, shall sign and return the acknowledged copy to OWNER.
- 37.2 The successful Bidder/Contractor shall be required to execute 'Contract Agreement' in the prescribed format given in this Tender Document (Form F-11) 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' specified in Bidding Data Sheet (BDS) only, within 'fifteen [15] days' of issuance of "Notification of Award i.e. 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 putting the bidder on watch list/holiday/ banning list (as per polices of TALCHER FERTILIZERS LIMITED in this regard).

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

- 38.1 Within 30 days of the issuance of Notification of Award i.e. Fax of Acceptance (FOA) by OWNER, the successful bidder shall furnish the Contract Performance Security (CPS). The CPS shall be in the form of either Banker's Cheque or Demand Draft or Bank Guarantee as per Format "F-4" and shall be in the currency of the Contract.
- 38.2 The CONTRACT PERFORMANCE SECURITY shall be for an amount equal to 3% of total contract value 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) to be reimbursed by the Owner. 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 in case of Indian bidder as well as foreign bidder. 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 the annulment of the award and putting the successful Bidder/Contractor on watch list/holiday/ banning list (as per polices of TALCHER FERTILIZERS LIMITED in this regard).

- 38.4 CPS/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.
- 38.5 The CPS has to cover the entire contract value including extra works also. As long as the CPS submitted at the time of award take care of the extra works executed and total executed value is 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.
- 38.6 In case of forfeiture of Contract Performance Security/ Security Deposit, 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.
- 38.7 The Contractor will also submit covering letter along with CPS as per format at F-4.
- 38.8 Please also refer 8.0 of GCC of NIT.
- 38.9 The Bidder shall submit the "Undertaking regarding submission of Contract Performance Security within stipulated time line" as per Form F-28 with their bid.

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

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

39.2 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 Vendors/ Suppliers / Contractors/Bidders/ Consultants 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), the contractor/bidder shall be banned (in terms of aforesaid procedure) from the date of issuance of such order by OWNER, to such Vendors/ Suppliers / Contractors/Bidders/ Consultants.

The Vendor/ Supplier / Contractor/ Bidder/Consultant understands and agrees that in such cases where Vendor/ Supplier / Contractor/ Bidder/Consultant has been banned (in terms of aforesaid procedure) from the date of issuance of such order by OWNER, such decision of OWNER shall be final and binding on such Vendor/ Supplier / Contractor/ Bidder/Consultant 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 Following provision has been incorporated in tender for MSEs, in line with notification of Government of India, vide Gazette of India No. 503 dated 26.03.2012 proclaiming the Public Procurement Policy on procurement of goods and services from Micro and Small Enterprises (MSEs)

- 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 under the Micro, Small and Medium Enterprises Development Act, 2006, the bidder shall submit the following:

- i. Ministry of MSME vide Gazette notification no. CG-DL-E-26062020-220191 dated 26.06.2020 has 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 enterprises registered prior to 30.06.2020 and who are not re-registered with Udyam Registration, shall continue to be valid for a period upto 31.03.2021. Such enterprises shall submit EM Part-II or Udyog Aadhar 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 OWNER, successful bidder(s) (other than Micro/Small Enterprise) is procuring material/services from their sub-vendor who is a Micro or Small Enterprise registered with District Industries Centers or Khadi and Village Industries Commission or Khadi and Village Industries Board or Coir Board or National Small Industries Corporation or Directorate of Handicrafts and Handloom or any other body specified by Ministry of Micro, Small and Medium Enterprises 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.

41 **DELETED**

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, wherever applicable, shall be deducted as per applicable act/law/rule.

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.

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

Payment of supplier/ contractor / service provider/ consultant shall be processed only after fulfillment of above requirement

44. 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.

45. DISPUTE RESOLUTION MECHANISM

1.0 CONCILIATION

Where invitation for Conciliation has been accepted by the other party, the Parties shall attempt to settle such dispute(s) amicably under Part-III of the Arbitration and Conciliation Act, 1996. It would be only after exhausting the option of Conciliation as an Alternate Dispute Resolution Mechanism that the Parties hereto shall invoke Arbitration Clause. For the purpose of this clause, the option of 'Conciliation' shall be deemed to have been exhausted, even in case of rejection of 'Conciliation' by any of the Parties.

2.0 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.

3.0 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.

4.0 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 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. 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 **DELETED**

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. **QUARTERLY CLOSURE OF THE CONTRACT [FOR APPLICABILITY OF THIS CLAUSE REFER BDS]:-**

During execution of contracts/orders, various issues may arise. In order to timely detect and to address the contractual issue (s) during the execution of contracts, OWNER has introduced a mechanism of quarterly closure of the contract, under which all the issues related to the contract execution will be monitored on quarterly basis for resolution.

Vendors/Contractors are required to co-operate with EIC for proper implementation of this mechanism for smooth execution of the contract.”

50 **PROVISIONS FOR STARTUPS (AS DEFINED IN GAZETTE NOTIFICATION 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 APPLICABILITY REFER BDS]**

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

51 **PROVISION REGARDING INVOICE FOR REDUCED VALUE OR CREDIT NOTE TOWARDS MAD (MUTUALLY AGREED DAMAGES)**

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

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

In case any financial implication arises on OWNER due to issuance of invoice without reduction in price or non-issuance of Credit Note, the same shall be to the account of supplier/ contractor/ service provider. OWNER 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 Supplier/Contractor under this contract or under any other contract.

52 **POLICY TO PROVIDE PURCHASE PREFERENCE (LINKED WITH LOCAL CONTENT) (PP-LC).**

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

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

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 as per procedure mentioned at Clause no. E for putting the agency on banning list.

After conclusion of process and issuance of Speaking order for putting party on banning list as per process defined in para E, 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 by Corporate C&P Department, the formal communication for suspension of Order (s)/ Contract (s) and payment with immediate effect will be issued by the following with copy to concerned F&A:

- (i) For Projects cases: concerned Project Managers in case of Purchase Orders and concerned Construction-in Charge (where PMC is EIC)/ Engineer-in-Charge (EIC) in case of Contracts
- (ii) For other than Projects cases: concerned Dealing officer in case of Purchase Orders and concerned Engineer-in-Charge (EIC) in case of Contracts.

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.

However, no suspension of contract/ order will be initiated in Exceptional Cases mentioned at Clause no. B.2.3.

(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	<p>Misrepresentation/False information other than pertaining to BEC of tender but having impact on the selection process.</p> <p>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.</p>	02 years
2 2.1	<p>Corrupt/Fraudulent (pertaining to BEC of tender) /Collusive/Coercive Practices</p> <p>If an agency again commits Corrupt/Fraudulent (pertaining to BEC of tender) /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:</p> <p>(i) Repeated once</p>	<p>03 years</p> <p>7 years (in addition to the period already served)</p>

	(ii) Repeated twice or more	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 same tender/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.

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

1.0 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 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.

2.0 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 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.

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

3.1 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 need to 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:

- (a) **First such instance: Advisory notice(Yellow Card)** shall be issued and Vendor/Supplier/Contractor/ Consultant shall be put on watch list for a period of Three (3) Years.
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 such instance in other ongoing order (s)/ contract (s) or new order (s) /contact (s) on such Vendor/ Supplier/ Contractor/ Consultant.**

- (i) Poor Performance due to reasons other than Quality: **Putting on Holiday for a period of One Year**
 - (ii) Poor Performance on account of Quality (if any mark obtained against Quality parameter is less than 30): **Putting on Holiday for a period of Two Years**
 - (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 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.3.16.1 of GCC-Consultancy)
- (a) **First instance: Advisory notice (Yellow Card)** shall be issued and Vendor/Supplier/Contractor /Consultant shall 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 subsequent 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.

3.2 FOR CONSULTANCY JOBS

Monitoring and Evaluation of consultancy jobs will be carried out in the same way as described in para 3.1 for Projects.

3.3 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 C&P and for Contracts/Services by respective Engineer-In-Charge.
- iii) Depending upon Performance Rating, following action need to be initiated by C&P:

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:

(b) **First such instance: Advisory notice (Yellow Card)** shall be issued and Vendor/Supplier/Contractor/ Consultant shall be put on watch list for a period of Three (3) Years.
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 such instance in other ongoing order (s)/ contract (s) or new order (s) /contact (s) on such Vendor/ Supplier/ Contractor/ Consultant**

- (i) Poor Performance due to reasons other than Quality: **Putting on Holiday for a period of One Year**
- (ii) Poor Performance on account of Quality (if any mark obtained against Quality parameter is less than 30): **Putting on Holiday for a period of Two Years**

(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 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.3.16.1 of GCC-Consultancy)

(d) **First instance: Advisory notice (Yellow Card)** shall be issued and Vendor/Supplier/Contractor /Consultant shall 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 subsequent instances of poor/ non-performance in other ongoing order (s)/ contract (s) or new order (s) /contact (s) on such Vendor/ Supplier/ Contractor/ Consultant.

(e) **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.

(f) **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.

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 valued 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 **REVIEW & RESTORATION OF PARITES PUT ON HOLIDAY**

5.1 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.

6.0 EFFECT OF HOLIDAY

- 6.1 If a Vendor/ Supplier/Contractor/ Consultant is put on Holiday, such Vendor/ Supplier/Contractor/ Consultant should not be considered in ongoing tenders/future tenders.
- 6.2 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.
- 6.3. Effect on other ongoing tendering:
- 6.3.1 After issue of the enquiry /bid/tender but before opening of Technical bid, the bid submitted by the party shall be ignored.
- 6.3.2 After opening Technical bid but before opening the Price bid, the Price bid of the party shall not be opened 6.3.3 After opening of price, 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.
- 7.0 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.
- 8.0 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.

9. 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).

10. **ERRANT BIDDER**

In case after price bid opening the overall lowest evaluated bidder 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, such bidders shall be debarred from participation in re-tendering of the same job(s)/item(s).

Further, such bidder will be put on holiday for a period of six months after following the due procedure.

11. 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 Consultant has not remitted the amount towards GST (CGST & SGST/UTGST or IGST) collected from TFL to the government exchequer, then, that Contactor 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.

**TALCHER FERTILIZERS 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 ≤ 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

TALCHER FERTILIZERS LIMITED
PERFORMANCE RATING DATA SHEET [PRDS]
(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

Marks	Delivery Period/ Completion Schedule	Delay in Weeks	
	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
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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

marks ii) When quality Failure of severe nature 0

failure endanger system integration and safety of the system - Moderate nature 5 marks
- low severe nature 10-25 marks

iii) Number of deviations 1. No deviation 5 marks
2. No. of deviations ≤ 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, CPS/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, CPS/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

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. ASSISTANCE TO BIDDERS

- 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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BIDDING DATA SHEET (BDS)

ITB TO BE READ IN CONJUNCTION WITH THE FOLLOWING:

ITB clause	Description				
A. GENERAL					
1.0	The Invitation for Bid/ Tender is for ELECTRICAL DISTRIBUTION SYSTEM AT TALCHER, ODISHA (INDIA) The Employer/Owner is: Talcher Fertilizers Limited				
3	BIDS FROM CONSORTIUM / JOINT VENTURE <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>APPLICABLE</td> <td style="text-align: center;">✗</td> </tr> <tr> <td>NOT APPLICABLE</td> <td style="text-align: center;">✓</td> </tr> </table>	APPLICABLE	✗	NOT APPLICABLE	✓
APPLICABLE	✗				
NOT APPLICABLE	✓				
B. TENDER DOCUMENT					
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 BID					
11.1.1	The Bidder shall submit with its Part-I (Techno-commercial/ Unpriced bid) as detailed in 11.1.1 of ITB				
14	The currency of the Bid shall be INR				
15	The bid validity period shall be 06 (Six) months from final 'Bid Due Date'.				
16.1	Deleted				
D. SUBMISSION AND OPENING OF BIDS					
22.3 and 4.0 of IFB	For submission of physical document as per clause no. 4.0 of IFB, the Owner's 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)				
26	The bid opening shall take place at: M/s Projects & Development India Limited,				

	P.D.I.L Bhawan, A-14, Sector-1, Noida, (PIN 201301) Dist. GautamBudh Nagar (UP). (India)				
E. EVALUATION, AND COMPARISON OF BIDS					
32	Evaluation Methodology is mentioned in Section-II.				
33	Compensation for Extended Stay <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>APPLICABLE</td> <td style="text-align: center;">✗</td> </tr> <tr> <td>NOT APPLICABLE</td> <td style="text-align: center;">✓</td> </tr> </table>	APPLICABLE	✗	NOT APPLICABLE	✓
APPLICABLE	✗				
NOT APPLICABLE	✓				
F. AWARD OF CONTRACT					
37	State of which stamp paper is required for Contract Agreement : Uttar Pradesh (U.P.) / State where Bidder's Corporate or Registered Office is located.				
38	Contract Performance Security (CPS)/ Security Deposit <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>APPLICABLE</td> <td style="text-align: center;">✓</td> </tr> <tr> <td>NOT APPLICABLE</td> <td style="text-align: center;">✗</td> </tr> </table> <p>The value/ amount of Contract Performance Security/ Security Deposit shall be @ 3 % of TOTAL LSTK PRICE/TOTAL CONTRACT PRICE (exclusive of GST).</p>	APPLICABLE	✓	NOT APPLICABLE	✗
APPLICABLE	✓				
NOT APPLICABLE	✗				
40	Whether tendered item is non-split able or not-divisible : <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>YES</td> <td style="text-align: center;">✓</td> </tr> <tr> <td>NO</td> <td style="text-align: center;">✗</td> </tr> </table>	YES	✓	NO	✗
YES	✓				
NO	✗				
41	Provision of AHR item: <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>APPLICABLE</td> <td style="text-align: center;">✗</td> </tr> <tr> <td>NOT APPLICABLE</td> <td style="text-align: center;">✓</td> </tr> </table>	APPLICABLE	✗	NOT APPLICABLE	✓
APPLICABLE	✗				
NOT APPLICABLE	✓				
49	Quarterly Closure of Contract <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>APPLICABLE</td> <td style="text-align: center;">✓</td> </tr> <tr> <td>NOT APPLICABLE</td> <td style="text-align: center;">✗</td> </tr> </table>	APPLICABLE	✓	NOT APPLICABLE	✗
APPLICABLE	✓				
NOT APPLICABLE	✗				
Clause no.	Bonus for Early Completion				

31.1.4 of GCC	<table border="1"> <tr> <td>APPLICABLE</td> <td>✗</td> </tr> <tr> <td>NOT APPLICABLE</td> <td>✓</td> </tr> </table>		APPLICABLE	✗	NOT APPLICABLE	✓
APPLICABLE	✗					
NOT APPLICABLE	✓					
50	<p>Applicability of BEC relaxation relating to Startups:</p> <table border="1"> <tr> <td>APPLICABLE</td> <td>✗</td> </tr> <tr> <td>NOT APPLICABLE</td> <td>✓</td> </tr> </table>		APPLICABLE	✗	NOT APPLICABLE	✓
APPLICABLE	✗					
NOT APPLICABLE	✓					

**PUBLIC PROCUREMENT
(PREFERENCE TO MAKE IN INDIA), ORDER 2017**

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.

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'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.

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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.

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(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

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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.

- 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.

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- 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.

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

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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

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: Schedule of Rates containing Total LSTK PRICE/ TOTAL CONTRACT PRICE & GST.
5. It is mandatory to quote prices in SOR and fill up figures in SOR.

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.

CLAUSE REGARDING PROVISION FOR 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 website <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.

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 TO BE IN 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

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-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	BIDDER'S QUERIES FOR PRE BID MEETING
F-12	E-BANKING FORMAT
F-13	FORMAT FOR POWER OF ATTORNEY
F-14	PROFORMA FOR CONTRACT AGREEMENT
F-15	INTEGRITY PACT
F-16	INDEMNITY BOND
F-17	DELETED
F-18	PROFORMA FOR 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 SUB-CONTRACTOR'S APPROVAL (To be provided by Successful Bidder)
F-21	DELETED
F-22	DELETED
F-23	DELETED
F-24	DELETED
F-25	DELETED
F-26	DELETED
F-27	UNDERTAKING REGARDING SUBMISSION OF AUTHENTICATED DOCUMENTS RELATING TO BEC, ORIGINAL POWER OF ATTORNEY (POA) & ORIGINAL INTEGRITY PACT
F-28	UNDERTAKING REGARDING SUBMISSION CONTRACT PERFORMANCE SECURITY (CPS) / SECURITY DEPOSIT (SD) WITHIN STIPULATED TIME LINE

	FORMS FOR PUBLIC PROCUREMENT (PREFERENCE TO MAKE IN INDIA) POLICY
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
FORM-II of Annexure-V	SALIENT POINTS OF PUBLIC PROCUREMENT (PREFERENCE TO MAKE IN INDIA) POLICY
	FORMS RELATED TO ANNEXURE-VII
Form-I of Annexure-VII	UNDERTAKING ON LETTERHEAD
Form-II of Annexure-VII	CERTIFICATE FOR SUB-CONTRACTING
	Deleted
FORM-29	Deleted
F-30	UNDERTAKING REGARDING SUBMISSION OF ELECTRONIC INVOICE (E-INVOICE AS PER GST LAWS)
F-31	CHECKLIST FOR BID EVALUATION CRITERIA (BEC) QUALIFYING DOCUMENTS FOR BIDDER

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 in ITB: Clause No. 40)
	Whether MSE is owned by SC/ST Entrepreneur(s)	Yes / No (If Yes, Bidder to submit requisite documents as specified in ITB: Clause No. 40)
	Whether MSE is owned by Women	Yes / No (If Yes, Bidder to submit requisite documents as specified in ITB: Clause No. 40)
17	Whether Bidder is Startups or not	Yes / No (If Yes, Bidder to submit requisite documents as specified in ITB: Clause No. 50)
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.	

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

LETTER OF AUTHORITY

[Pro forma for Letter of Authority for Attending Subsequent 'Negotiations' / '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 'Negotiations' / 'Meetings [Pre-Bid Meeting]', 'Un-priced Bid Opening', 'Price Bid Opening' and for any subsequent correspondence / communication against the above Bidding Documents:

[1] Name & Designation _____ Signature _____
Phone/Cell:
Fax:
E-mail: @

[2] Name & Designation _____ Signature _____
Phone/Cell:
Fax:
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:

Note: This "Letter of Authority" should be on the **"letterhead"** of the Firm / 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 "Techno-commercial / Un-priced" & "Price Bid" Openings (if applicable). Bidder's authorized representative is required to carry a copy of this authority letter while attending the un-priced and priced bid opening, the same shall be submitted (if applicable).

FORMAT 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/supplier" which expression shall wherever the context so require include its successors and assignees) have been placed/ awarded the job/work of _____ vide PO/ DLOA /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 SUPPLIER/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 supplier/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 supplier/contractor is unable to complete the supply/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 supplier/contractor fails to perform the supply/work fully, the bank hereby agrees to further extend this guarantee at the instance of the supplier/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 supplier/contractor and notwithstanding any security or other guarantee that TFL may have in relation to the supplier's/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 Supplier/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 Supplier/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 / her by the Bank.
10. 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 _____ (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. In case of foreign bank, the said Bank Guarantee to be issued by its correspondent bank in India on requisite non-judicial stamp paper and place of Bid to be considered as Delhi.
2. The Bank Guarantee by Bidders will be given from bank as specified in Tender.
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.

Form-4 (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]	<table border="1"><tr><td>Contract Performance Security (CPS)</td><td>Advance</td></tr></table>	Contract Performance Security (CPS)	Advance
Contract Performance Security (CPS)	Advance		
4. Purchase Order (PO) / Fax of Acceptance (FOA) / Detailed Letter of Acceptance (DLOA) No.			
5. Details of Bank issuing Bank Guarantee (BG)			
(A) Name of Contact Person			
(B) E-mail ID			
(C) Address			
(D) Phone No. / Mobile No.			

F-5
AGREED 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.

SI.	DESCRIPTION	BIDDER'S CONFIRMATION
1	Bidder's name and address	
2.	Bidder confirms currency of quoted prices is in Indian Rupees	
3.	Bidder confirms quoted prices will remain firm and fixed till complete execution of the order.	
4.1	Bidder confirms that they have quoted rate of GST (CGST & SGST/ UTGST or IGST) in Price Schedule / Schedule of Rates (SOR)	Confirmed
4.2	Service Accounting Codes (SAC)/ Harmonized System of Nomenclature (HSN)	
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	
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	i. Whether bidder as a seller is liable to levy TCS on sale of goods as defined under the said provision of Income Tax. ii. If yes, bidder as a seller will raise proper tax invoice on sale of goods to TFL showing TCS component. iii. Bidder as a seller will comply with all the statutory requirements of TCS regarding deposit of TCS with Government on receipt/collection of consideration from TFL and issue of TCS certificate to TFL timely. iv. If TFL is unable to avail the benefit of TCS Credit on such amount collected by the Supplier, for any reason attributable to Supplier, then TFL shall be entitled to deduct / recover such amount together with penalties and interest, if any, by adjusting any amounts to be paid or becomes payable in future to the Supplier under this contract or under any other contract.	i. _____ ii. _____ iii. _____ iv. _____
5.	Bidder confirms acceptance of relevant Terms of Payment specified in the Bid Document.	
6.	Bidder confirms that Contract Performance Security will be furnished as per Bid Document.	

Sl.	DESCRIPTION	BIDDER'S CONFIRMATION				
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. Confirm contract period 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 shall be submitted after deducting the mutually agreed damages 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 furnishes EMD/Bid Security details : a) EMD/ Bid Security No. & date b) Value c) Validity					
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 Owner or (ii) the bidder is not a firm in which any Director (in Board of Director) of Owner or their relative is not a partner.	<table border="1"> <tr> <td>Confirmed</td> <td></td> </tr> <tr> <td>Not confirmed</td> <td></td> </tr> </table>	Confirmed		Not confirmed	
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 shall be borne by Bidder.					
18.	<u>No Deviation Confirmation:</u> 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.					

Sl.	DESCRIPTION	BIDDER'S CONFIRMATION
19.	<p>If Bidder becomes a successful Bidder and pursuant to the provisions of the Tender Document, award is given to them against subject Tender Document, the following Confirmation shall be automatically enforceable:</p> <p>"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."</p>	
20.	<p>Bidder to ensure all documents as per tender including clause 11 of Section III and all Formats are included in their bid.</p>	
21.	<p>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.</p>	
22.	<p>Bidder hereby confirms that they are not on 'Holiday' by OWNER or any of the JV partners of OWNER (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.</p> <p>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, FCIL.</p> <p>Bidder also confirms that they are not under any liquidation, court receivership or similar proceedings or 'bankruptcy'.</p> <p>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</p>	

SI.	DESCRIPTION	BIDDER'S CONFIRMATION
	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.	
23.	Bidder confirms that, in case of contradiction between the confirmations provided in this format and 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:

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 tender 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-8
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 Corrigendum / Addendum / Amendment (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	Power of Attorney in the name of person signing the bid.	
iv	Details and documentary proof required against BEC Criteria of Tender Document	
3.0	Confirm that all format duly filled in are enclosed with the bid duly Digitally Signed / Signed and Stamped by authorised person(s)	
4.0	Confirm that the price part as per Price Schedule has been uploaded.	
5.0	Confirm that annual reports, duly filled in Form F-10 & Form F-9, if applicable are enclosed in the offer for financial assessment	
6.0	Confirm that statutory auditor certificate as per Form 1 have been submitted (applicable for PP-LC bidder).	

Place:
Date:

[Signature of Authorized Signatory of Bidder]

Name:
Designation:

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./USD

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 the above figures 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 financial year would be the same as one normally followed by the bidder for its Annual Report.
2. 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.
3. 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.
4. **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.**
5. This certificate is to be submitted on the letter head of Chartered Accountant/CPA.

F-11
BIDDER'S QUERIES FOR PRE BID MEETING

To,

M/s TALCHER FERTILIZERS LIMITED
NOIDA

SUB:

TENDER NO:

SI. 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-12
E-Banking Mandate Form

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 Talcher Fertilizers Limited 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 Talcher Fertilizers Limited 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-13

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-14
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 : _____

Place: _____

IN PRESENCE OF TWO WITNESSES

1. _____

2. _____

Date : _____

Place: _____

1. _____

2. _____

F-15
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"

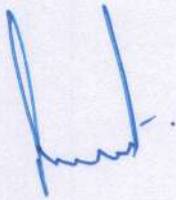


INDEPENDENT EXTERNAL MONITORS (IEMS)

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: anjan.banerjee@gov.in)
- 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.



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.



- 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,



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"



Section 6 – Equal treatment to all Bidders / Contractors / Subcontractors

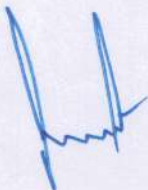
1. In case of Sub-Contracting, the Principal Contractor shall take the responsibility of the adoption of Integrity Pact by the Sub-contractor.
2. The Principal will enter into agreements with identical conditions as this one with all Bidders and Contractors.
3. The Principal will disqualify from the 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 Contract documents, whenever required. It will be obligatory for him/ her to treat the information and documents of the Bidders/ Contractors as confidential. He/she reports to the 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 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 the MD, TFL within 10 days as far as possible 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 the MD, TFL, a substantiated suspicion of an offence under relevant IPC/PC Act, and the MD, TFL has not, within reasonable time, taken visible action to proceed against such offence or reported it to the Chief Vigilance Officer, the Monitor may also transmit this information directly to the Central Vigilance Commissioner.
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.

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 the MD, TFL.

Section 10 – Miscellaneous provisions

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 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.



 (For & on Behalf of Principal) **S. DASGUPTA**
 Dy. General Manager (C&P)
 Talcher Fertilizers Ltd.
 (Office Seal) प्लॉट नं० 24, सेक्टर-16ए, नोएडा-201301(उ.प्र.)
 Plot No. 24, Sec.-16A, Noida-201 301(U.P.)

 (For & on Behalf of Bidder/Contractor)
 (Office Seal)

Place -----
 Date -----

Witness 1:
 (Sign, Name & Address)
 [FOR PRINCIPAL]

Seogam (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]

.....

F-16
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.

F-17

DELETED

**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:

- 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)

FORMAT OF LETTER OF NO DEVIATIONS

(ON BIDDER'S LETTERHEAD)

(NIT NO : PNMM/PC-183/E-4006/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.

SUBJECT : [NIT NAME]

(APPROVAL OF SUB-CONTRACTOR)

1)	NAME OF MAIN CONTRACTOR	: _____
2)	NAME OF WORK, LOCATION 1.1.1	: _____
3)	NAME OF PROPOSED SUB-CONTRACTOR 1.1.2	:
4)	SCOPE OF WORK PROPOSED TO BE SUB-CONTRACTED (BRIEF) 1.1.3	:
5)	ESTIMATED VALUE OF THE PROPOSED WORK TO BE SUB-CONTRACTED (INR) 1.1.4	:
6)	QUALIFYING CRITERIA FOR SUB-CONTRACTOR	
i)	Similar Work experience during last 07 (seven) years to be reckoned from submission of request: 1 Contract of 60% of estimated value of proposed work to be sub-contracted.	
ii)	Annual Turnover : Not less than 125% of estimated value of proposed work to be sub-contracted	
7)	EXPERIENCE AND FINANACIAL DETAILS OF PROPOSED SUB-CONTRACTOR : 1.1.5	
i)	Contract Value of similar work executed (as evidenced by work Order & Completion Certificate) During the last 7 years.	
ii)	Maximum Annual Turnover during last 3 (three) years (as evidenced by Balance Sheets)	
8)	CRITERIA FOR QUALIFICATION OF SUB-CONTRACTOR 1.1.6	
i)	Sl.No. 7(i) > 6 (i)	YES / NO
ii)	Sl.No. 7(ii) > 6 (ii)	YES / NO
9)	Based on above information, we M/s. _____ (Name of Main Contractor) propose M/s. _____ for mentioned works. We understand that notwithstanding above approval, we shall remain fully responsible for the performance of the said sub-contractor and any failure of the sub-contractor shall not absolve/relieve us of our responsibility to complete the work as per the terms and conditions of the Contract. 1.1.7	

NOTE :	Bidders to fill all the details in the above proforma. Further, Bidder shall also fill-in the details at Sl.No.5 above based on the estimated value of the proposed work to be sub-contracted. 1.1.8
10)	QUALIFICATION STATUS (TO BE STAMPED BY OWNER) :

For and on behalf of :

Stamp & Signature :

Name :

Designation :

Date :

F-21

DELETED

F-22

DELETED

F-23

DELETED

F-24

DELETED

F-25

DELETED

F-26

DELETED

F-27

DELETED

Form F-28.

**UNDERTAKING REGARDING SUBMISSION 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:

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% <input type="checkbox"/> b) LC More than 20% but less than 50% <input type="checkbox"/>
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 <u>Form-I</u> 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

UNDERTAKING ON LETTERHEAD

To,

M/s Talcher Fertilizers Limited

SUB:
TENDER NO:

Dear Sir,

We have read the Provisions for Procurement from a Bidder which shares a land border with India as per Annexure VII of Section-III. We certify that 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 hereby further certify that bidder M/s.....(Name of Bidder) fulfills all requirements in this regard and is eligible to be considered against the tender.

Place: [Signature of Authorized Signatory of Bidder]

Name:

Date: Designation:

Seal:

CERTIFICATE FOR SUB-CONTRACTING OF WORKS

To,

M/s Talcher Fertilizers Limited

SUB:

TENDER NO:

Dear Sir,

We have read the Provisions for Procurement from a Bidder which shares a land border with India as per Annexure VII of Section-III. We 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.

Place:

[Signature of Authorized Signatory of Bidder]

Name:

Date:

Designation:

Seal:

FORM F-29

DELETED

Form F-30

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:

CHECKLIST FOR BID EVALUATION CRITERIA (BEC) QUALIFYING DOCUMENTS FOR BIDDER

BEC Clause No.	Description	Documents required for qualification	Documents Submitted by Bidder
Technical BEC			
1.	Experience	<p>a) Copy of Detailed Letter of Acceptance (DLOA)/ Work Order/ relevant extract of work Order/ Contract Agreement along with detailed scope of work.</p> <p>b) The Detailed Letter of Acceptance (DLOA) / Work Order / Contract Agreement must clearly indicate nature of Work, period and contract value. Similarly, the Completion Certificate must clearly indicate reference of relevant work order/DLOA/Contract Agreement, Name of Work, Contract Value, Completed order value and date of completion</p> <p>c) Documents in support of Technical Criteria of BEC to be furnished by the Bidder, shall necessarily be duly certified/ attested by Chartered Engineer and Notary Public with legible stamp.</p> <p>Note: In case, bidder submits 'Details of financial capability of bidder' in prescribed format in support of financial criteria of BEC duly signed and stamped by its Statutory Auditor, authentication of</p>	

		audited financial statements as mentioned above may not be necessary.	
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.	
Financial BEC			
1.	Annual Turn Over	Audited Financial Statements [including Auditor's Report, Balance sheet, Profit & Loss Accounts statements, Notes & schedules etc.] for any of the last three preceding financial years, whichever meets the Annual Turnover Criteria	Submitted <i>(for any one of the preceding three (03) financial years/Calendar years (i.e. FY 2019-20 / FY 2018-19 / FY 2017-18 or calendar years 2019/2018/2017) whichever meets the annual turnover criteria.)</i>
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 <i>(last Audited Financial Statements (F.Y. 2019-20 or calendar year 2019)</i>



3.	Working Capital	<p>Audited Financial Statements [including Auditor's Report, Balance sheet, Profit & Loss Accounts statements, Notes & schedules etc.] for last Audited Financial Year.</p> <p>If the bidder's working capital is negative 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.</p>	<p>Submitted <i>(last Audited Financial Statements (F.Y. 2019-20 or calendar year 2019))</i></p> <p>Submitted/ Not Applicable <i>(Bidder to tick appropriate option)</i></p>
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: [Signature of Authorized Signatory of Bidder]

Date: Name:



Designation:

Seal:

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SECTION – IV

GENERAL CONDITIONS OF CONTRACT



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CONTENT



SL. NO.	DESCRIPTION
1.0	DEFINITION OF TERMS
2.0	CONTRACT CONFIRMATION
3.0	MODIFICATIONS IN CONTRACT
4.0	USE OF CONTRACT DOCUMENTS AND INFORMATION
5.0	PRICES, TAXES & DUTIES AND OTHER LEVIES
6.0	INCOME TAX
7.0	PATENT INFRINGEMENT AND INDEMNIFICATION
8.0	CONTRACT PERFORMANCE SECURITY (CPS)
9.0	DELETED
10.0	SIGNING OF CONTRACT
11.0	DELETED
12.0	ASSIGNMENT OR SUBLETTING OF CONTRACT AND SUB-CONTRACTING
13.0	STANDARDS
14.0	INSTRUCTIONS, DIRECTIONS
15.0	DELETED
16.0	TIME SCHEDULE, AND PROGRESS REPORTING
17.0	CONTRACTOR TO INFORM HIMSELF FULLY
18.0	SUITABILITY OF PLANT FOR INTENDED PURPOSES
19.0	FEES FOR ROYALTIES AND PATENT RIGHTS
20.0	ACTS OF PARLIAMENT, LOCAL AND OTHER AUTHORITIES REGULATIONS AND BYELAWS
21.0	TIME - PROJECT SCHEDULE
22.0	CONTRACT PRICE
23.0	DEDUCTIONS FROM CONTRACT PRICE
24.0	DELETED
25.0	DELETED
26.0	TAXES APPLICABLE TO CONTRACTOR'S MANPOWER, TURNOVER, EQUIPMENT, ETC
27.0	PACKING, FORWARDING AND SHIPMENT
28.0	INSURANCE
29.0	DELETED
30.0	LIABILITY FOR ACCIDENTS AND DAMAGES
31.0	DELETED
32.0	DELETED
33.0	TIME EXTENSION OF CONTRACT
34.0	TERMINATION OF CONTRACT
35.0	FORCE MAJEURE
36.0	NO WAIVER OF RIGHTS
37.0	BANKRUPTCY AND LIQUIDATION OF CONTRACTOR OR BUSINESS UNDER RECEIVERSHIP
38.0	CERTIFICATE NOT TO AFFECT RIGHT OF OWNER AND LIABILITY OF CONTRACTOR
39.0	SETTLEMENT OF DISPUTES

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SL. NO.	DESCRIPTION
40.0	ARBITRATION
41.0	GOVERNING LAWS , LANGUAGE AND MEASURES
42.0	RELEASE OF INFORMATION
43.0	COMPLETION OF CONTRACT
44.0	ENFORCEMENT OF TERMS
45.0	OWNER'S DECISION
46.0	CO-OPERATION
47.0	SUSPENSION OF WORK.
48.0	REPLACEMENT OF PARTS AND MATERIALS (DEFECTIVE/ DAMAGED/ LOST DURING TRANSIT/ERECTION AND COMMISSIONING)
49.0	DEFENCE OF SUITS
50.0	CONTRACTOR'S RESPONSIBILITIES
51.0	PROGRESS REPORTS AND PHOTOGRAPHS
52.0	DELETED
53.0	SECRECY
54.0	CORRESPONDENCE
55.0	MATERIALS AND EQUIPMENTS
56.0	MEASUREMENT, CERTIFYING INSPECTION & PAYMENTS
57.0	UNDER GROUND OBSTRUCTIONS
58.0	REGISTRATION TO THE CONTRACTOR WITH STATUARY AUTHORITIES
59.0	STATUARY OBLIGATIONS
60.0	UTILISATION OF LOCAL RESOURCES
61.0	FUEL REQUIREMENT OF WORKERS
62.0	SURPLUS MATERIAL
63.0	CO-ORDINATION WITH OTHER AGENCIES
64.0	ERECTION OF EQUIPMENT
65.0	ELECTRICAL CONTRACTOR LICENCE
66.0	RENT & ROYALTIES
67.0	GOVT. OF INDIA NOT LIABLE
68.0	SITE CLEANING
69.0	ACCESS TO SITE
70.0	INDEPENDENT CONTRACTOR
71.0	PAYMENT TO THE SUB – CONTRACTOR
72.0	ORDER OF WORKS / PERMISSION / RIGHT OF ENTRY / CARE OF EXISTING SERVICES
73.0	GIFTS, COMMISSIONS,ETC
74.0	LABOUR LAWS-PF, EPF AND ESI
75.0	GENERAL PROVISIONS
76.0	IMPLEMENTATION OF APPRENTICES ACT 1961
77.0	CHANGE IN CONSTITUTION
78.0	ACCESS BY ROAD
79.0	MEMBERS OF THE OWNER NOT INDIVIDUALLY LIABLE

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SL. NO.	DESCRIPTION
80.0	OWNER NOT BOUND BY PERSONAL REPRESENTATIONS
81.0	LAND FOR CONTRACTOR'S FIELD OFFICE, GODOWN AND WORKSHOP
82.0	ROUNDING-OFF OF AMOUNTS
83.0	DELETED
84.0	WORK IN MONSOON AND DEWATERING
85.0	GENERAL CONDITIONS FOR CONSTRUCTION AND ERECTION WORK
86.0	ACTION WHERE NO SPECIFICATION IS ISSUED
87.0	CARE OF WORKS
88.0	FIELD MANAGEMENT & CONTROLLING/COORDINATING AUTHORITY
89.0	LOCAL CONDITIONS
90.0	SPECIAL CONDITIONS OF CONTRACT
91.0	POWER OF ENTRY
92.0	LIENS

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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

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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,

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manuals or records.

22. 'DRAWINGS' or 'PLAN' shall mean all
- Drawings furnished by the OWNER as a basis for proposals;
 - Supplementary drawings furnished by the OWNER to clarify and to define in greater detail the intent of the CONTRACT;
 - DRAWINGS submitted by the CONTRACTOR with his proposal provided such drawings are acceptable to the OWNER.
 - DRAWING furnished by the OWNER to the CONTRACTOR during the progress of the works; and
 - 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(EIC)" 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 commissioning 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



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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. " PRE-COMMISSIONING" 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.
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, Bhubaneswar 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. Deleted.
44. 'PLANT' shall be as defined in the SPECIAL CONDITIONS OF CONTRACT.

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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. Deleted
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.

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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) Reply to Pre Bid Queries
- h) Complete Original Tender Document with all enclosures
- i) 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.



ORDER OF PRECEDENCE

In the event of any ambiguity or conflict between the Contract Documents listed in clause 2.0 above, the order of precedence shall be the order in which the Contract Documents are listed above.

2.1 INTERPRETATION OF CONTRACT DOCUMENTS



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- 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 In the event of any ambiguity or conflict between the Contract Documents listed in clause 2.0 above, the order of precedence shall be the order in which the Contract Documents are listed in Clause 2.0 (CONTRACT DOCUMENTS) above.
- 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,

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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.

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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

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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 pursuant 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 Contractor 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

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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 be 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 licensor'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,

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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 Clause 7.1.4, 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

7.2.1.1 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

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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.

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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 be 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.

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- 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

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

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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-

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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



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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 Warranty 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)

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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:

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- 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.

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- 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.

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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

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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 ROYALTIES 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

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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

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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) civil & erection (iv) Pre-Commissioning and (v) commissioning.



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 Plant, Equipment, Bulk Materials, Chemicals & Lubricants and consumables
- d. Supply of spares
- e. Allapplicable taxes and duties including GST, Indian Income Tax, etc.
- f. Civil and Structural works
- 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. Handing over of PLANT to OWNER.

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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

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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

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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 and OWNER'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

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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

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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 commissioning.

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

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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

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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

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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

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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 34.4.2 the 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,

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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

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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**

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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.



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- (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 within 120 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

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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.

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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.

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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

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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 OTHER CONTRACTORS 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 CONTRACTOR 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

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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.

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- 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
- 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
 - would improve operating or life cycle costs of the PLANT; or
 - 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 CONDITIONS OF 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)

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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**

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- 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

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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

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- 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



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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 anyway 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

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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 anyway 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**

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- 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 weightment 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 anyway 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 anyway 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

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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.

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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.) : _____

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- 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.**

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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, easements and 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 within 15 (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.

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- 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 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

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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 or 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

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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

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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

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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.

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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.

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.

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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.

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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.

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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

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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.

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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

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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.

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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:

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- (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

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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.

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- 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



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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-



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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.

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SECTION – V

SPECIAL CONDITIONS OF CONTRACT

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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 Lumpsum turnkey contract 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 bidder shall carry out the Design, detail Engineering, manufacturing/Procurement, Supply, Fabrication, Third Party Inspection (TPI) as applicable, Expediting, Site Survey and Condition Assessment, Insurance, Transportation of all Equipment / Materials to Work Site, Storage & Materials Management, Construction and Erection of all Civil & Structural works, Mechanical, Electrical and Instrumentation Works, Assembly and Installation of Equipments, Obtaining all necessary Statutory Approvals, Testing, Pre-Commissioning, Commissioning, Functional & Operational Check of entire system including Complete Project Management and Handing Over of 'PLANT' on a Lump-Sum Turnkey (LSTK) Basis under Single Point Responsibility basis, at Talcher, Angul district, Odisha for Talcher Fertilizers Limited.

'PLANT' for this NIT shall mean the 'Electrical Distribution System' as detailed below and in the Technical Section of NIT:

The Electrical Distribution System would essentially consist of Gas Insulated Switchgears (GIS), Main Receiving Substation (MRSS) and Offsite & Utilities Main Substation (OUSS) along with Civil & Structural Work, all Electrical Equipment, Mechanical Equipment, HVAC System, Fire Fighting System etc. The LSTK Contractor shall consider all the equipment with all relevant facilities of appropriate capacity for smooth, safe and reliable operation of the Electrical Distribution System as per NIT.



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The Electrical Distribution System consists of 220 kV GIS Switchgears, 33 kV GIS Switchgears, Transformers, Busducts, NER/NGT, ICOG Panel, 11 kV Switchboards, 3.3kV Switchboards, 415 V Switchboards, UPS Systems, DC System, Cables, Cable Trays, Lighting System, Earthing System, Lightning Protection System, DG Set, Electrical Control & Monitoring System of entire fertilizer complex and Electrical System Study of entire fertilizer complex etc.

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 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, civil and structural construction; mechanical, electrical and instruments erection and installation services, inspection, testing and commissioning 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. 415V feeder of 250A at Existing Substation Near 132 kV Switchyard and CONTRACTOR to arrange tap off Power from this feeder) shall be provided within 6 months of issuance of FOA on chargeable basis (presently @ of Rs 4.50/m³ 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)

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(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, expeditors 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 necessary full technical assistance to 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 PERFORMANCE SECURITY as 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, pre-commissioning and commissioning within the scope of CONTRACT.
- 1.2.0 CONTRACTOR's Scope of Work**
- 1.2.1 CONTRACTOR shall provide and be responsible for the tasks specified in this Clause under the following heads:
- 1.2.2 Deleted
- 1.2.3 Design & Engineering**
-

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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 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 as per the contract, PLANT shall be capable of meeting the requirement with respect to quality & quantity of Equipments/Systems as well as Pollution Norms as per CPCB/State Pollution Control Board and shall be reliable & safe and operable in accordance with the sound engineering practice. CONTRACTOR shall ensure design of PLANT in accordance with \ 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, during Pre-bid stage only.

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

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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 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 specified in CONTRACT.



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

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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 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 Electrical EQUIPMENT and in a separate bound book 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 in correct 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.

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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) Drawings & Documents as defined in Section VI
- b) 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 as described in Section -VI 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 as defined in Section-VI.

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.

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- 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.
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- 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 15 DAYS 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 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 here to 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 all inspections / approvals required by Statutory Authorities and as specified in Section -VI shall be made by CONTRACTOR.

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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.

1.2.8.7.17.6 In 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

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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, 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 COMMISSIONING OF PLANT.

1.2.8.10.2 Generally, on-Deck shipment shall not be made without prior permission of OWNER. However, in case of 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 COMMISSIONING 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 COMMISSIONING of all Plants. 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.

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1.2.8.10.4.8 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 and Consumable**

1.2.9.1 CONTRACTOR shall procure and supply commissioning spares, special maintenance tools and fixtures for EQUIPMENT, lubricants and consumable in sufficient quantity for COMMISSIONING and maintenance of PLANT, as described in Section-VI. The commissioning spares, special maintenance tools, lubricants, and consumable procured and supply shall be optimum, so as not to fall short during COMMISSIONING. 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 along with the related items of EQUIPMENT and form part of PURCHASE ORDER for the related items of EQUIPMENT.

1.2.9.2 **Deleted**

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 COMMISSIONING 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.

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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 & TESTING, COMMISSIONING, and FUNCTIONAL & OPERATIONAL CHECK 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-10.0, of Technical Document. Notwithstanding anything contained in this CONTRACT, the Prices for Mandatory Spares/Insurance Spares shall be included in TOTAL CONTRACT PRICE.

The Lumpsum price for “Mandatory Spares/Insurance Spares” shall be as included in the supply portion of Total Contract Price. However, details along with breakup for the above shall be submitted by successful bidder during execution.



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.

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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 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 supplied by CONTRACTOR shall be valid for minimum 12 months for all EQUIPMENT from the date of COMMISSIONING..



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 COMMISSIONING 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 5 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.

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- 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 24 months 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.

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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 Deleted

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(ies) 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

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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 COMMISSIONING. 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,

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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 endeavour 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 civil and structural work, foundations, insulating & painting works, erection, site fabrication, piping, instrumentation, electrical installation, and other miscellaneous construction jobs of PLANT leading to PRELIMINARY ACCEPTANCE of PLANT. CONTRACTOR shall organise all 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).

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1.2.15.2 CONTRACTOR shall submit and adhere to the completion schedule of construction leading to COMMISSIONING.

1.2.15.3 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.

1.2.15.4 **Civil Work Warranty**

1.2.15.4.1 CONTRACTOR shall certify that the all civil works, reinforced concrete, structures, permanent buildings and foundations has been designed in accordance with stipulations of relevant BIS Codes.

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 Deleted



1.2.18 **PRE-COMMISSIONING**

1.2.18.1 CONTRACTOR shall be responsible for completing the design, engineering, procurement, inspection and expediting, arranging for transportation of EQUIPMENT, construction and testing and all statutory clearance for making PLANT ready for COMMISSIONING.

"PRE-COMMISSIONING" shall mean completion of erection to such an extent that PLANT is ready for commissioning. This shall happen when:

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- A. 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.
- B. The EQUIPMENT are installed, aligned and grouted (wherever applicable) in accordance with drawings, specifications as per finally approved Drawings/Documents and in accordance with all applicable codes, and laws.
- C. Instruments, control system, instrument cable, safety interlock are installed, inspected and such non-operating checks are made as to ensure operability in the manner.
- D. Deleted.
- E. 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.
- F. Deleted .
- G. Pipe support system installed as per drawings.
- H. Painting is completed. EQUIPMENT /MACHINERY, piping duly marked and labelled.
- I. Safety equipments, systems are installed and checked for operations. Effluent management and treatment systems are installed and operational.
- J. All Emergency & Instrument power system are checked and operating.
- K. Obtained all statutory clearance/approvals like CEA, Electrical Inspector etc. as defined in Section-VI. The PLANT is ready to be charged.
- L. Liquidation of all punch list applicable for achieving pre-commissioning . Balance items of punch list, if any, shall be liquidated as mutually agreed
- M. Temporary constructions facilities are removed to extent necessary to permit start of commissioning of Plant

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N. CONTRACTOR shall provide experienced personnel as required for carrying out the PRE-COMMISSIONING activities.

O. 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.

1.2.19 **Commissioning Services of PLANT**

1.2.19.1 CONTRACTOR shall be responsible for COMMISSIONING after PRE-COMMISSIONING activities 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. LSTK CONTRACTOR shall provide operating and maintenance personnel for the same. The COMMISSIONING activities shall be conducted as detailed in Section VI-5.0 of NIT)

1.2.19.2 CONTRACTOR shall provide engineers as required to commission the SYSTEM.

1.2.20 **FUNCTIONAL & OPERATIONAL CHECK**

FUNCTIONAL & OPERATIONAL CHECK' shall mean all 'functional & operational checks required for to determine and demonstrate capacity, efficiency and operating characteristics as specified in the CONTRACT documents.



1.2.21 Deleted

1.2.22 **Deleted**

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.

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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 COMMISSIONING. CONTRACTOR shall submit PROJECT MASTER SCHEDULE and detailed Network Schedule covering the activities and milestones starting from date of FOA until COMMISSIONING, 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 **SITE FACILITIES FOR WORKMEN**

Following facilities are to be ensured at all work places where workmen are deployed /engaged by Contractor:



- i. Arrangement of first aid.
- ii. Arrangement of clean drinking water.
- iii. Toilets
- iv. Canteen where tea & snacks are available
- v. A crèche where 10 or more women workmen are having childred below the age of 6 years.

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

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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.



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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

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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.

1.2.33 Execution of Electrical Works

The Contractor shall engage an approved electrical agency for execution of electrical works holding valid electrical contractor license. In case contractor himself execute electrical works then he shall arrange valid electrical contractor licence before start of electrical works at site. Notwithstanding, contractor shall adhere to all the safety standard as included in bidding document. All the electrical works shall be done under authorized electrical supervisor license holder person only.

1.2.34 SUB-CONTRACTOR

- 1.2.34.1 A minimum of the following activities shall be performed by the Main Contractor directly and shall not be further sub-contracted:
- a) Project Management
 - b) Planning
 - c) Procurement
 - d) Construction Management
 - e) Commissioning
- 1.2.34.2 Bidders may Sub-contract Work, to the Sub-contractor having prior proven experience of similar Work and on specific approval by Owner/ PDIL after award of WORK.
- 1.2.34.3 Following the notification of acceptance of bid , the Contractor will submit to Owner/PDIL for approval with the details of nominated Sub-contractor as per Form F-20. Contractor shall ensure that very competent and resourceful agencies with proven track record and performance should be proposed for the work to be sub-Contracted.

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1.2.34.4 The LIST OF CONSTRUCTION Sub-Contractor proposed in the Bids (if any) by the Bidder shall be considered as indicative only.

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

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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 Deleted

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 subject to availability.

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 WARRANTIES 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



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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.

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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 India upto the 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 Commissioning of PLANT and Facilities in respect of product quality and pollution level shall be discharged only when the COMMISSIONING as stipulated in Section VI 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 conducting successful COMMISSIONING as per NIT 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 COMMISSIONING of all the PLANT.

6.0 PRELIMINARY ACCEPTANCE

PRELIMINARY ACCEPTANCE shall mean that following milestones have been achieved (i) PRE_COMMISSIONING has occurred, (ii) COMMISSIONING of the PLANT have been accomplished, (iii) (iv) OWNER has received all DOCUMENTS required hereunder to operate and maintain the PLANT(v) 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 (vi) all special tools and spare parts purchased by CONTRACTOR as provided herein have been delivered to OWNER; and (vii) CONTRACTOR has completed the training program of OWNERS personnel as required under this CONTRACT(viii) All demonstration runs have successfully completed

6.1 ISSUANCE OF PRELIMINARY ACCEPTANCE CERTIFICATE

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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 for complete package 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

TRAINING OF OWNER'S PERSONNEL shall be as detailed in Section –VI.

9.0 MODE OF CONTRACTING

- 9.1 Notwithstanding anything stated elsewhere in the CONTRACT documents, the CONTRACT is awarded on Lumpsum turnkey basis with single point responsibility.
- 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".

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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

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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, or 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 Deleted

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14.2.1 A FOR SUPPLIES:

- i) 10% (Ten Percent) of Total supply value excluding GST (excluding, spares, construction material, 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 as per format attached at F-18 ,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.

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- (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 PRE COMMISSIONING Certificate against CONTRACTOR's certified running Accounts Bill(s).
- v) 8% (Eight percent) as indicated in the approved Billing schedule on successful COMMISSIONING and 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 & Catalyst
- 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.

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(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 PRE COMMISSIONING Certificate against CONTRACTOR's certified running Accounts Bill(s).
- iv) 8 % (Eight percent) as indicated in the approved Billing schedule on successful COMMISSIONING and 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.

14.2.2 FOR SERVICES (including insurance, installation Civil & Structural Work Erection & Commissioning and excluding Training of Owner's Personnel & Inland Transportation)



- 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 PRE COMMISSIONING Certificate against CONTRACTOR's certified running Accounts Bill(s).
- iii) 8 % (Eight percent) as indicated in the approved Billing schedule on successful COMMISSIONING and 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.

14.2.3 TRAINING OF OWNERS PERSONNEL

100% (Hundred Percent) of payment shall be released on completion of training as indicated in the approved Billing schedule.

14.2.4 INLAND TRANSPORTATION

100% (Hundred Percent) of Local Transportation charges (including inland transit insurance charges) for the plant and equipment including mandatory spares/insurance spares and also recommended spares (if ordered) shall be paid to the Contractor as indicated in the

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approved Billing schedule on pro-rata to the value of the equipment/spares received at site and on production of invoices by the Contractor.

- 14.3 All payments shall be released only after finalization of the planning and monitoring documents and Progress Schedule.
- 14.4 All invoices shall be submitted in quadruplicate to EIC by the Bidder. The payment shall be released within 30 days of submission of invoice.
- 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.

15.0 BILLING SCHEDULE

The CONTRACTOR shall provide a billing schedule based on payment terms within 30 days from the date of FOA for APPROVAL by the OWNER. Payment shall be made as per the approved 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) <ul style="list-style-type: none"> - 220 KV GIS - 33 KV GIS - Transformers - 11 kV & 3.3 KV Switchboards - Upto 415 V Switchboards - ECMS - HVAC System - Fire Fighting System - Others
b)	Mandatory/Insurance Spares as per list enclosed in Section VI-10
c)	Others

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2.0	SERVICES
a)	System Study Report (Break-up In line with the Document Control Index-DCI)
b)	Detailed Engineering (Break-up In line with the Document Control Index-DCI)
c)	Civil And Structural Works
d)	Installation
e)	Erection
f)	Pre-Commissioning
g)	Commissioning
h)	Insurance
i)	Others
3.0	Transportation Charges
4.0	Training of Owner's Personnel

The CONTRACTOR shall raise "Tax Invoices" on the OWNER against the GST to enable OWNER to reimburse the same



Similarly, in case of imports (if applicable), the import duty paid shall have to be indicated separately in the invoice, duly supported by all the necessary documents, so as to enable the OWNER to reimburse the same.

Likewise, 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.

The Bill of Entry shall have to be filed by the CONTRACTOR within the stipulated time with the appropriate authorities.

Note:

- Bidder shall indicate all Prices in INR only
- Spares for Commissioning and Mandatory Spares/Insurance Spares are in CONTRACTOR's scope of supplies and are to be included in the quoted TOTAL CONTRACT PRICE.
- It will be the responsibility of the contractor to include prices of all materials/equipments/Services/Civil & Structural Works required for completion of work as per the CONTRACT.
- The total price payable under the CONTRACT shall be restricted to TOTAL CONTRACT PRICE.
- The Civil & Structural Works shall include but not limited to the Price of Piling, Equipment

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Foundation, Buildings, Structural Works, etc.

6. Total price of SUPPLIES shall not exceed 60% of the TOTAL 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.
7. Total price of Basic Engineering and Detailed Engineering quoted in shall not exceed 10% of the TOTAL CONTRACT PRICE. 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, etc.
8. 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 of a PLANT is delayed by 12 months from successful PRE COMMISSIONING of the particular 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 COMMISSIONING shall be worked out mutually and shall be retained by OWNER. Payment against PRELIMINARY 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 PRE COMMISSIONING . In that case, Commissioning and remaining activities 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.

The CONTRACTOR may, in consultation with the OWNER, demobilise the team from the Site. It shall remobilise at the time of conductance of COMMISSIONING by OWNER which shall be within DEFECT LIABILITY PERIOD. The OWNER shall reimburse the reasonable cost to be incurred by the CONTRACTOR for remobilization.

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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 Commissioning 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 COMMISSIONING/DEEMED ACCEPTANCE of the complete package i.e. DLP will commence from COMMISSIONING of the PLANT.

If at any time before the COMMISSIONING 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 COMMISSIONING as specified in Section-VI is 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.

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- 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 of the complete package.
- 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 If COMMISSIONING fails due to any reason, CONTRACTOR has to make necessary adjustments and modifications and take all remedial measures at his own cost.

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The OWNER shall permit to CONTRACTOR to make adjustments and modifications to any part of the Plant.

The CONTRACTOR shall submit details of the adjustments and modifications which he proposes to make.

18.2 Deleted

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.

18.3 The result of the Commissioning tests shall be compiled by the CONTRACTOR and to be submitted to OWNER/PMC for evaluation.

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 thereunder, 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:

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- (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.

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

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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 COMMISSIONING of PLANT within the CONTRACTUAL COMPLETION SCHEDULE 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.

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) Termination of CONTRACT (c) Carrying out balance work at the risk and cost of the CONTRACTOR, re-engineering, make good, mechanical warranty (d) Patent infringement and (e) 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

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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 III.

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 Portal, 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).

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:

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.....

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	

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SECTION: VI - 1.0

PROJECT DESCRIPTION

PLANT : ELECTRICAL DISTRIBUTION SYSTEM

**PROJECT : INTEGRATED COAL BASED FERTILISER
COMPLEX, AT TALCHER, ANGUL DISTRICT,
ODISHA**



0	26.03.2021	26.03.2021	Issued for Enquiry	RK	SKB	SKB
REV	REV DATE	EFF DATE	PURPOSE	PREPD	REVWD	APPD

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LIST OF ATTACHMENTS

Attachment Number	Description	Number of Sheets
Attachment-1	Plot Plan of Proposed Integrated Coal Based Fertilizer and Chemicals Complex (Drg. No: PC009-0000-0001)	1

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1.0 INTRODUCTION

Talcher Fertilizers Ltd. (TFL), *hereinafter also referred to as “OWNER”* A joint venture company of four major Public Sector Units – M/s GAIL (India) Limited (GAIL), M/s Rashtriya Chemicals & Fertilisers Ltd. (RCF), M/s Coal India Ltd. (CIL) and M/s Fertilizers Corporation of India Ltd. (FCIL) has decided to build a world class coal based fertilizer complex at **Talcher, Angul District, Odisha (India)** consisting of Coal Gasification Plant, Ammonia and Urea Plant, along with other associated Offsite and Utility Plants. To cater the requirement of electrical power for the entire fertiliser complex, TFL intends to set up “Electrical Distribution System” under one LSTK package. Accordingly, TFL intend to invite quotations from eligible contractors on LSTK basis for setting-up Electrical Distribution System for entire Fertiliser Complex.

1.1 Projects & Development India Ltd. (PDIL) has been retained by **M/s TFL** as a Project Management Consultant for selection of a suitable LSTK Contractor for execution of the project on a Lump-Sum Turnkey basis with Single point responsibility.

1.2 LSTK CONTRACTOR is advised to visit and examine the site conditions and obtain the necessary information/ inputs on its own responsibility that may be necessary for preparing their bid and entering into the Contract. Claims of any kind due to variation or ignorance of site and environmental conditions will not be eligible and entertained by TFL under in any circumstances.

2.0 PLOT AREA



Main Receiving Substation (MRSS) and Offsite & Utilities Main Substation (OUSS) shall be built in the earmarked area Electrical Distribution System and Offsite & Utilities Substation respectively as shown in the Plot Plan for Talcher Project (Refer: Attachment-1, Drawing No.PC009-0000-0001). LSTK CONTRACTOR should ensure that the available area should be used in the most optimum way. Dedicated Substations of respective Packages of other LSTK Contractor / Owner’s scope shall be as shown in the Plot Plan.

2.1 Plant Site

A brief status of infrastructure at Talcher Fertiliser Plant Site is furnished below:

- The proposed project will be located within the existing premises of proposed Coal gasification based Fertilizer Complex, Talcher Fertilizer Limited at Talcher, Angul, Odisha.
- The total land area of the site is 933.60 acres and 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 a 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. The old abandoned plant machinery, building, facilities etc have been demolished and removed from site.

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- 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 which is at about 7 km from the site. Nearest air port Bhubaneswar is about 150 km, about 3 hours journey by road/ rail. Nearest sea port is Paradip, 200 km by rail/road from the site. Talcher is situated at 21° 10" N Latitude and 82° 5" E LONGITUDE.

3.0 Electrical Distribution System

The Electrical Distribution System would essentially consist of Main Receiving Substation (MRSS) and Offsite & Utilities Main Substation (OUSS) alongwith Civil & Structural Work, all Electrical Equipment, Mechanical Equipment, HVAC, Fire Fighting System etc. , and its associated facilities. The LSTK Contractor shall consider for installation of all the relevant facilities of appropriate capacity as necessary for smooth, safe and reliable operation of the Electrical Distribution System .

a. Electrical Distribution System

The Electrical Distribution System consists of 220 kV GIS Switchgear, 33 kV GIS Switchgears, Transformers, Busducts, NER/NGT, ICOG Panel, 11 kV Switchboards, 3.3kV Switchboards, 415 V Switchboards, UPS Systems, DC System, Cables, Cable Trays, Lighting System, Earthing System, Lightning Protection System, DG Set, Electrical Control & Monitoring System (entire fertiliser complex), Electrical System Study (entire fertiliser complex) etc. For further details, refer Section-VI-3.1.

b. Civil & Structural Work

Civil Building, Foundations for various Equipments etc.. For further details, refer Section-VI-3.3.

c. HVAC/ EOT Crane works



Both the Substations shall be fully air-conditioned. For further details, refer Section-VI-3.1 and 3.2.2. EOT shall also be provided in MRSS (GIS Section). For further details, refer Section-VI-3.1 and 3.2.3.

d. Interconnecting Piping

Interconnecting piping for Fire Water System between LSTK Battery Limit and balance of plants shall be under Owner's scope. Owner shall provide Fire Water etc., at Electrical Distribution System battery limit, at one point each for both MRSS & OUSS.

e. Fire Fighting System

All requirement of fire fighting system inside Electrical Distribution System shall be as per NFPA standards with due approval from relevant authorities are in LSTK Contractor's scope.

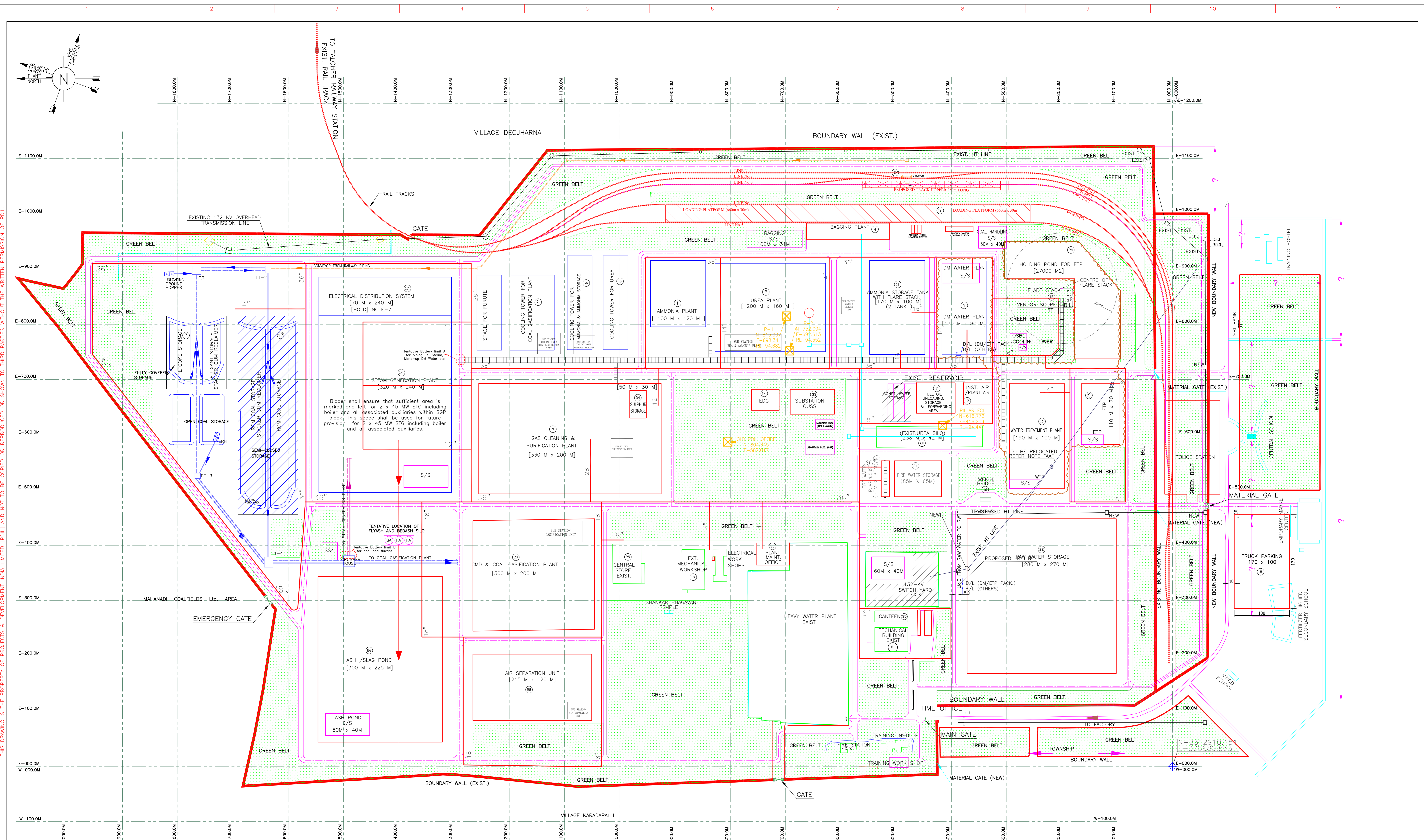
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LSTK Bidder shall indicate fire water requirement in their bid which shall be supplied at a given point at the battery limit.

f. Temporary Construction Facilities

The LSTK Contractor shall arrange following facilities at his own cost for Construction/Erection purpose.

1. Tapping of Construction Power (on chargeable basis) from Owner's 415 V Feeder rated for 250 A (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. This Owner's 415 V, 250 A feeder is located at Existing Substation near 132 KV Switchyard.
2. Construction Water on chargeable basis (at one point within factory premises and CONTRACTOR to arrange the pipeline up to their Battery Limit) shall be made available.
3. Construction sheds
4. Construction offices
5. Temporary Communication facilities
6. Office furniture
7. Temporary stores & security

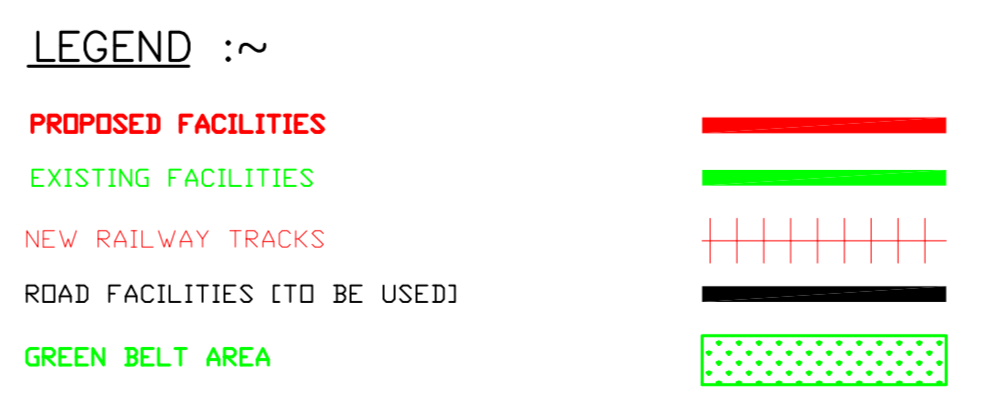


SLNO	BLOCK DESCRIPTION	SIZE IN METRE	REMARKS
1.	AMMONIA PLANT	100 M x 120 M	
2.	UREA PLANT	200 M x 160 M	
3.	PETCOKE/FUXANT STORAGE	200 M x 100 M	
4.	BAGGING PLANT	150 M x 30 M	
5.	WAGON LOADING PLATFORM	650 M x 20 M	
6.	COOLING TOWER FOR AMMONIA & UREA	-	
7.	FUEL OIL UNLOADING, STORAGE & FORWARDING AREA	70 M x 35 M	
8.	ADMIN / TECHNICAL BUILDING (EXIST.)	60M X 40 M	
9.	DM WATER PLANT	170 M x 80 M	
10.	WATER TREATMENT PLANT	190 M x 100 M	
11.	AMM. STORAGE TANK(S) WITH FLARE STACK	170 M x 100 M	
12.	INST. AIR / PLANT AIR	50 M x 40 M	
13.	COVERED STORAGE SHED (RDM COAL)	290 M x 85 M	
14.	STEAM GENERATION PLANT	320 M x 240 M	
15.	FLARE STACK	R 100M	
16.	TRUCK / LORRY WEIGH BRIDGE	20 M x 16 M	
17.	ELECTRICAL DISTRIBUTION SYSTEM & EDG	70 M x 240 M	
18.	TRUCK PARKING	170 M x 100 M	
19.	MECHANICAL/ELECT. WORKSHOP (EXIST.)	70 M x 40 M	

SLNO	BLOCK DESCRIPTION	SIZE IN METRE	REMARKS
20.	UREA SILD (EXIST.)	238 M x 42 M	
21.	GAS CLEANING & PURIFICATION PLANT	330 M x 200 M	
22.	RAW WATER STORAGE	280 M x 270 M	
23.	CMD & COAL GASIFICATION PLANT	300 M x 200 M	
24.	HOLDING POND FOR ETP	27000 M2	
25.	ETP	110 M x 70 M	
26.	ASH /SLAG POND	300 M x 225 M	
27.	COOLING TOWER FOR CGP	-	
28.	AIR SEPARATION UNIT	215 M x 120 M	
29.	CENTRAL STORE (EXIST.)	60 M x 40 M	
30.	PLANT MAINT. OFFICE	60 M x 40 M	
31.	FIRE WATER STORAGE	85 M x 65 M	
32.	WAGON TIPPLER FOR COAL/PETCOKE/FUXANT	20 M x 10 M	
33.	SUB-STATION	65 M x 35 M	
34.	SULPHUR STORAGE	50 M x 30 M	
35.	CANTEN	40 M x 20 M	
36.	LAB. TECH. BUILDING	30 M x 18 M	
37.	FIRE WATER PUMP HOUSE	65 M x 15 M	

- NOTES:-
- ALL DIMENSIONS AND COORDINATES ARE IN METERS UNLESS OTHERWISE SPECIFIED.
 - REFERENCE BENCH MARK (⊕) POINTS IS W.R.T GLOBAL CO-ORDINATES HAVING N-2312910.151 & E-308680.833 (GRID COORDINATES E=000.0M, W=000.0M)
 - EQUIPMENT SIZES AND LOCATIONS ARE TENTATIVE.
 - BLOCK SIZE OF FACILITIES ARE TO BE FINALIZED AFTER GETTING VENDOR INFO.
 - PIPE RACK LOCATION & SIZES MARKED ARE SCHEMATIC.
 - CENTER LINE OF EXISTING ROAD & PERIPHERAL ROAD TO BE MAINTAINED WITH MINOR ADJUSTMENT & SAME SHALL BE ALIGNED WITH EXISTING BOUNDARY WALL.
 - IT IS ASSUMED THAT 220 KV EXTERNAL POWER SUPPLY TIE-IN SHALL BE AT THE BOUNDARY WALL CLOSE TO THE LOCATION OF ELECTRICAL DISTRIBUTION SYSTEM BLOCK.
 - RAW WATER TREATMENT PLANT, DM WATER, CONDENSATE POLISHING UNIT, EFFLUENT TREATMENT PLANT WITH ZLD & SEWAGE TREATMENT PLANT AREA HAS BEEN MARKED IN CLUDD.
 - BATTERY LIMIT IS TENTATIVE AND SHALL BE FINALISED DURING DETAILED ENGG.

TOTAL PLANT AREA = 490.7 ACRE (APPROX.)
 AREA FOR NEW PLANT = 326.8 ACRE (APPROX.)
 TOTAL GREENBELT AREA = 163.9 ACRE (APPROX.)



ISSUED FOR TENDER PURPOSE ONLY

NO.	DESCRIPTION	DATE	BY
04.	TOPOGRAPHICAL & CONTOUR SURVEY DRAWING	SA/RCF/TALCHER/2017/TOPO-DWG	
05.	MASTER PLAN OF MINING	FURNISHED BY CLIENT	
03.	MASTER PLAN (FCI, TALCHER UNIT)	DRG. NO. 501	
02.	INDEX PLAN (FCI, TALCHER UNIT)	DRG. NO. 635	
01.	PLANTS LAYOUT (FCI, TALCHER UNIT)	TFU-M-GN-6341	
S.NO.	REFERENCE DRAWINGS	NUMBERS	

P1_OP	PRELIMINARY ISSUE	AM	DD/NS	AMAR
P	19.01.21			
REV.	DATE	DESCRIPTION		
		PPD.	CKD.	APPD.

CLIENT : M/s. TALCHER FERTILIZER LIMITED
 LOCATION : TALCHER, ANGUL DISTRICT, ODISHA(INDIA)
 TITLE : PLOT PLAN OF PROPOSED INTEGRATED COAL BASED FERTILIZER AND CHEMICALS COMPLEX

SCALE : 1 : 2200

DRG. No. :- PC183-0000-001
 FILE :- PC183-0000-001
 Rev.P1_OP

PROJECTS & DEVELOPMENT INDIA LTD. NOIDA



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SECTION: VI - 2.0

BIDDER'S SCOPE OF WORK



PLANT : ELECTRICAL DISTRIBUTION SYSTEM

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1.2	BROAD SCOPE OF WORK/ SERVICES	
2.0	OTHERS REQUIREMENT	

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1.0 GENERAL

LSTK CONTRACTOR shall supply & install Electrical Distribution System on proposed Coal Gasification based Fertilizer complex, Talcher Fertilizers Ltd. (TFL) at Talcher, Angul District, Odisha (India) as per the requirements and specifications.



1.1 BIDDER'S SCOPE OF WORK

Scope of work of the LSTK Contractor shall include Detailed Engineering, Procurement, Supply, Fabrication, Testing at works, Inspection by Third Party Inspection Agency (TPI), Expediting, Site Survey and Condition Assessment, Insurance, Transportation of all equipment / materials to work Site, Storage & Materials Management, construction and erection of all civil & structural works, mechanical works, electrical works, Assembly and Installation of Equipments, obtaining all necessary statutory approvals, Testing, Commissioning including Total Project Management and handing over of LSTK Contractor's scope of work duly completed on single point responsibility basis.

1.2 BROAD SCOPE OF SUPPLY/ WORK/ SERVICES

Bidder's scope of work shall include (but not limited to) following in respect of all equipment, works, systems, facilities & services as required for completeness, satisfactory operation of 'Electrical Distribution System (Main Receiving Substation and Offsite & Utilities Substation)' on Lump Sum Turn Key (LSTK), single-point responsibility basis:



- a) Electrical System for MRSS and OUSS : 220 kV GIS Switchgear, 33 kV GIS Switchgears, Transformers, Busducts, NER/NGT, ICOG Panel, 11 kV Switchboards, 3.3kV Switchboards, 415 V Switchboards, UPS Systems, DC System, Cables, Cable Trays, Lighting System, Earthing System, Lightning Protection System, DG Set, Electrical Control & Monitoring System (entire fertiliser complex), Electrical System Study (entire fertiliser complex) etc. as defined in Section-VI-3.1 Design Philosophy - Electrical.
- b) All interconnection between MRSS & OUSS.
- c) Visual Monitoring System (CCTV) at both Substations.
- d) Fire water network system within Battery limit. Fire fighting & safety system for LSTK's scope of work as per requirement of NFPA, IS, TAC (Refer Section-VI-3.2.1 Design Philosophy : Fire Fighting for details)
- e) DG Set including Automatic Mains Failure (AMF) panels etc. and associated Fuel Feeding System and accessories etc. to meet Emergency Power requirement of MRSS as defined in Section VI-3.1 Design Philosophy - Electrical.
- f) Civil & Structural Work including landscaping & Rain water Harvesting for complete area within the battery limit (Refer Section VI-3.3 Design Philosophy : Civil & Structural Works for details).
- g) All HVAC and EOT Crane works within Battery Limit (Refer Section VI-3.2.2 / VI-3.2.3 respectively). Both the Substations shall be fully air-conditioned.
- h) Fire fighting & Fire protection system of both the substations and complete area within Battery Limit like but not limited to Fire water network, fire hydrant, supply of DCP type fire extinguisher, CO2 type extinguisher, etc.
- i) Dismantling of temporary construction facilities and cleaning the site by removal & disposal of debris etc. after project completion.
- j) LSTK Contractor shall design the Electrical Distribution System to accommodate within the available area marked in plot plan.
- k) All mandatory approval including liaisoning from various authorities like Electrical Inspectorate, Central Electricity Authority, OPTCL, CESU/TPCODL, State Pollution

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Control Board, Central Pollution Control Board etc. pertaining to execution of Electrical Distribution System.

The followings shall also be under the scope of the LSTK Contractor for Electrical Distribution System :



- a. Detailed engineering
- b. Compliance of all statutory requirements during complete project execution period.
- c. Preparation of drawings and Documents with necessary software and hardware including submission of as built drawings.
- d. Getting the drawings approved by Owner/PMC/OPTCL, making prints available well before those are actually required by manufacturer, inspector, erector, constructor, site engineer
- e. Procurement and/ or Manufacture and/ or Fabrication,
- f. Quality assurance & Quality Control
- g. Inspection, Testing, checking, Expediting at Manufacturer's works including inspection by Owner/ Consultant/ Third party/ Statutory Authorities.
- h. Supply, Packing, loading, un-loading, Transportation of all equipment & material to site including customs clearance and port charges, port handling & handling at work site.
- i. Storage, preservation and conservation at site as per manufacturer's recommendation until erection,
- j. Security, Watch & ward till handing over
- k. Insurance during transit, storage, erection and commissioning
- l. Construction and Erection of all civil, structural, mechanical and electrical items/ works, assembly, installation including loading of materials at contractors warehouse, transportation of materials to contractor's works/erection site.
- m. Testing/ checking at site by Owner/ Consultant/ Statutory Authorities and obtaining all necessary statutory approvals from concerned government authorities as applicable.
- n. Supply of spares shall be as per Section-VI-7.0 of NIT.
- o. Supply of all equipment, machinery, tools etc required for proper & safe erection/ construction work.
- p. Supply of all special tools & tackles
- q. Training of Owner's personnel.
- r. Handing over of 'Electrical Distribution System' with all final/ 'As-built drawings/ documents' and operating manual, drawings, documents & operating manual of bought out items, Test certificates, statutory approvals etc.
- s. Preparation of Network and schedules in latest version of Primavera. Project Planning, Scheduling & monitoring, progress Monitoring and Reporting, Total project management.
- t. Co-ordination with all agencies concerned with implementation of the project.
- u. Safety and Security.
- v. Bidder shall note that any work and/ or services mentioned in other sections of tender document and not mentioned in this section or mentioned in this section and not mentioned in other sections shall be considered as if mentioned in both.

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- w. All supervision personnel, skilled/ unskilled labour for completing the job in all respect as per provision of the contract.

2.0 OTHER REQUIREMENTS

- 2.1 Tie-up/ hook-up with designated tie-up points for hooking up to other systems like Fire Water, Pipe Rack/Structure for Cable Trays, CCTV System etc. executed by other agencies. Perform construction management and supervision of all equipments, material and works.
- 2.2 Factory acceptance test for ECMS in presence of Owner/PMC.
- 2.3 Provide and perform comprehensive quality assurance, quality control and inspection of all equipments, materials works - both in manufacturing shop and at work site.
- 2.4 Provide all manpower, materials, consumables, construction equipment / machines, tools, instruments, storage, fabrication, facility and all other services and inputs etc. necessary to perform the work and complete the plant.
- 2.5 Comply with all Central, State & Local Govt. regulations, laws and requirements applicable to the work and seek & obtain approvals/ clearances from such statutory bodies/ agencies, as required. Scope of Talcher Fertilizers Limited in this regard will be only to provide authorization in favour of LSTK CONTRACTOR for which all the necessary paper work will be done by LSTK CONTRACTOR.
- 2.6 Provide necessary temporary construction facilities like fabrication, storage, illumination etc. and removal of temporary arrangement to make the space reusable.
- 2.7 Comply with all safety practices for and during work as per applicable standards.
- 2.8 Strictly comply with applicable codes and standards of Engineering, Fabrication, Inspection, Construction etc.
- 2.9 Arrange services of Manufacturer's installation/ commissioning Engineer(s) at Site during Pre-commissioning, Commissioning, of the entire major equipment and systems.
- 2.10 Provide all the temporary connections/ supplies required for testing/ pre-commissioning activities.
- 2.11 Provide spare parts including all consumables for commissioning. All such spares are to be available at site prior to commissioning.
- 2.12 Perform testing, commissioning and functional & operational check of entire system.
- 2.13 Submission of final drawings and documents shall be as per Section No VI-6.0 (Drawings and Documents).
- 2.14 Project Management and planning, scheduling and monitoring/ comprehensive reporting services, periodic reviews, meeting notes with Talcher Fertilizers Limited / PMC.
- 2.15 The scope of work as described above shall be supplementary to the scope of work mentioned under various parts of Tender Document. In case of any contradiction between the two, the stipulations mentioned under various disciplines shall be governing. In this regard, Owner's interpretation shall be final and binding to LSTK CONTRACTOR.
- 2.16 Transportation of all the materials supplied by Owner , if any, from TFL's store to LSTK CONTRACTOR's Store/ work site including loading/ unloading.
- 2.17 Total painting including special paints, color coding, CS / S.S. name plates etc. as per applicable standards.

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- 2.18 **All items, equipment, works though not specifically mentioned, but required for completeness of Electrical Distribution System shall be undertaken by the LSTK Contractor without any additional cost and time implication to the Owner.**
- 2.19 LSTK CONTRACTOR shall adhere to Design Control exactly as per provisions of latest ISO 9001. LSTK CONTRACTOR shall submit required records as evidence for review by Owner/ PMC as and when required, and shall carry out changes based on Owner/ PMC review.
- 2.20 Supervisory assistance from OEM of major equipment (GIS, Transformer, ECMS etc.) for two weeks, after commissioning, during functional & operational check.
- 2.21 LSTK contractor shall arrange requisite manpower for works, erection, testing & commissioning.
- 2.22 List of equipment & apparatus shall be furnished along with BID by LSTK contractor required for erection, testing during the commissioning & subsequent Operation.
- 2.23 All civil works and supplies such as painting, provision of the fire water network as per TAC, IS, NFPA.
- 2.24 During erection/ construction LSTK contractor shall ensure that construction of other LSTK contractor should not hamper.

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SECTION : VI- 3.1

DESIGN PHILOSOPHY- ELECTRICAL

PLANT : ELECTRICAL DISTRIBUTION SYSTEM



**PROJECT :INTEGRATED COAL BASED FERTILISER COMPLEX
AT TALCHER, ANGUL DISTRICT, ODISHA (INDIA)**

0	26.03.2021	26.03.2021	Issued for Enquiry	RK	SKB	SKB
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5.0	Sub Station
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7.0	Control and Monitoring
8.0	Equipment Specification
9.0	Cabling
10.0	Illumination System
11.0	Earthing and Lightning Protection
12.0	Capacitor Banks
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14.0	CCTV
15.0	Spares
16.0	Vendor's Services
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18.0	Maintenance & Testing Equipments
19.0	Documentation
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26.0	Quality Assurance
27.0	Coordination with Other Contractors
28.0	Deviations
Annexure-I	Illumination Levels

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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
PC183-TS-0830	Diesel Generator Sets
PC183-TS-0831	Electrical System Study
PC183-TS-0832A	220kV Gas Insulated Switchgear
PC183-TS-0832B	33kV Gas Insulated Switchgear
PC183-TS-0833	Electrical Control & Monitoring System
PC183-TS-0837	CCTV
PC183-TS-0838	Maintenance & Testing Equipments

--	Conceptual SLD 220 kV & 33 kV GIS (Drg. No. PC183-7411-0985A)
--	Conceptual SLD 11 kV – MRSS (Drg. No. PC183-7411-0985A)
--	Conceptual SLD 11 kV – OUSS (Drg. No. PC183-7411-0985B)
--	Conceptual SLD 3.3 kV – OUSS (Drg. No. PC183-7411-0985B)
--	Typical 33 kV ICOG (Drg. No. PC183-7411-0985C)
--	Typical SLD - 11 kV Switchboard (Drg. No. PC183-1225)
--	Typical SLD - 3.3 kV Switchboard (Drg. No. PC183-1226)
--	Typical I SLD - 415V Switchboard (Drg. No. PC183-1227)
--	Conceptual Architectural Drawing for ECMS

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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 464	Schematic Diagram Panic Light
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/AI 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

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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 system required for 'Electrical Distribution System'.



Although every item of supply and/ or installation might not have been described, the LSTK 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 LSTK Contractor shall comprise complete electrics of the Electrical Distribution System. The scope of work/ services shall broadly comprise but not limited to the following:

1.2.1 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; 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.

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- 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 LSTK 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, OPTCL/ TPCODL and all coordination for getting the installation approved for energisation & use. Carrying out all modifications/ alterations required by statutory authorities, OPTCL/ TPCODL . All expenses on these activities shall be carried out and borne by LSTK 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 LSTK Contractor and necessary coordination and liaison work in this regard shall be the responsibility of the LSTK Contractor.

All liaisoning work with OPTCL/TPCODL till final commissioning & acceptance shall be in LSTK Contractor's scope.

LSTK Contractor shall carry out all modifications / alterations required by all statutory bodies. However, necessary statutory fee shall be deposited by the Owner.

- 1.2.2 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 system of 'Electrical Distribution System' (hereinafter referred as Plant in short) comprising as per SLDs, but not limited to :



- a. 220 kV Double Bus Indoor GIS Switchgear to receive OPTCL Power (Double Circuit) through 220 kV Single Core EHV (Cu) XLPE Cable and distribute the same through 220/34.5 kV Grid Transformers and connected to 33 kV GIS Switchgear.

Refer Conceptual SLD (PC183-7411-0985A).



Final SLD of 220kV GIS shall be got approved by LSTK Contractor from OPTCL/TCODL, Electrical Inspector, CEA etc.

- b. Metering System in Incoming Bays of 220 KV GIS shall be as per OPTCL/ TPCODL requirement suitable for receiving power from OPTCL, complete in all respect including CT, PT, LA etc. strictly as per OPTCL/TPCODL requirement.

LSTK Contractor shall liaison with OPTCL/ TPCODL regarding Specification of Metering System etc. and shall obtain approval from OPTCL/ TPCODL, so that no issue arises during execution, commissioning / charging.

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- c. OFC based communication System between Switching Substation of OPTCL & 220 kV GIS of TFL in line with OPTCL requirement including all telecommunication equipments at both the ends required for ABT Metering and Open Access Power Purchase.
- 220 kV Double Bus Indoor GIS shall have 2 Nos. Incomer Bays, 1 No. Bus-coupler and 2 Nos. Outgoing Bays. 220 kV Double Bus Indoor GIS shall also have space for 2 Nos. Bays for future expansion.
- Refer Conceptual SLD (PC183-7411-0985A).
- Cables between Switching Substation of OPTCL and 220 KV GIS at MRSS shall be laid by Owner, however cable connection (including supply of Termination Kit) at 220kV GIS Incoming Bays shall be in LSTK Contractor's scope.
- All required co-ordination with OPTCL/ TPCODL shall be in LSTK Contractor's scope.
- d. 33 kV Double Bus Indoor GIS Switchgear shall have 2Nos. Incomer Bays through 220/34.5 kV transformers) and Bus-coupler & Outgoing Bays as per SLD (PC183-7411-0985A).
- 33 kV Double Bus Indoor GIS shall also have space for 8 Nos. Bays for future expansion (2 Nos. Incomers from CPP).
- 33 kV Double Bus Indoor GIS Switchgear shall be designed for maximum reliability of availability of power. 33 kV GIS Switchgear shall be designed considering continuous parallel operation of both Bus with any 2 Incomers at a time.
- e. Relay system for Grid disturbance sensing & Grid Isolation facility to Island in-house generation (CPP in future) in case of Grid Disturbances in 33KV Switchboard.
- f. 11 KV Switchboard(at Main Receiving Substation, hereinafter called MRSS) connected to 33 kV GIS through 2 Nos. 33/11.5 KV Transformers and Outgoing Feeders, as indicated in SLD (PC183-7411-0985A).
- g. 11 KV Switchboard (at Offsite & Utilities Substation, hereinafter called OUSS) connected to 33 kV GIS (at MRSS) through 2 Nos. 33 KV ICOG Panel & 2 Nos. 33/11.5 KV Transformers and 2 Nos. Incomers form DG Synchronisation cum Distribution Panel and Outgoing Feeders, as indicated in SLD (PC183-7411-0985B). 11 kV Switchboard shall be Ring Type Configuration.
- h. 33 KV ICOG Panels connected between 33 kV GIS and 33/11.5 kV Transformers, at OUSS, as indicated in SLD (PC183-7411-0985C).
- i. Separate Emergency DG set including Automatic Mains Failure (AMF) Panel and associated Fuel Feeding System and accessories etc. to meet emergency and essential loads of Electrical Distribution System at MRSS. .
- j. Bus Ducts (11kV, 3.3 kV, 415 V as required)
- Minimum Busduct as below has been envisaged :
- 11 kV Busduct between 33/11.5 kV Transformers and 11kV Switchboard at MRSS
 - 11 kV Busduct between 33/11.5 kV Transformers and 11kV Switchboard at OUSS
 - 3.3 kV Busduct between 11/3.45 kV Transformer and 3.3 kV Switchboard at OUSS
- k. Transformers viz.
- 220 kV/34.5 kV Grid Transformers including OLTC,RTCC Panels. RTCC panel shall be located in MRSS.
 - 33/11.5 kV Transformers at MRSS and OUSS
 - 11/3.45kV Transformers at OUSS,

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- 11/0.433 kV Transformers, for Substations Auxiliary Loads at MRSS and O&UMSS
- Lighting Transformers, Isolation Transformers.
- Special application transformers like Zigzag transformer, earthing transformer etc. as required.

Refer SLD PC183-7411-0985A and PC183-7411-0985B.

i. Switchgears:

- 11 KV Switchboard (at MRSS), 11 KV Switchboard (at OUSS)
- 415 V Switchboards(for Lighting, UPS, DC System, EOT, welding receptacle auxiliary loads etc.), 415 V Switchboard (for HVAC System) at MRSS.
- 3.3. kV Switchboard, 415 V Switchboards (for Lighting, UPS, DC System, EOT, welding receptacle, auxiliary loads etc.), 415 V Switchboard (for HVAC System) at OUSS.
- 33 KV ICOG Panels at OUSS
- 415 Volt Switchgears/ switchboards includes PCCs, PMCCs, MCCs, EPMCCs MLDBs, ASPBs (welding receptacle & other non-plant / non-critical loads are generally feed through ASPB LSDB, PDB, Junction boxes etc. as required.
 - Local control Panels, Local Control stations, Switch Sockets.
 - Variable Frequency Drive Panels, as required.
 - RTCC Panel,

Refer SLD PC183-7411-0985A and PC183-7411-0985B.



m. 3.3 kV / 415V Motors and other special application/ voltage motors, as required.

n. All Cables viz



- Power Cables (220 kV, 33 kV, 11kV, 3.3kV and 1.1kV) for all the equipment in scope of LSTK Contractor.
- Control Cables,
- Earthing Cable
- Signal cables,
- Optical fibre cables
- Data Cables
- Communication cables
- Special application cables
- FO Cables & control cable from OPTCL switching Substation to 220 kV GIS at MRSS for interlocking, communication and Protection.
- 33 kV Power Cables/Control Cables/FO Cables from 33 kV GIS at MRSS to 33 kV ICOG Panel to 33/11.5 kV Transformers (installed in OUSS)
- All Power, Control, communication cables between MRSS & OUSS.

o. Erection/ installation & all sundry materials for installation, testing & commissioning of equipment/ panels/ fittings/ cables (including jointing & termination of cables) comprising (but not limited to) following:

- Foundations,

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- Brackets, support structures, erection materials & accessories, as required
 - Cable trays, racks, pipes, ducts, cable channels etc as required.
 - Testing checking kits/ instruments.
- p. Illumination system -Normal, emergency and evacuation lighting.
- q. Area lighting .
- r. Aviation lighting, as required.
- s. Neutral Grounding Resistor (NER), Neutral Grounding Transformer, Motorised NER as required
- t. Earthing and equi-potential bonding of equipment & structures including Earth Mat., Earthing electrodes etc..
- u. Protection against lightning.
- v. Separate 110VDC Batteries, battery chargers and DC distribution boards as required, at MRSS and OUSS.
- w. Programmable Logic Controller (PLC)/RTU based Operation, Logic Control, Synchronisation, Monitoring, Supervisory Control & Data Acquisition, Event Management & Printing and Reports generating systems etc. for entire complex including SCADA system & Giant screen.
- x. Electrical Control & Monitoring System (ECMS) of entire fertiliser complex (loading/unloading of generators, transfer & switching of loads etc). The ECMS shall send command to the switchboards, MCC feeders for tripping or starting the loads in preset sequence/ protocol by taking reference of the power generated by the STGs, power availability from grid, operational & safety requirements etc. (Refer Conceptual Architectural Drawing & Plot Plan indicating Substations/Control Room)
- y. Separate 240V AC UPS System complete with batteries & UPS Power Distribution Boards at MRSS and OUSS.
- z. Separate 115V AC UPS System complete with batteries & UPS Power Distribution Boards at OUSS. (for Owner Use)
- aa. Complete Electrics for Air Conditioning and Ventilation systems.
- bb. Complete Electrics for fire fighting system,
- cc. Complete Electrics for EOT Crane, Hoists, Elevators/Industrial Goods Lift.
- dd. Cable trench/Cable tray with supporting structure. Cable Trays and Structure within Substations and upto 15 Mtrs from Substation outer wall to Owner's Piperack (for Owner's requirement as well as LSTK Contractor's requirement) shall be provided by LSTK Contractor. However, cable trays and all accessories from MRSS to OUSS connectivity shall be done by LSTK Contractor using support structure of Owner's Piperack.
- ee. Visual Monitoring System (CCTV) at both Substations & provision for integration with the Owner's main CCTV system of the plant. However integration of CCTV system between the both substations (MRSS & OUSS) shall be in the scope of LSTK contractor.
- ff. The scope shall also include the erection, testing, commissioning of above equipments.
- gg. The contractor shall clear the site after commissioning of the equipments / system and obtain the Site Clearance Certificate from Owner's Engineer-in-charge
- hh. 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

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safety, maintainability and reliability in compliance with all applicable codes, standards, guidelines, statutory regulations and safety requirements in force.

- ii. Any other equipment, not specified, but required for safe, proper, trouble free and efficient operation of the system
- jj. LSTK Contractor shall consider any other requirement which is not covered in this NIT, but required for successful operation of the plant.
- kk. Spares & consumables for complete electrics as follows:
 - Commissioning Spares (as per Clause No. 15.0 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.
 - LSTK 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.
- ll. Tools & Tackles.
 - mm. Testing Equipments/ instruments
 - nn. Arranging services of major equipment suppliers during installation and commissioning.
 - oo. Training of Owner's Personnel for Operation & maintenance of the Electrical Distribution System.
 - pp. Any and all other items/ facilities/ services not specifically mentioned but essential/ required for completeness of the systems/ equipments/ facilities
- 1.4 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.
- 1.5 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 LSTK Contractor shall supply all items of a particular type or make for whole Electrical Distribution System of the same manufacturing company for ease of maintenance and less spares inventory.
- 1.6 1 No. 415 V Feeder (rated for 250 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 LSTK Contractor's scope.

In construction Power, LSTK Contractor shall ensure that the minimum power factor of 0.9 shall be maintained at their end by providing suitable power factor improvement devices.

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LSTK 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, LSTK contractor shall have to arrange emergency power, if required, through DG set at their own cost.

- 1.7 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.
- 1.8 Contractor shall carry out following minimum Electrical System Studies of the electrical installation of entire fertiliser complex (including Coal Gasification Plant, Ammonia-Urea Plant, Steam Generation Plant, Offsite & utilities) using latest version of ETAP and the result of the same shall be furnished.
- Load flow studies (includes recommendations for transformer tap settings).
 - Short circuit studies for 3 phase and single phase faults.
 - Earthing Scheme
 - Transient motor starting studies for critical and large motors including support required for the drive motor starting selection
 - Motor re-acceleration studies (Including motor on EDG Bus when motors are started on EDG power supply)
 - Transient stability studies
 - Harmonic study and recommendation of filter if required
 - Power factor correction requirement
 - Arc flash studies
 - Insulation coordination studies
 - Protection relay coordination
 - Cable temperature rise simulation.
 - Voltage profile (Overvoltage & Undervoltage study)
 - Operation philosophy
 - Adequacy of all protection functions in the complete electrical network.
 - Recommendation for equipment parameters & operational restriction in the electrical network, if any.
 - Lighting Risk Assessment Study & mitigation methodology.

Electrical Equipment shall be designed as per worst operating conditions.

- 1.9 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 & Monitoring System (ECMS) for entire fertiliser complex (including Coal Gasification Plant, Ammonia-Urea Plant, Steam generation Plant, Offsite & utilities) shall be provided by LSTK Contractor.

Other LSTK Contractor of entire Fertiliser Complex i.e. Coal Gasification Plant, Ammonia-Urea Plant, Steam Generation Plant, Offsite & Utilities shall provide the required multifunctional dual channel transducers, Digital Multi-function Meters, latest version numerical/Communicable type protective relays, comprehensive unit providing protection, metering, control & communication provision with communication port in panels, communication facility in supplied UPS, Battery Chargers, VFD, Soft starter, DG sets, 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

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Meters, Motor Protection Relay (MPR) and other equipment, Ethernet communication module shall also be used. 100% redundancy shall be provided for communication.

Separate room for ECMS equipment shall be provided by Owner in all other substations. Supply erection testing & commissioning of all equipment related to ECMS shall be in LSTK contractor scope

Provision of future expansion of Data Concentrator Panels etc. shall also be considered while designing separate room for ECMS in MRSS and OUSS.

All ECMS equipments (Data Concentrator Panels, I/O Rack, OWS, EWS, PC console, chairs & furniture of reputed make etc.) of all the Substations in entire fertilizer complex shall be in LSTK Contractor's scope.

LSTK Contractor shall provide all equipments and accessories for ECMS including I/O Racks, Data Concentrator Panels, Communication cables between substations, OWS, EWS, Chair, Tables etc. to all the Substations in entire fertilizer complex. There are approx. 21 substations (MRSS, OUSS, 5 Nos. Substations in Coal Gasification Plant, 4 Nos. Substations in Ammonia-Urea Plant, 1 No. Substation in Steam Generation Plant, 3 nos. in Water Plant, 1 No. in Coal Handling, 1 No. in Urea Handling, 1 No. in Ash handling, 1No. in 132kV Switchyard, 1 No. in OSBL Cooling Tower, 1 No. OSBL Substation).

Centralised ECMS control room shall be provided at MRSS and shall be integrated with ECMS in all these Substations. Complete Integration and Load Shedding System in consultation with Owner / Consultant shall be in LSTK Contractor's scope.

- 1.10 The scope shall also include obtaining all required statutory approvals from all statutory bodies including Electrical Inspectorate, Central Electricity Authority, CCOE, State Pollution Control Board, Central Pollution Control Board etc. but not limited to. . 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 LSTK Contractor's name.

- 1.11 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.



- 1.12 Final location of equipments as well as route of cable trays shall be finalised during detailed engineering.

- 1.13 All electrical works associated with the followings but not limited to, shall be in scope of LSTK Contractor :

- a) Air conditioning and Ventilation systems of MRSS and OUSS
- b) Fire fighting system,
- c) Fire protection system
- d) Diesel Generator Sets including diesel storage system of MRSS.
- e) EOT at MRSS (GIS Section)
- f) Pollution control and monitoring equipment for DG Set at MRSS (if required)
- g) All auxiliary building & associated electrical building/rooms such as MRSS, O&UMSS, Transformer Room, DG Shed etc.

- 1.14 Following Integrations are envisaged presently in scope of LSTK Contractor ;

- Protection for all outgoing feeders of 33 kV, 11 kV, 3.3. kV Switchboard at MRSS and O&UMSS to other LSTK Contractors Switchboards / other Switchboards of the plant. (Inter tripping, Cable Protection etc.
- Electrical Control & Monitoring System complete in all respect for entire fertiliser complex including all inter-substations cabling

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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 LSTK Contractor's scope without any cost and time implication.

1.15 Both the sub stations shall be provided with following equipment separately :

- CO₂ fire extinguishers (4.5 litre capacity) as per applicable NFPA.
- DCP extinguisher as per applicable NFPA
- Synthetic insulating mats on front and back side of all the switchboards. 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 02No.for each Voltage level at each substation.
- Sets of Sand buckets with stand (each with at least 3 sand buckets), as required.
- DCP fire extinguishers for substations and transformer yards.
- HT discharge rod (2 Nos. for each substation).
-
- HT and LT hand Gloves (3 Sets each for each substation).
- A Type FRP ladder 3 feet & 8 feet – 2 Nos. each type for each substations.
- First Aid Box (1 No. in each substation)

Other requirement or any other unforeseen which may arises during detailed engineering shall also be in LSTK Contractor's scope.

2.0 BASIS OF DESIGN



2.1 General

2.1.1 The electrical installation shall be designed to provide:

- 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

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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 While sizing the system necessary consideration shall be given to restrict the system voltage drop within permissible limits during starting of large rated motors over Base Load. 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.

2.1.4 LSTK 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, LSTK 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. LSTK contractor shall develop detailed drawings and submit for owner's approval.
- c) LSTK 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) LSTK 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 LSTK contractor.
- f) LSTK contractor shall Liaison and in all interface coordinate 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 equipment shall be prepared by the LSTK Contractor based on relevant codes and Technical specifications/ Data sheets attached

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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) LSTK 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 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 LSTK contractor to determine ratings of electrical equipments (DG set, transformer, switchgears, cables etc.), to evenly distribute plant loads among the substations and switchgear, and to evaluate the need for power factor correction. All calculation shall be necessarily reviewed/approved by Owner/Consultant. Minimum rating of all equipment shall be as mentioned in SLD.

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.



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.

Minimum P.F. shall be maintained as 0.95 at every voltage level.

All the electrical equipments like Transformers, DG Set, 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 LSTK Contractor i.e. DG Set, Transformers, Switchgears, MCCs, PCCs etc. shall have capacity for future requirements. The Margin shall be as follows:
 - i) DG Set sizing: 40% is added to the Maximum Emergency Load.
 - ii) HV Transformer: 25% is added to the Continuous Peak Load.
LV Transformer: 30% is added to the Continuous Peak Load.
 - iii) 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.
 - iv) 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.

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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:

- 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.
- PA & Paging system (Load Details by Owner during detailed engineering).
- Starting system of DG set.
- AC Emergency Lub Oil Pump
- CCTV system
- Any other load (To be indicated by LSTK 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.

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.

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- 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

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

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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
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

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	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
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 60947	LV 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, LSTK Contractor shall refer to Owner for clarification. However, most stringent specification shall be followed with Owner's approval. Owner's decision shall be considered as final.

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2.6 Site Conditions

The equipment shall be designed for the following site conditions:-

- Minimum ambient Temperature 1 C.deg
- Maximum ambient Temperature 46 C.deg
- Design Reference Temperature 50 C.deg
- 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 Substations / Control rooms shall be designed for + 50° C so that in case of failure of Air-conditioning/ ventilation facilities, the operation/ functioning of equipment is not be affected.



3.0 SYSTEM DETAILS AND UTILIZATION VOLTAGES

3.1 The various voltage levels for in plant power distribution shall be as follows:

A. Normal Power	33KV ± 10%, 50Hz ± 5%, 3Ph, 3 W 11KV ± 10%, 50Hz ± 5%, 3Ph, 3 W
B. State Grid Power	<p>Grid power will be available at 220 kV. 220 kV Double Bus Indoor GIS shall be in LSTK Contractor's scope.</p> <p>Grid power details is as below:</p> <ol style="list-style-type: none"> 1. Voltage Grade: 220KV 2. Voltage variation: ±12.5% * 3. Frequency: 50 Hz 4. Frequency variation: ±5% * 5. Combined voltage and Frequency variation: Limited to ±12.5% * 6. Fault level: * <p>* Bidder shall co-ordinate with OPTCL and accordingly consider the same. .</p> <p>Following data pertaining to State Grid (OPTCL) supply shall be collected and considered by LSTK Contractor for design of 220 kV System :-</p> <ul style="list-style-type: none"> - Maximum OPTCL supply - X/R Ratio - Maximum fault level of OPTCL supply - Minimum fault level of OPTCL supply - Minimum power factor of OPTCL supply - System neutral earthing

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	<p>- Basic Insulation Level</p> <p>The rating of Grid Transformer shall be as per Conceptual SLD.</p> <p>Electrical system shall be designed for continuous parallel operation of any 2 out of 4 incomer on both Buses at 33kv GIS.</p>
C. Emergency Power	<p>Voltage Variation $\pm 5\%$, 50Hz $\pm 3\%$, 3Ph, 3 W</p> <p>LSTK Contractor shall indicate Emergency Power required at OUSS.</p> <p>Emergency Power at MRSS shall be met by dedicated DG Set, which shall be in LSTK Contractor's scope</p> <p>Voltage Level of DG Set at MRSS preferably at 415V.</p>
D. Distribution Equipment	<p>a) 11KV $\pm 10\%$, 50 Hz $\pm 5\%$, 3 Ph, 3 W with resistance earthed neutral</p> <p>b) 3.3KV $\pm 10\%$, 50 Hz $\pm 5\%$, 3 Ph, 3 W with resistance earthed neutral</p> <p>c) 415V$\pm 10\%$, 3 Ph, 4 W/240V $\pm 10\%$, 1 Ph, 2W, 50 Hz $\pm 5\%$ solidly grounded neutral.</p>
Combined variation in voltage & frequency	$\pm 10\%$
<p>Control Supply for:</p> <p>- 415V motors</p> <p>- Switch Gear Breaker controlled feeders:</p> <p>a. Closing, tripping & spring charging motor</p> <p>b. Auxiliary power</p>	<p>AC 240V $\pm 10\%$, 50 Hz $\pm 5\%$, 1Ph (For contactor controlled motors)-</p> <p>DC 110V $\pm 5\%$ (For breaker controlled motors) – Battery Charger</p> <p>DC 110V $\pm 5\%$, 2 W - Battery Charger</p> <p>AC 240V $\pm 10\%$, 50 Hz $\pm 5\%$, 1Ph, 2W</p>
<p>Voltage Ratings</p> <p>- Motors above 150 KW up to 1000 KW.</p> <p>-Motors up to150 KW</p>	<p>3.3 KV, 3 Ph AC</p> <p>415 V, 3 Ph AC</p>
<p>- Space heaters</p> <p>- Lighting</p> <p>- Panic Lights</p> <p>- Power Sockets/Receptacle</p> <p>- Portable safety lamps & Tools</p>	<p>240V, 1 Ph AC</p> <p>415V/240V AC</p> <p>110V DC</p> <p>415V, 3 Ph AC/240V, 1 Ph AC</p> <p>24V AC</p>

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3.2 Electrical System Studies

LSTK Contractor shall conduct Electrical System Studies for entire fertiliser complex using latest version of ETAP at appropriate stage of design-engineering and Electrical equipment of Plant shall be designed and selected accordingly. Study & implementation of efficient Grid Isolation System with latest technology and load shedding scheme shall be in the scope of LSTK Contractor.

Electrical System study for the entire fertilizer complex shall be conducted by the following:

- ETAP Automation Private limited
- Tata consulting Engineers Limited
- Development Consultants private limited.

LSTK Contractor has to perform the system study keeping in view the synchronization of CPP (Future Provision) and DGs with OPTCL Grid power.

Owner will provide the required details for carrying out the electrical system study of entire fertiliser complex. LSTK Contractor shall coordinate and liaison with OPTCL/ TPCODL to get Grid Data for Electrical System Study.

All the Electrical equipments shall be designed and selected according to the Short Circuit Study Report.

Electrical Power System Study shall be in three stages i.e. preliminary, intermediate and final along with all the necessary calculation for Owner/Consultant's approval /comments. All equipment Rating to be finalised only after necessary approval and supply / modification in any equipment shall be done accordingly without any cost and time implication.

LSTK Contractor shall provide all editable ETAP working files of latest version with complete library/Backup, during design engineering as well as after completion of project. Pre-defined Library shall be used or inform the source in case model has been created. Also, LSTK Contractor shall explain the complete ETAP Study in detail at Owner/Consultant' office up to their full satisfaction.

In case equipment is ordered before studies are completed and revision of rating or design is required as a result of study then inclusion of such revisions shall be in LSTK Contractor's scope without any cost and time implication.

Final ETAP editable file along with library and base files and final ETAP study Report shall be provided by the LSTK Contractor.

For all other specifications, refer PC183-TS-0831.

3.3 The actual fault levels shall be arrived at on the basis of incoming power sources from GRID & CPP, transformers, contribution of motors, etc.

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:

- 220 kV GIS :50kA for 3 Seconds
- 33 kV GIS. : 40kA for 3 Seconds
- 11 kV Switchgear – 40kA for 3 Seconds.
- 3.3 kV Switchgear – 26.24kA 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.

Impedance of transformers shall be selected suitably as per IEC to limit the fault level of 33kV system.

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 LSTK Contractor after substantiating

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the same by calculation.

3.4 System Earthing

The neutral of 33kV, 11 KV and 3.3 KV systems shall be non-effectively earthed through resistance. The earth fault current of 33kV, 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.

4.0 POWER SUPPLY AND DISTRIBUTION.

4.1 Power from OPTCL

4.1.1. Power from OPTCL shall be received at 220 kV through EHV single core cable to 220 KV Indoor GIS Incomers. Termination (including supply of required cable termination kit) in incomer bays at 220kV indoor GIS shall be in LSTK Contractor's scope. LSTK Contractor shall liaison with OPTCL/TPCODL and finalise CT/PT specification and rating as well as Metering Equipment, Communication Equipment etc. LSTK Contractor shall get all the drawings of 220KV System viz. Isolator with Earthing Switch, Surge Arrestor, CT, PT, Metering Equipment, Earthing system, Protection system, Communication system between TFL & Grid Substation, lighting protection, etc. approved from OPTCL/ TPCODL

4.1.2. 33 kV Double Bus Indoor GIS Switchgear shall have 2Nos. Incomer Bays through 220/34.5 kV transformers) and Bus-coupler & Outgoing Bays as per SLD (PC183-7411-0985A).

33 kV Double Bus Indoor GIS shall also have space for 8 Nos. Bays for future expansion (2 Nos. Incomers from CPP).

33 kV Double Bus Indoor GIS Switchgear shall be designed for maximum reliability of availability of power. 33 kV GIS Switchgear shall be designed considering continuous parallel operation of both Bus with any 2 Incomers at a time.

4.1.3. Transformers Area as a whole shall be filled with 40mm gravel to a minimum depth of 200mm above PCC of 300mm thickness.. Chain link mesh fencing shall be provided all around the Transformers Area having minimum height of 2.5 meter with two openable doors of 6m width.

Fire proof wall of min. 355 mm thick brick work or min. 240 mm thick RCC and extending at least 600 mm above the top of transformer shall be provided between two transformers also shall be extended at least 1 Meter on both side of transformer end. Space to install a transformer of similar capacity to be kept for future use.

4.1.4. Earthing mat shall be designed such that:



- It can carry the fault current for duration of 1 second.
- The overall earth resistance in dry weather conditions is less than 1 ohm.
- Step and touch potential shall be restricted to lower value than the allowable limit.
- Switchyard fence shall also be earthed at maximum 10m interval.

Earthing shall be designed as per latest edition of IS-3043/IEEE-80.



4.1.5. Lightning Protection shall be provided considering the zone of protection as per latest IS/IEC 62305.

4.1.6. The clearances of insulators and bushings shall be suitable for heavily polluted atmosphere as per IS/IE Rule.

4.1.7. The creepage distances of insulators and bushings shall be 31 mm/kV (considering highest system voltage) .

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- 4.2 220 KV GIS
- 4.2.1 220 kV Double Bus Indoor Type GIS (2 Nos. Incomers, 1 No. Bus-coupler, 2 Nos. Outgoing Feeders for 220/34.5 kV Grid Transformers and Space for 2 Nos. Feeders shall be provided for receiving Grid Power and distributing the same at 33 kV. All the Incomer & Bus coupler shall have synchronisation facility.
- 4.2.2 Separate electronic ABT metering arrangement(Main & Check) shall be provided for both the grid lines of 220kV switchyard to measure KWH, KVARH, KVAH, KVAR, Power factor and maximum demand in KVA as per tariff metering requirement of OPTCL and Open Access Power Purchase.. Summation meter shall be provided for both grid incomers as per OPTCL norms/guidelines. All liasioning in this regard shall be in LSTK Contractor's scope.
- 4.2.3 OFC based communication facility between TFL GIS & OPTCL's Grid GIS as per the norms / standard of OPTCL . Communication equipment at both the ends shall be supplied , installed & commissioned by LSTK contractor. All liasioning & approval from OPTCL shall be in the scope of LSTK contractor.
- 4.2.4 Interface of 220kV GIS with ECMS shall be provided. ECMS interface with 220KV switchyard shall be implicitly understood as remote control of breaker and isolator from ECMS system.
- 4.2.5 Auxiliary power supply requirement for GIS shall be in LSTK Contractor's scope.
- 4.3 33 kV GIS
- 4.3.1 Power supply from State Grid shall be fed to 33 kV Double Bus Indoor Type GIS through 2 Nos. 220/34.5 kV Grid Transformers.
- 33 kV Double Bus Indoor GIS shall also have space for 8 Nos. Bays for future expansion. 33 kV Double Bus Indoor GIS Switchgear shall have 2Nos. Incomer Bays through 220/34.5 kV transformers), All the Incomer & Bus coupler shall have synchronisation facility.
- 4.3.2 This 33 kV GIS Switchgear shall feed following :
- 2 Nos. Outgoing Transformer feeders for (33/11.5 kV Transformers) for 11 kV Switchgear at Gasification Substation of Coal Gasification Plant
 - 2 Nos. Outgoing Transformer feeders for (33/11.5 kV Transformers) for 11 kV Switchgear at Cooling Tower Substation of Coal Gasification Plant
 - 2 Nos. Outgoing Transformer feeders (33/11.5 kV Transformers) for 11 kV Switchgear located at MRSS.
 - 2 Nos. Outgoing Transformer feeders (33/11.5 kV Transformers) for 11 kV Switchgear, located at OUSS..
 - 2 Nos. Spare Transformer Feeders.
 - Space for 8 Nos. Bays.
- 4.3.3 Reverse Power Protection Relay shall be considered for both the grid Incomers.
- 4.3.4 Separate electronic tri-vector meter shall be provided in all Incoming and Outgoing feeders. of 33kV Switchgear.
- 4.4 11 kV Switchgear at MRSS, 11 kV Switchgear at OUSS, 3.3 kV Switchgear at OUSS shall have feeders as indicated in SLDs PC183-7411-0985A, PC183-7411-0985B.
- 4.5 Separate electronic tri-vector meter shall be provided in all Incoming and Outgoing feeders. of 11kV Switchgear
- 4.6 MRSS shall have 220 kV GIS, 33 kV GIS, 11 kV Switchboard, , 415 V Switchboard, transformers, UPS System, DC System, PLC/RTU based ECMS, Centralised PLC/RTU based ECMS (for entire fertiliser complex), Fire Fighting System etc.

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Further distribution to equipment at 11 KV, , 415/240 V, 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 LSTK Contractor's scope. Double radial system of power supply shall be followed for entire plants.

- 4.7 Indoor Type GIS Switchgears shall be in separate building or in separate Area in above building, complete with EOT Crane.
- 4.8 Distribution, protection and metering scheme shall be such that these meet the requirements of the project, provide safety to personnel/equipments and parameter monitoring requirements of the project/client.
- 4.9 33 kV ICOG Panels shall be provided at OUSS before 33/11.5 kV Transformers
- 4.10 OUSS shall have 11 kV Switchboard, 3.3kV switchboard, 415 V Switchboard, transformers, UPS System, DC System, PLC/RTU based ECMS, Fire Fighting System etc.

Further distribution to equipment at 11 KV, 3.3 KV, 415/240 V, 240 V(UPS) AC, 115 V (UPS) AC, 110 V DC etc. through proper type and size of cables, their supply, erection, testing and commissioning etc. shall be in LSTK Contractor's scope. Double radial system of power supply shall be followed for entire plants.

4.11 Emergency Power

4.11.1 MRSS

Separate Emergency DG set including automatic mains failure (AMF) panels and associated Fuel Feeding System and accessories etc. to meet emergency and essential loads of Electrical Distribution System. Capacity & Voltage of the DG set shall be finalised by LSTK Contractor subject to approval by Owner/PMC. . Voltage of the DG set shall be preferably be 440 V.

DG Set shall be located at the MRSS .The DG Set shall have 40 % future margin for DG sizing calculation. The rating of DG Set shall be minimum 500 KVA.

DG set shall be capable for starting synchronizing and taking full load within maximum 10 Seconds, without undue vibration and overheating of the engine.

After restoration of normal power, stopping of D.G. shall be done from the D.G. Control Panel. DG set shall have provision of starting and stopping through ECMS. Restoration of Power will be without Break i.e. after synchronization and Manual.

Capacity and reactance of DG shall be selected in such a way that following performance requirement are also fulfilled.

- 1. Auto starting of AC emergency lube oil pumps and seal oil pumps shall be possible.
- 2. Starting of emergency drives of largest rating shall be possible with the DG operating at its base load ie. with all emergency loads in operation except of largest rating. Largest motor rating with DOL starting shall be considered.

4.11.2 DG Set shall be rated for continuous operation i.e. Mode of DG shall be Continuous Power.



DG Set shall be suitable for Black start.

The auxiliary load shall be minimised.

DG Set shall be located inside building near MRSS. The building shall have RCC Roof.

Fuel storage facility shall be for continuous running of DG set at full load for 24 hours.

4.11.3 DG set shall have necessary provision & protection system for continuous parallel operation with Normal (Grid) Power with suitable Load control facility to control the Loading of DG set during parallel operation with Grid.



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4.11.4 OUSS

LSTK Contractor shall provide the emergency load details within scope of LSTK Contractor at OUSS, to Owner for design of DG System at OUSS (DG at OUSS in Owner's scope)..

Owner shall provide 1 No. feeder at Owner's 415 V EPMCC (located at OUSS) and tapping of power from Owner's EPMCC to shall be in LSTK Contractor's scope. However Emergency Switchboard for OUSS Emergency Loads shall be in LSTK Contractor's scope. Further distribution to all emergency equipments etc. shall be in LSTK Contractor's scope.

- 4.11.5 In addition to 30% Lighting Load , DC Battery Charger, AC UPSs, PA system, Fire Alarm system, ECMS/SCADA, and HVAC shall be fed from emergency switchboard.
- 4.12 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.
- 4.13 The insulation system of cable, 220kV, 33kV, 11 KV & 3.3 KV equipments shall be based on unearthed system only.
- 4.14 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 33 kV Switchboard, 11KV switchboards & 3.3 KV switchboards shall be same considering provision of interchange ability , except Incomer & Bus coupler Circuit Breakers.
- 4.15 Primary connections of transformers shall be provided with cables of suitable size and secondary connections shall be through bus duct for above 2000A and Cable for upto2000 A, if not specified in SLD/ Data sheet. Extension Box in Incomer Feeders, as required shall be provided.
- 4.16 The entry of cables in all the switchboards shall be from bottom only.
- 4.17 All switchboards shall be provided with minimum two incoming feeders and one bus tie having auto/manual changeover facility.
- 4.18 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. 33kV switchgear shall be of continuous paralleling operation of all Incoming sources.
- 4.19 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:
- 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.
 - 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.
 - 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.
 - 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



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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).
- 4.20 EPMCC shall have 2 Nos. Normal Power Incomers & 1 No. Emergency Power Incomer feeding critical load 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 feed breaker controlled feeders and various power feeders whereas MCC shall feed contactor controlled load and various power feeders.
- 4.21 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, EOT crane and other auxiliary loads.
- 4.22 Separate MCCs be provided for Air conditioning and Ventilation systems. MCC for Air conditioning and Ventilation systems shall 1 No. Emergency Incomer to feed Emergency Loads of Air conditioning and Ventilation systems. .
- 4.23 Separate 240VAC UPS System shall be provided to feed MCC control supply, 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.
- 4.24 **Lighting Distribution**
- 4.24.1 In each substation a 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. Lighting Transformers shall be dry type & indoor. The MLDB Incomers shall have Metering facility with Digital communicable Multi-function Meters. 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. 10% of total light or required Number of lights for safe evacuation, whichever is higher, shall be used as panic light (240V AC UPS), in case of complete shutdown.
- 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 photo-cells / digital clock timer. There shall be provision to Switch ON & OFF Outdoor Type feeders from ECMS in Remote Mode.
- 4.24.3 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.

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- 4.24.4 All outdoor lighting fixtures and outside lighting of Sub-Stations, Offices, Control Rooms etc., shall receive power from outdoor lighting bus.
- 4.24.5 Main Lighting Distribution Board shall feed Lighting Sub Distribution board having 63A 4 Pole MCB as incomer, 16Amp DP RCBO as outgoing. The outgoing RCBO shall have rating of 300 /100 mA. Six, Nine or Twelve way Lighting Sub Distribution board shall be used having 30 % as spare outgoing MCB feeder.
- 4.24.6 MLDBs at both MRSS and OUSS shall have additional 3 Nos. 63 A Spare Feeders in Indoor Bus and 4 nos. 63 A Spare Feeders in Outdoor Bus, for Owner's use. . Accordingly Lighting Transformers shall be designed.
- 4.24.7 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.
- 4.25 **DC Power**
- 4.25.1 110 V DC system shall be provided for control of circuit breaker feeders. It shall be obtained from Ni-Cd batteries.
Separate dedicated Battery, Battery Charger and DC Distribution Board shall be provided in MRSS and OUSS.
- 4.25.2 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.
- 4.25.3 Both substations (MRSS and OUSS) shall have independent battery charger and battery banks.
- 4.25.4 Each rectifier-cum- battery charger shall have independent power supply to be fed from the emergency source.
- 4.25.5 110V DCDB shall have 2 sources with auto changeover facility in case of failure of 1 source.
- 4.25.6 Battery end cell voltage shall 1.1V. Aging factor shall considered 125% and spare capacity shall have 120%.
- 4.25.7 For Temperature derating factor shall be based upon Minimum Ambient Temperature i.e. 50C.
- 4.25.8 DC System at MRSS shall have at least 20% additional capacity for Owner use and DC System at OUSS shall have at least additional 40% extra capacity for Owner Use. Battery Charger shall have 110 V DC system.
- 4.25.9 The battery and charger combinations shall be such as to ensure continuity of D.C. supply at load terminals without even momentary interruption.
- 4.25.10 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.
- 4.25.11 For all other specifications of Battery Charger refer PC183-TS-0813 and Battery Bank, refer PC183-TS-0814.

5.0 SUB-STATION

- 5.1 Elevated with trays in cable cellar : Yes
- 5.2 Complete Substation : Air-conditioned
- 5.3 Roof slab for
a Power transformer :Yes (upto 25 MVA Transformer)
b Distribution transformer :Yes
c. DG Sets : Yes

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- 5.4 Batteries in substation and control Rooms : Separate room
- 5.5 Switchgear room : Air-conditioned
- 5.6 Battery charger in substation : Air conditioned
- 5.7 UPS Systems :Air conditioned
- 5.8 Nickel- Cadmium Battery :Separate room (Ventilated)
- 5.9 ECMS : Air-conditioned substation (Separate Room)
- 5.10 GIS : Air-conditioned substation (Separate Room)
- 5.11 Cable Cellar : Ventilated
- 5.12 Actual size of substations shall be based on the final dimensions of substation equipments. Each Substation shall include Control Room, ECMS Room, Maintenance Room, Engineer Room, Shift Office (Staff Room), Store Room, Gents toilet (both Indian and western WC), Ladies toilet (both Indian and western WC) etc.
- 5.13 The sub-station building shall have double storey construction. The ground floor shall have cable gallery and first floor shall have all switchboards, control panels etc. The switch room shall have Epoxy flooring. False ceiling shall be provided in Substation except Switchgear Room.
- 5.14 The cable gallery shall have a minimum clear height of 2.2 M (i.e. lowest cable tray should run at a height of 2.2 mtr. from finished floor level of cable cellar) and shall be closed on all 4 sides with two entries, preferably on opposite sides. It shall house all cable trays and their supports.
- The Cable Gallery of (MRSS) shall have Minimum 6 tier of 600 M Cable trays throughout the Cable Cellar (below each Switchboard) for Owner's use.
- The Cable Gallery of (OUSS) shall have Minimum 7 tier of 600 M Cable trays throughout the Cable Cellar (below each Switchboard) for Owner's use.
- These trays shall be in addition to the cable trays of LSTK Contractor's requirement. The Entry/Exit of Cable Cellar shall be considered for Minimum 18 Nos. of 600 M Cable trays (for Owner Use) in addition to Cable Trays of LSTK Contractor. Accordingly Structure with Cable Tray Support at Entry/Exist of Cable Cellar and Structure with Cable Tray Support including all civil foundation & structural works upto 15Mtrs from Substation outer wall, towards Owner's. Pipe rack shall be in LSTK Contactor's scope. Height of Structure of Cable Trays shall be minimum 10 Mtrs at road crossing.
- 5.15 Transformer floor shall be at least 300 mm above the finished floor level of cable cellar room.
- 5.16 In addition to the entry to substation for operating personnel, a separate entry of minimum 3.5M (H) X 3M(W) with rolling shutter shall be provided for all equipment entry. The rolling shutters should be manually operated with gear box. The Sub-station shall also have an emergency door opening outwards.
- 5.17 Sub-station wall adjacent to the transformer bays and walls separating transformers shall be 355 mm thick (inclusive of plastering) in case of brick construction or 240 mm thick in case of RCC construction upto roof slab. RCC roof slab shall be provided for Transformer, Series Reactor, capacitor etc. The gate of Transformers shall be designed to prohibit bird entry.
- 5.18 Adequate number of Portable Fire Extinguishers of Dry Chemical Powder and Carbon dioxide shall be provided in suitable location in Substation, Transformer bays, and DG Building in addition to sand bucket as per CEA requirement etc. 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.



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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.

- 5.19 Sub-station building shall be without any columns within the switchgear room to ensure optimum space utilization.
- 5.20 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 (Minimum) shall be maintained for 11 kV/3.3 kV/415 V Switchboards:
- a) The clear space of 2.5 M at rear side and 3.5 M from front side of GIS.
 - b) The clear space of 2.5 M at rear side of 33 kV /11kV/3.3 kV Switchboard.
 - c) A clear space of 1.5M behind the double front switchboards and 1M for single front.
 - d) A clear space of 3.0M between the two boards facing each other.
 - e) A clear space of 2.5M on either side at entrance/exit.
 - f) A clear space of 2.0M between two boards in same line after future panel space of switchboard.
 - g) A clear space of 1.0 M in switch room from top of equipment.
- 5.21 The substation Switchgear Room, UPS & Battery Charger room, ECMS room, Control Room, Maintenance Room, Engineer Room, and Shift Office shall be fully air conditioned through centralised HVAC with (n+1) 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.
- 5.22 Separate Room of size 6 X 4 M for Owner use shall be provided at OUSS.
- 5.23 Epoxy flooring of 5mm minimum thickness, shall be done to reduce the heat load and improve the aesthetic look.
- 5.24 The battery room shall form a part of the sub-station. Battery room shall be provided with n+1 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.
- 5.25 Location of battery charger shall be nearer to battery room.
- 5.26 To the extent possible Bus duct shall be in straight position. Bending of bus duct shall be avoided.
- 5.27 Staircases (with SS Handrail) and other rooms shall be paved with Kota stone.
- 5.28 Fixed type glass ventilators on all sides shall be provided near the ceiling height for natural lighting.

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- 5.29 Arrangement shall be provided for lifting heavy equipment to be brought into the sub-station.
- 5.30 Sufficient nos. of entrances in line with National Building Code (min. 2) shall be provided for each floor.
- All doors of sub-station shall be air-tight fire proof steel doors except doors of control rooms/ PLC rooms which may have anodised aluminium frame with toughened glass panel. All doors shall open towards exit.
 - Windows shall have anodised aluminium frame and provided with toughened glass.
 - In case height is more than 10 meters, elevators (of capacity for 10 persons) shall be provided. Elevator shall be suitable for the area of installation.
 - 1000 mm wide insulated insulating mat as per latest IS standard, of appropriate voltage grade shall be provided in front as well as rear of each panel.
- 5.31 The Sub-stations shall also have emergency doors opening outwards as per latest edition of National Building Code.
- 5.32 The MRSS 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: -
- 220 KV GIS
 - 33 kV GIS
 - 220/34.5 kV Transformers, 33/11.5 kV Transformers, 11/0.433 kV transformers
 - Transformers located in separate Bay/Room with RCC roof slab (Upto 25 MVA)
 - Transformers in open with fencing and removable shed etc. (Above 25 MVA) .
 - High Voltage Switch Boards (11kV , 3.3kV)
 - Power Control Centres / Power & Motor control centres
 - Emergency Power & Motor control centres
 - Motor Control Centres
 - Auxiliary Service Panel Boards
 - Lighting Transformer
 - Main Light Distribution Board
 - Lighting Distribution Boards (Normal & Emergency)
 - Lighting Sub-Distribution Boards
 - Battery Sets
 - Rectifier-Cum-Battery Charger
 - Cell Booster
 - DC Distribution Boards
 - Rectifier-inverter Sets
 - 240 V UPS System along with UPS distribution board.
 - Neutral Earthling Resistors (Indoor / Outdoor as per requirement)
 - Input / Output Panels
 - VFD System
 - ECMS / SCADA System, Centralised ECMS / SCADA System
 - PA System (Space only)
 - DG System complete in all respect
 - CCTV System
 - HVAC System
 - Any other equipment required
- 5.33 The OUSS 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: -
- 33 kV ICOG Panel

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- 33/11.5 kV Transformers, 11/3.3 KV Transformer, 11/0.433 kV transformers, 3.3/0.433 kV Transformers
- Transformers located in separate Bay/Room with RCC roof slab (Upto 25 MVA)
- Transformers in open with fencing and removable shed etc. (Above 25 MVA) .
- High Voltage Switch Boards (11kV , 3.3kV)
- 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 (Normal & Emergency)
- Battery Sets
- Rectifier-Cum-Battery Charger
- Cell Booster
- DC Distribution Boards
- Rectifier-inverter Sets
- 240V UPS System along with UPS distribution board.
- 115V UPS System along with UPS distribution board.
- Neutral Earthling Resistors (Indoor / Outdoor as per requirement)
- Input Output Panels
- VFD System
- ECMS / SCADA System
- PA System (Space only)
- CCTV System
- HVAC System
- Any other equipment required

The OUSS shall house following Owner's Equipment :

- 2 Nos. EPMCC (Approx. Sizes 15000 x 1800 mm each)
- 2 No. PMCC (Approx. Sizes 15000 x 1800 mm each))
- 6 Nos. 11/0.433kV, 2 MVA Transformers
- Instrument Air System Panel (Approx. Sizes 6000 x 1500 mm)
- DCS I/O Rack (Approx. Sizes 6000 x 1500 mm)
- VFD/Soft Starters for 3 Nos. 1300 KW Motors for Inst. Air Compressors. (Approx. Sizes 1000 x 800 mm each)

LSTK Contractor shall consider the same while designing Substation sizes, HVAC , etc. Clear space shall also be considered for Owners Equipments.

- 5.34 Both MRSS and OUSS shall have separate Room for ECMS.
- 5.35 MRSS shall have a master Control room for ECMS & Load Shedding of the Entire Plant.
- 5.36 Heat load for panel to be taken by panel manufacturer.
- 5.37 Separation walls between transformers in substations and safe inter transformer distances for Grid transformers shall be provided.
- 5.38 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.
- 5.39 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.

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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.

5.40 A clear space of at least 1.5 meters shall be maintained all around the transformers after installation of Nitrogen Fire Protection & extinguishing System etc. Nitrogen Fire Protection & Extinguishing System complete with piping as required shall be separate for each transformer.

5.41 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.

5.42 In MRSS and OUSS substation, space for future extension of switchboards shall be provided.



In both substations, 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.

In addition, space for future extension of the substation/MCC room building shall be considered. Substations shall have provision for future expansion Minimum 5 Mtrs space for future horizontal expansion.

5.43 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.



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In case of contradiction / conflict, most stringent specification shall be followed.



5.44 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 and Panel entry points for above ground cables.

6.0 PROTECTION & METERING

- 6.1 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.
- 6.2 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/ECMS. 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.
- 6.3 The relay should have facility to comprehensively monitor the healthiness of its circuits and components by own monitoring system. In case of any problem of hardware and software elements of the relay, the fault diagnosis information shall be displayed on the LCD and an alarm should be generated by one of the output contacts. The alarm as soft signal to be sent to ECMS / SCADA system as well. Necessary support documentation explaining the self-diagnostic feature shall be furnished. Watch dog contact shall be provided
- 6.4 All relay shall be provided with ' Relay Failure Annunciation Contact'
- 6.5 The relay setting and programming should be stored in EEPROM so that during auxiliary supply failure the said data is not lost.
- 6.6 The relay should be suitable for operation in ambient temperature of +55 degrees Celsius and relative humidity of 93%.
- 6.7 The relay should conform to the IEC60255-5 or equivalent BS / ANSI for following :
- Overload withstand test
 - Dielectric withstand: 2kV in common, 1 W in differential mode
 - Impulse Voltage: 5kV in common, 1kV in differential mode
 - Insulation resistance > 100 M-ohm.
 - Vibration: Shock and bump and Seismic
 - Storing and transportation
 - Radio Interference: IEC 61000 for high frequency disturbance, Transient disturbance, Electrostatic discharge
- 6.8 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.
- 6.9 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.

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- 6.10 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.
- 6.11 The relay shall be provided with suitable security (Password protection) against unauthorised WRIRE ACCESS for change in relay setting. However it should be possible to view metering, protection settings, status and event data as READ ONLY without password protection. The security should be available for change in relay settings locally from relay HMI as well as when relay is accessed remotely through manufacturer software / remote HMI.
- 6.12 All PCB used in relays should have harsh environmental coating as per standard IEC 60068 (HEC) to increase the particle repellence and thereby increasing the life of relay or it should be tested as per IEC60068 to operate under extreme harsh environmental conditions given in G3. Test report needs to be submitted on request. IED shall be manufactured using lead-free components.
- 6.13 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.
- 6.14 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.
- 6.15 Relay should comply to IEC 61850 protocols without any external protocol converter. The relays shall generate GOOSE messages as per IEC 61850 standards for interlocking and also to ensure interoperability with third party relays. Goose signals shall be freely configurable for any kind of signals using graphic tool/user friendly software. The relay must support IEC 61850 GOOSE messaging with the performance requirements for tripping applications type 1A, Class P1 with GOOSE time <10ms as defined by the IEC 61850 standard so that any time critical interlocking can be built over communication.
- 6.16 The relay should have time synchronization through SNTP / IRIG-B
- 6.17 Fault record: The relay shall have the facility to store at least 8 last fault records with information on cause of trip, date, time, trip values of electrical parameters.
- 6.18 Event record: The relay shall have the facility to store at least 250 time stamped event records with 1 ms resolution.
- 6.19 Disturbance records: The relay shall have capacity to store at least 50 disturbance record waveforms. The relay shall have a disturbance recorder supporting a sampling frequency of 32 samples per cycle and featuring up to 12 analog and 50 binary signal channels.
- 6.20 Event log, trip log and disturbance record should go in to history. The relay settings shall be provided with adequate password protection with 4 alternative setting groups.
- 6.21 The numerical relays shall be provided with 1 set of common support software compatible with both Windows 98/ NT 4.0/ 2008/ Windows 7/ Windows 10 or higher, which will allow easy settings of relays in addition to uploading of event, fault, disturbance records, measurements and troubleshooting purposes.
- 6.22 Standard documentation per Relay, according to IEC 61850:
- MICS document (model implementation conformance statement)
 - PICS (protocol implementation conformance statement)
 - Conformance Test certificate from laboratory issuing Level A Certification under accreditation of UCA luG.

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- PIXIT document
 - All the above mentioned certificates shall be submitted.
 - ICD file
 - SCD file
- 6.23 Offered relay shall be type tested as per IEC 60255 standard.
- 6.24 LSTK 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. 2 Nos. Laptop (Minimum 8GB RAM, Minimum 1 TB hard Disk, latest processor) with all required software and accessories complete in all respect shall also be provided.
- 6.25 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.
- 6.26 In general all protection shall be through microprocessor based numerical relay. However high speed tripping relay shall be separate.
- 6.27 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.
- 6.28 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.
- 6.29 Bare minimum protection for power distribution system shall be as indicated below. However, LSTK contractor shall provide any other necessary protection required for complete protection of system:.

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.	220kV I/C	220kV O/G	33kV I/C	33 kV O/G	33/11 kV I/c with Transf.	HV Tr. Fdr. Sec Wdg. Volt 11 /3.3KV	HV Tr. Fdr. Sec Wdg. Volt< 3.3 KV	HV /LV Motor Fdr., HV Breaker controlled contactor controlled	O/G Bkr. HV Plant Fdr.	O/G Bkr. MV PMCC	I/C HV	I/C MV PMCC
1.	IDMTL Over-Current Relay	51	YES (2)	YES	YES	YES	YES	YES	YES	-----	YES	YES	YES (2)	YES
2.	IDMTL Earth-Fault Relay	51N	YES (2)	YES	YES Also 51N2	YES	YES Also 51N2	YES (4)	YES	-----	YES	YES	YES (2)	YES
3.	Standby Backup Earth Fault Relay (earthed neutral)	51G (11)	-----	-----	YES	YES	YES	YES (22)	YES (22)	-----	-----	-----	-----	-----
4.	Motor Protection Relay with (50, 50N, 46, 49, 50L/R, 95)	99	-----	-----	-----	-----	-----	-----	-----	YES	-----	YES	-----	-----
5.	Instantaneous Restricted Earth Fault Relay (Earthed side)	64R	-----	-----	YES (24)	YES (24)	YES (24)	-----	-----	-----	-----	-----	YES (24)	YES
6.	Instantaneous	50	YES	YES	-----	YES	-----	YES	YES	-----	-----	-----	-----	-----



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	Over current Relay													
7.	Instantaneous Earth Fault Relay	50N	YES	YES	-----	YES	-----	YES (5)	YES	-----	-----	-----	-----	-----
8.	Differential Protection Relay	87	YES	YES	-----	YES	-----	YES (6)	-----	YES	YES (8)	-----	-----	-----
9.	High speed tripping relay	86 (20)	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
10.	Trip Circuit Supervision Relay	95	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
11.	Transformer Auxiliary Relay	63	-----	YES	-----	YES	-----	YES	YES	-----	-----	-----	-----	-----
12.	Under Voltage Relay with timer	27 / 2	YES (9)	-----	YES (9)	-----	YES (9)	-----	-----	YES	-----	-----	YES (9)	YES (9)
13.	Check Synchronisation Relay	25	YES (10)	-----	YES (10)	-----	YES (10)	-----	-----	-----	-----	-----	YES (10)	YES (10)
14.	Busbar Differential	87B & 95B	YES (16)	YES (16)	YES (16)	YES	YES (16)	YES (16)	YES (16)	YES (16)	YES (16)	-----	YES (16)	-----
15.	Directional phase over current	67	YES	-----	YES	-----	YES	-----	-----	-----	-----	-----	-----	-----
16.	Directional earth fault	67N	YES	-----	YES	-----	YES	-----	-----	-----	-----	-----	-----	-----
17.	Circuit Breaker Failure	50	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

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:
 1. Relay 21 for distance protection, Relay 59 for overvoltage protection with timer, Relay 67 for directional overcurrent protection, Relay 67N for directional earth fault protection, Relay 81 for under frequency / df/dt protection and Relay 98 as dead bus charging relay.
 2. 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. .
8. For critical/long feeders and plant feeders connected to main power generation and distribution bus. A plant feeder implies outgoing feeders from one switchboard to another switchboard of same voltage level.
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. .

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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. 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. One set of bus differential relays (87B) and bus wire supervision relay (95 B) for each bus section shall be provided for HV switchboards connected directly to generation buses.
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. DG set shall be provided with protection but not limited to 51V,51G,40,46,86,95,80,64R etc. for generator rated above 500KVA and Generator rated less than 500KVA shall have 51V,51G,40,46,86,95,80 unless otherwise agreed with the owner.
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 Incomers only) 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(for Incomers only) 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 & LV 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.

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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 outgoing feeders (for Owner's use) shall be supplied as free issue. However, same shall be installed in LSTK Contractor's switchgear by LSTK Contractor. Cable Differential Relay in 220KV GIS Incomers at MRSS & OPTCL Switching Substation and all the cables shall be in LSTK Contractor's scope. 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. Redundant Relay shall be provided in all 220KV GIS Bays.
 42. Capacitor Feeder : 59, 27,50, 51, 50N, 51N, 60, CBFP etc.
 43. Auxiliary Relays shall not be part of Numerical Relay.
- 6.30 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 :

Trivector Meter shall be provided in all 220 KV Incomers, 33 kV O/G feeders, 11 kV O/G Incomers Feeders at both MRSS and OUSS.

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.	Grid Incomer	YES	YES	YES	YES	YES	YES	----	YES	YES	YES
2.	Grid Bus Tie	YES	----	----	----	----	----	----	----	----	----
3.	Grid O/G	YES	YES	----	----	YES	YES	----	----	----	----
4.	Grid Bus PT	----	YES	----	----	----	----	----	----	----	----
5.	HV Incomer	YES	YES	YES	YES	YES	YES	----	YES	YES	YES
6.	HV Bus Tie	YES	----	----	----	----	----	----	----	----	----
7.	HV Transformer	YES	YES	----	----	YES	YES	----	----	----	----
8.	HV Bus PT	----	YES	----	----	----	----	----	----	----	----
9.	HV Power	YES	YES	----	----	----	YES	----	----	----	----
10.	HV Motor	YES	----	----	----	----	YES (kWh)	YES	----	----	----
11.	HV Capacitor	YES	YES	----	----	----	----	----	YES	----	----
12.	PMCC Incomer	YES	YES	----	YES	----	YES (kWh)	----	----	----	----
13.	PMCC Bus Tie	YES	----	----	----	----	----	----	----	----	----
14.	PMCC Bus PT	----	YES	----	----	----	----	----	----	----	----

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15.	ACB Outgoing (Non Motor)	YES	----	----	----	----	YES (kWh)	----	----	----	----
16.	MV Motor (>55 KW)	YES	----	----	----	----	----	----	----	----	----
17.	MCC / ASB Incomer	YES	YES	----	----	----	----	----	----	----	----
18.	MCCB O/G (250A and above)	YES	----	----	----	----	YES (kWh)	----	----	----	----
19.	MLDB Incomer	YES	YES	----	----	----	YES (kWh)	----	----	----	----
20.	DG Set	YES	YES	YES	YES	YES (kW)	YES (kWh)	YES	----	----	----

Notes for Metering:-



1. MVA meter in external power supply incomers shall include maximum demand indication also.
2. Separate MW, MVAR, MVA and MVAH meters shall be provided for EHV external power and STGs incomers supply.
3. Separate analogue type voltmeters with voltmeter selector switch and analogue type ammeters with ammeter selector switch shall be provided for incomers of all switchboards.
4. Ammeter (size 48mm x 48mm) shall be provided in space heater circuit of breaker fed HV & MV motors.
5. 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.
6. 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.
7. Power factor meter shall be provided for synchronous motors in addition to the metering provided for induction motors.
8. For current feedback to DCS and VFD feeders motor current transducers shall be provided and mounted in switchgear panel.
9. 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.
10. 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.
11. Hour run meter shall be provided in all breaker controlled motor feeder.
12. Power Quality Meter shall be provided in Incomer Bays of 220 kV GIS.

7.0 CONTROL AND MONITORING

The following provision shall be made for control and monitoring of following electrical equipments.

7.1 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 33kV, 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'.
- Ammeter and voltmeter on both primary and secondary side.

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- Load break switch with Earthing Switch on transformer primary side (only where primary side circuit breaker is not located in the same sub-station).

7.2 Motors Controlled Through Circuit Breakers

- OFF- ON switch with Ammeter on LCS
- - OFF-AUTO/MAN-L/R-ON switch with Ammeter on DCS.
- Ammeter in 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 for Service', 'Test', 'Service', 'Space Heater ON'.
- Emergency trip in switchgear.
- Winding and bearing temperatures of motors shall be available at DCS in control room.
- Process interlock in CCR, where required.
- Indication lamp for 'ON', 'OFF' and "Ready to Start "in remote (DCS/PLC etc.)
- Motors controlled through Circuit breakers should also be provided with ammeter, KVAh, KWH and running hour counter. These shall be incorporated in Numerical relay Or Multi-function Meter.

7.3 Medium Voltage Motors Controlled Through Contactors

- OFF- ON switch on LCS
- OFF-AUTO/MAN-L/R-ON switch on DCS.
- Current monitoring in DCS, where required from process 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' and 'Fault' in switchgear.
- Indication lamp for 'ON', OFF' and "Ready to Start " 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.



7.4 PLC based or advanced software based Control Panel for DG set

7.4.1 DG Relay & Control Panel

DG Relay & Control Panel shall have following features:-

All Protection, control, monitoring, measurement, annunciation of the Generator. However, the all Alarm & trip indication and monitoring shall be extended to ECMS as well as DCS.

- All protection alarms shall also be provided in separate hardwires annunciator in the Substation / Control room.
- This Control Panel shall have the following facility as a minimum :
 - Digital Display: Power (MW), Voltage, current, Frequency, Power factor, Field Voltage, Field Current.

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- b) Indication: AVR Position (auto, manual, max position, min position etc.), Excitation status (On, Off, Trip, Ammeter etc.), MVAR / PF control status (On, Off, Trip), Generator Cooling status, Indications for Generator circuit breaker (Close, open, service and auto trip).
 - c) Protection: as mentioned above at clause 7.10, Winding temperature high alarm, Bearing temperature high alarm, Stator over-load alarm, Oil temperature high alarm, oil level low alarm, Auxiliary protection relay.
 - d) Control: Control for AVR (Raise/lower selection switch for voltage), Control for excitation (Raise/lower selection switch for field current), Control for Governor (Raise/lower selection switch for speed), Control for PF/ MVAR (Raise/lower selection switch).
- iii. An electronic trivector meter shall be provided in generator control panel to measure KWH, KVARH, KVAH and maximum demand in KVA of accuracy class 0.2
 - iv. All above metering parameters shall be made available in DCS System / ECMS. Necessary transducers shall be provided and mounted in Control panel. Transducers shall have 0.2 accuracy class in line with metering CT.
 - v. Any other requirement, which felt necessary for Generator protection / monitoring shall also be provided.
- 7.4.2 The PLC shall have event logging with 10 ms resolution to diagnose the fault in case of any failure.

8.0 EQUIPMENT SPECIFICATION



8.1 General Features

- 8.1.1 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 furnished on all ventilating openings to prevent entry of insects.

- 8.1.2 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.
- 8.1.3 The equipment to be installed in outdoor plant area shall have IP 65 enclosure.
- 8.1.4 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.
- 8.1.5 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.
- 8.1.6 Creepage distance shall be 31mm/kV (for highest system voltage) for all equipment.
- 8.1.7 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
- 8.1.8 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.

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8.1.9 All similar equipment (viz. HV Switchboard, LV Switchboard – PCC, PMCC, MCC, EPMCC, ASB, LDB, DCDB, Transformers, Numerical relays, UPS, Battery Chargers, Motors, etc.) supplied should be of single Make only – for ease of O&M and spare management.

8.2 DG Sets

8.2.1 In order to meet the emergency power requirement for critical loads and also for safe shut down; suitably rated DG sets shall be provided. In the event of the failure of normal power; DG set will supply the total emergency power requirement.

8.2.2 Emergency power from DG Set shall cater to:-

- (a) Essential loads of the package
- (b) Loads of emergency and aviation lighting
- (c) UPS Loads
- (d) Battery Charger & DCDB Loads
- (e)
- (f) Lighting Loads
- (g) Any other load recommended by the LSTK Contractor for proper and safe operation & control of the facilities under the package.

8.2.3 The DG Sets control shall have PLC/microprocessor based latest state of art technology. Brushless excitation system shall be used in generator.

8.2.4 The starting of engine of DG Sets shall be electric type. System should be capable of minimum 3starts.

8.2.5 DG Set shall have all its auxiliaries installed and controlled from same place. The control of DG Set shall be based on 110 V DC which shall be supplied from the DC panel. Separate DC battery bank with battery charger shall be provided for control supply. Starting Battery and Battery Charger for DG shall be separate. 110 V DC System Battery and Battery Charger may be separate or may be taped-off from Substation DC System. Both Control supply and Starting Battery Charger shall be (1 + 1) configuration.



8.2.6 The auto starting time (i.e. the time between actuation of loss of power in case of failure of main power to the time of loading of total emergency load) shall be in accordance with the load requirement. The maximum starting and synchronising time of Sets shall be 30 seconds even after 4th attempt and shall be able to take full load. LSTK Contractor shall submit during detailed engineering, the calculation for 'Time to start' Indicating break up of time for voltage build up 100% loading in steps as required.

8.2.7 The auxiliary power supply board to feed the auxiliaries of DG Sets shall have dual power supply, one from the normal power supply source of plant and other from the DG Set itself with the provision of changeover in the incoming supply in auto mode as well as manual mode. DG Rooms shall be provided for DG Set. The incomers and larger rated feeders shall be provided with air circuit breakers and Numerical relays. The feeders of smaller ratings shall be provided using MCCBs. A comprehensive electrical protection system shall be provided to protect the incomer as well as outgoing feeder. The incomer shall have a KWH meter, ammeter, voltmeter etc.

8.2.8 DG Set shall be supplied with day oil storage tank of capacity suitable for 24 hours continuous operation at full load, bulk oil storage tank, associated piping, valves, accessories, earthing of all equipment and power and control cables as required.

8.2.9 Emission from DG Set shall meet the requirement of Local Pollution Norms.

8.2.10 DG Set shall be provided with suitable acoustic enclosure to restrict the noise level to 85 dB at 1 metre.

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8.2.11 DG Set shall be provided with digital multifunctional meter with communication port for energy management at remote location. Additionally digital type ammeter, voltmeter and Hour Meter shall be provided separately.

8.2.12 Bare minimum protection devices for DG Set have been as indicated below; however LSTK contractor shall provide any other necessary protection relays required for complete protection of system.

Differential, Stator Earth Fault, Rotor Earth Fault, Phase Unbalance, Field Failure, Over Current (Voltage Restrained), Over Voltage, Winding Temp. Alarm, Bearing Temp. Alarm, Under Frequency, Over Frequency, Reverse Power. A microprocessor based composite generator management relay shall be used for the above mentioned protections. All Numerical Relays and DG set management relays should have dual IEC 61850 communication port for hook-up with ECMS.

8.2.13 Following signals for Emergency DG system shall be taken through hard wired/ communication to ECMS in addition to various Electrical parameters viz. KW, KVAR, PF, etc.

- DG Set breaker ON/OFF status
- Auto/Manual switch position status
- DC control supply failure
- Tripped on fault
- Generator voltage & current
- DG set run hours
- Number of starts & number of consecutive starts (i.e. DG set auto start blocked due to exhaustion of consecutive starts)
- Day tank diesel level

8.2.14 For all other specification refer PC183-TS-0830.

8.3 Power Transformers

8.3.1 The transformers shall be double wound, copper conductor, and Dyn11 type (in General) . Transformers shall rated for 220/34.5 kV, 33/11.5 kV, 11/3.45 kV, 11/0.433 kV , 3.3./0.433 kV, as required.

LSTK Contractor shall coordinate with OPTCL regarding Vector Group of Grid Transformer



8.3.2 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:-

- 30% spare capacity in LV transformers above continuous peak load.

8.3.3 The transformers shall have 'OFF' load tap changers except Grid Transformers (i.e. 220/34.5 kV Transformers), which shall be equipped with 'ON' load tap changer (OLTC). For on load tap changer, provision shall be made for Auto – Manual and Local – Remote electrical operation of the tap changer.

8.3.4 The rating of power transformers shall be selected keeping following into considerations:

- | | |
|-------------------------|--|
| (a) Duty | : Continuous |
| (b) Outdoor type | : ONAN |
| (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 |

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8.3.5 Maximum temperature rise over ambient of 50 Degree Celsius shall be limited to:

(a) Outdoor transformers:

Top oil (measured by thermometer) : 50 ° C

Winding (measured by resistance) : 55 ° C

(b) Indoor transformers:

Winding (by resistance method) : 90 ° C or lower as permissible for class of insulation offered

8.3.6 Special consideration shall be given in specifying the percentage impedance of the transformers to suit the switchgear short-circuit capacity available.

8.3.7 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 LSTK 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 inside the transformer.

8.3.8 Nitrogen Injection Fire Prevention and Extinguishing System (NIFPES) shall be considered for transformers having oil capacity more than 2000 Ltrs.

Additionally, Auto High Velocity Water Sprinkle System (HVWS) complete with Piping shall also be provided for Grid Transformers.

8.3.9 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.



8.3.10 The instruments such as OTI/WTI, Buchholz relay and MOG shall have Magnetic Reed Switches. The mercury switch contacts are not acceptable.

8.3.11 For all transformers, conservators shall be provided with Magnetic Oil Gauge (MOG) having 1NO contact activated on Low oil level. For transformers above 2000 KVA, Air cell shall be provided in the conservator.

8.3.12 Transformer rooms shall have roof slab.

8.3.13 Routine test on all transformers and heat run test on one transformer of each rating shall be performed in presence of Owner/Consultant.

8.3.14 All Routine, Heat Run 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) including SFRA Test before dispatch from Manufacturer's works and at erection site during commissioning or latest

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editions or any other authoritative standard. Certificates for Type Tests on similar type Transformers shall be submitted. SFRA test (Frequency Response analysis) to be done for all Power Transformers of 220/34.5KV & 33/11.5KV rating as routine test at factory and also at site. Transformers 220/34.5 KV and 33/11.5KV Transformers shall have Molecular sieve based online Automatic transformer oil moisture removal system installed as a part of the Transformer with provision for display of in-coming and Outgoing oil moisture ppm with Remote display (in ECMS) Modbus communication.

8.3.15 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.

8.3.16 For all other specification refer PC183-TS-0803.

8.4 Neutral Earthing Resistor (NER)

8.4.1 The NER shall be provided to earth the neutral of 33 kV, 11 kV and 3.3 kV systems. Neutral of 415V supply system shall be solidly earthed.

8.4.2 Neutral earthing resistor shall be outdoor type made of AISI 304/406 punched stainless steel grid element. The earth fault current of 33 kV, 11 KV & 3.3 kV shall be limited to full load current of transformer or 400 A, whichever is less.

8.4.3 NER/NGT requiring operation shall be provided with electrically operated Vacuum Circuit Breaker / Vacuum Contactor. NER/NGT requiring operation shall be controlled from ECMS. All NER not requiring operation shall be provided with isolator.

8.4.4 At any condition, only 1 No. NER shall be connected at each voltage level.

8.4.5 For all other specification refer PC183-TS-0804.

8.5 Switchboards

8.5.1 General

8.5.1.1 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.

8.5.1.2 Suitable shutter arrangement shall be provided to protect the person from accidental contact with live bus in trolley chamber.

8.5.1.3 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.



8.5.1.4 All HV, MV & LV Switchboards shall be LOTO compliance. 11 kV & 3.3 kV Switchboard shall conform 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 conform 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.

8.5.1.5 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



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window shall be of same material and construction as the type tested design/construction as specified in IEC.

- 8.5.1.6 Each cubicle shall be equipped with anti-condensation heater controlled by thermostat.
- 8.5.1.7 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 venting out the arc out of the switchgear room.
- 8.5.1.8 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.
- 8.5.1.9 The switchgear shall have integral making type earth switch with proper Mechanical & Electrical interlock. .
- 8.5.1.10 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.
- 8.5.1.11 Tripping and closing coils shall be of continuous rated type to ensure longer life. All Feeders of 220KV, 33KV & 11 KV shall have Double Trip coil for safety.
- 8.5.1.12 Circuit breakers shall be provided with a mechanically operated visual indicating device to display the circuit breaker switching state and a mechanical operation counter.
- 8.5.1.13 The circuit breaker operations of closing and opening shall be possible with the circuit breaker compartment door closed.
- 8.5.1.14 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.
- 8.5.1.15 Voltage transformer shall be independent of circuit breaker carriage
- 8.5.1.16 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 cannot be closed when the Bus-bar Isolator of any circuit in the section is closed.
- 8.5.1.17 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.
- 8.5.1.18 All CT & PT must be suitable for continuous operation of min. 20 % overload and for service under all rated and fault conditions.
- 8.5.1.19 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.
- 8.5.1.20 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.
- 8.5.1.21 The CT rating plate and the terminals must be accessible after the Power cables have been installed.
- 8.5.1.22 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.

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- 8.5.1.23 LV switchboard (EPMCC/PMCC/MCC) shall comply with Internal Arc Containment test as per IEC 61641.
- 8.5.1.24 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.
- 8.5.1.25 Clearance between gland plates to cable termination point in all switchboards shall be adequate but not less than 300mm to ensure proper cable termination.
- 8.5.1.26 FRP supports shall be used for bus bars with adequate clearances and creepage distance to prevent flash over due to effect of dust moisture.
- 8.5.1.27 Protective relays shall be mounted on the front of the switchgear panel.
- 8.5.1.28 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 are not acceptable.
- 8.5.1.29 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.
- 8.5.1.30 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.
- 8.5.1.31 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.
- 8.5.1.32 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.
- 8.5.1.33 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.
- 8.5.1.34 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

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motor control, disconnect switch motor control, alarm, space heater, trip, etc., shall be wired in series to a group / common alarm terminal.

8.5.1.35 Busbar Differential Protection (for 220 kV GIS, 33 kV GIS and 11 kV Switchboard)

- 8.5.1.35.1 A numerical low impedance bus-bar protection scheme with phase segregated measurement shall be offered (ANSI 87BB). It shall be capable of detecting all types of faults, i.e. multi-phase and single phase-to-ground faults with an overall operating time of less than 1.5 cycles. The architecture of the bus-bar protection shall be derived from using individual bay units along with a central fault-measuring unit.
- 8.5.1.35.2 In the architecture of the bus-bar protection, the central unit shall receive data from all bays /feeders , carry out computation and comparison of the restraint and differential currents, locate the fault position, and send the trip decision to the respective bays/feeders operating on the faulted bus-bars.
- 8.5.1.35.3 The bus-bar protection shall support automatic transfer of data to ECMS at the substation, whenever system fault-related information or data is produced. The design shall support being scanned by ECMS and FMS for both SCADA like data (protection status, protection start / trip, fault values, fault location and fault records, etc.), and historical data (waveform records). Facilities shall include user interface (both front and rear ports), serial communication and diagnostic / self-supervision, etc. Communication software for local and remote access of data from, and parameter download into, the bay units and / or central unit shall also be provided.
- 8.5.1.35.4 The bus-bar protection, on operation, shall trigger the breaker fail relay scheme. The breaker failure relay (BFR, ANSI 50BF) scheme shall be provided to monitor the post-trip currents on all bays following fault detection by any of the generic protection relays. The BFR shall be integrated into the bus-bar protection scheme with the supply of additional software package to perform breaker fail relaying function. It shall be sensitive enough to operate between 20 % and 200 % of nominal current, adjustable in steps of less than or equal to 10 %.
- 8.5.1.35.5 The bus-bar protection shall be capable of being blocked by a lockable manual switch. Under this condition, the tripping functions shall also be blocked on all feeders (to be provided as hardwired facility). However, the measuring function of the bus-bar protection should remain in service to facilitate signal measurement checks in the restraint and operating circuits of the protection.
- 8.5.1.35.6 Extension of the bus-bar protection system shall easily be made possible. The protection cubicles shall be completely wired for the total number of feeders specified in the scope of works. However, protection cubicles shall be designed to provide at least 2 spare wired points for each bus-bar section. In wired points, terminal blocks, wiring and space are provided but hardware equipment and other slot-in modules will not be supplied.
- 8.5.1.35.7 The busbar differential protection bay units shall also provide the possibility to be used as additional back-up overcurrent protection with protection functions ANSI 50/50N and 51/51N.
- 8.5.1.36 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.
- 8.5.1.37 LSTK contractor shall supply minimum 2No. laptops with licensed software for communication & configuration of all make& Type of Numerical Relays.
- 8.5.1.38 GPS system and associated hardware & software shall be provided for synchronisation of clocks of numerical relay and metering LA&ECMS



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- 8.5.1.39 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.
- 8.5.1.40 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.
- 8.5.1.41 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.
- 8.5.1.42 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.
- 8.5.1.43 Control supply shall be tapped from control bus in each cubicle/ panel itself through DP MCB of suitable rating.
- 8.5.1.44 The minimum thickness of sheet steel used in HV and LV switchgear including charger, UPS, ASPB etc. shall be as under:-
- Base Channel minimum 3.0 mm
 - Load Bearing Members minimum 2.0 mm
 - Doors and covers minimum 1.6 mm
- 8.5.1.45 A bottom channel of not less than 100 mm shall be provided.
- 8.5.1.46 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.
- 8.5.1.47 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.
- 8.5.1.48 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.
- 8.5.1.49 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.
- 8.5.1.50 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.
- 8.5.1.51 All HV & LV Switchgear, UPS, Battery Charger etc. shall have designated space in each Bus section for Network Switches and other communication equipments.
- 8.5.1.52 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)



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- 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



- 8.5.1.53 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
- 8.5.1.54 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.
- 8.5.1.55 Paralleling of two incoming feeders is not foreseen. However, facility for momentary paralleling shall be provided for intentional changeover without interruption of supply.
- 8.5.1.56 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.
- 8.5.1.57 Separate redundant AC and DC control supply shall be provided for each Switchboard.
- 8.5.1.58 Control supply for motor feeders having MCCB in PMCC/MCC 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.
- 8.5.1.59 For motors with auto-starting provision, trip of a running motor shall start standby motor automatically.
- 8.5.1.60 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.
- 8.5.1.61 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.
- 8.5.1.62 The CB ON and OFF lamp shall be provided at rear and front side of 11kV/3.3kV switchboards.
- 8.5.1.63 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.

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- 8.5.1.64 All breakers shall be electrically operable and mechanical operation from the breaker shall be possible locally. Manual breakers are not acceptable.
- 8.5.1.65 Separate Ammeter shall be provided for panel and motor feeder Space heater circuit for each panel.
- 8.5.1.66 The terminal strips used shall be of stud and nut type and control wiring shall be done with ring tong lugs only.
- 8.5.1.67 Dual channel output with display type current transducer for all HV and LV switchboard feeder shall be provided requiring Ammeter at control panel.
- 8.5.1.68 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.
- 8.5.1.69 All external hardware shall be of stainless steel only.
- 8.5.1.70 The control compartment and power compartment shall be separate.
- 8.5.1.71 All HV and LV breakers shall have remote switching facility as well as ON/OFF/TRIP indication at ECMS.
- 8.5.1.72 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
- 8.5.1.73 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.
- 8.5.1.74 Gland plate for single core cables shall be non-magnetic.
- 8.5.1.75 For all other specifications, refer PC183-TS-0805, PC183-TS-0806, PC183-TS- 0808 and PC183-TS-0809.
- 8.5.1.76 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.
- 8.5.1.77 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.
- 8.5.1.78 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.

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- 8.5.1.79 All 11kV, 3.3kV and 415V Switchboards shall preferably be of same make for ease of operation & maintenance.
- 8.5.1.80 Supervision of installation, testing and commissioning including testing of Relays of all switchboards shall be done through OEM only.
- 8.5.1.81 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 LSTK Contractor's scope.
- 8.5.1.82 All Numerical Relays shall be of same Make and Model (series).
- 8.5.1.83 11kV & 3.3kV Breaker rack in rack out facility should be operable only when breaker panel door is closed position.
- 8.5.1.84 LV Switchgear design shall be such that the feeder doors should not open in locked out tagged out condition .
- 8.5.2 11 kV Switchboard
- 8.5.2.1 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.
- 8.5.2.2 Degree of protection shall be IP4X as per IS/IEC 60529,IEC 60298. Switchgear sizes and configuration shall be rationalized to minimum spare holding.
- 8.5.2.3 A study shall be conducted by LSTK 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.
- 8.5.2.4 Incoming, bus coupler and outgoing feeders shall be provided with ON, OFF, Trip, Trip Circuit Healthy indications.
- 8.5.2.5 Control supply shall be 110 V DC.
- 8.5.2.6 Extra anti-condensing space heater shall be provided in Bus –Bar and Cable chamber of 11KV Switchboard.
- 8.5.3 3.3kV Switchboard.
- 8.5.3.1 The 3.3kV 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.
- 8.5.3.2 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.
- 8.5.3.3 A study shall be conducted by LSTK 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.
- 8.5.3.4 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.
- 8.5.3.5 Control supply shall be 110 V DC.
- 8.5.3.6 Extra anti-condensing space heater shall be provided in Bus –Bar and Cable chamber of 3.3KV Switchboard.

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- 8.5.4 Low Voltage Switchgears
- 8.5.4.1 415 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)
- 8.5.4.2 Low voltage switchboards shall be metal clad, arranged with self supporting units and assembled together in a row.
- 8.5.4.3 Internal physical separation / segregation of 415 V Switchboards shall be 3 B for Non-ACB feeders and 4 B for ACB feeders.
- 8.5.4.4 The switchboards shall be suitable for extension at both the ends.
- 8.5.4.5 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.
- 8.5.4.6 The horizontal busbars as well as vertical droppers of LV switchboards shall have heat shrinkable insulated sleeves.
- 8.5.4.7 Sufficient bus supports shall be given to give adequate mechanical strength during short circuits.
- 8.5.4.8 A continuous ground bus shall be provided at the bottom in the PCC/PMCC/MCC for grounding the PCC/PMCC/MCC.
- 8.5.4.9 Rated short circuit breaking capacity shall be 50 KA for 1 sec.
- 8.5.4.10 The PCC, 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.
- 8.5.4.11 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.
- 8.5.4.12 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.
- 8.5.4.13 All ACBs shall be without any internal releases. The required protections shall be wired by means of external numerical relays.
- 8.5.4.14 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. All outgoing feeders shall be draw-out type in all the switchboards.
- 8.5.4.15 Switchboards shall be provided with thermostatically controlled anti-condensation heaters.
- 8.5.4.16 All units in the MCC shall be completely accessible and removable from front. Both power and control connections shall be stab-in type.
- 8.5.4.17 Bus bar clearances shall conform to relevant Indian Standard/IEC for equipment voltages up to and including 500 V AC.

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- 8.5.4.18 The switchboards shall be compartmentalized and individual feeder modules shall be draw-out type. Fixed type modules shall not be acceptable.
- 8.5.4.19 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.
- 8.5.4.20 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.
- 8.5.4.21 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.
- 8.5.4.22 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.
- 8.5.4.23 Provisions shall be made to manually close/trip circuit breakers on loss of control voltage.
- 8.5.4.24 LV motor and power feeder above 100A shall have CBCT and Digital earth leakage relay.
- 8.5.4.25 All external hardware shall be of stainless steel only.
- 8.5.4.26 The control compartment and power compartment shall be separate.
- 8.5.4.27 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; Substation lights, ECMS Equipment, Fire Detection & Alarm System etc. Breaker control supply shall be 110V DC
- 8.5.4.28 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.
- 8.5.4.29 The timers shall be electronic type only. Pneumatic or synchronous type timers are not acceptable.
- 8.5.4.30 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 is 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 above 1.5 KW, all MOV and LOPs at both LCS and Feeder end.
 - k) Selector switches as per requirement.

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8.5.4.31 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

8.5.4.32 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, 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.

8.5.5 **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. Each Substation station shall have separate ASPB.

8.5.5.1 Additional 5 Nos.63A Feeders at both MRSS & OUSS for Owner's use. at MRSS

8.5.6 Lighting Sub Distribution Boards

The Distribution Boards shall be single front, non-draw out wall mounted type.

8.5.7 UPS Distribution Boards

8.5.7.1 The UPS Distribution Boards shall be single front, floor mounted non-drawout type for supply of 240 V AC UPS Distribution Boards at MRSS and OUSS shall have 20% spare outgoing feeders of each rating & Type (fully wired) and with all the components

8.5.7.2 240V AC UPS Distribution Boards at OUSS shall have additional 20 Nos. 32A/63A Feeders for Owner's use. 240V AC UPS Distribution Boards at MRSS shall have additional 6 Nos. 32A A Feeders for Owner's use.



8.5.7.3 115V AC UPS Distribution Boards at OUSS shall have 20 Nos. 32A/63A A Feeders.

8.5.8 **Direct Current Distribution Boards**

8.5.8.1 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.

8.5.8.2 DCDB at MRSS and OUSS shall have 20% spare outgoing feeders of each rating & Type (fully wired) and with all the components

8.5.8.3 DCDB at OUSS shall have additional 14 Nos. 32A A Feeders.

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8.6 Motors

8.6.1 The rating of LV and HV motors shall be selected from the sizes as recommended in relevant Indian Standard/IEC.

8.6.2 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%

8.6.3 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

All motors shall be designed for 3-Phase supply only.

8.6.4 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.

8.6.5 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.

8.6.6 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.

8.6.7 All motors 30 KW and above shall have space heater provision.

8.6.8 All HV motors shall have winding, hot air and bearing RTDs. All the temperature signals shall be terminated to DCS as well as ECMS.

8.6.9 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.

8.6.10 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 breakaway current.



8.6.11 The starting current of 3.3 KV motors shall not exceed 550% of FLC. No positive tolerance is acceptable over 550% FLC.

8.6.12 Type test certificate of similar motor for use in specified hazardous area (if applicable) shall be furnished.



8.6.13 The duty cycle of the motor shall meet the process and driven machine requirement.

8.6.14 In case of 3.3 KV motor, the terminal box shall be suitably designed for proper termination of XLPE insulated Aluminium cables through heat shrink termination kit.

8.6.15 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.

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- 8.6.16 Motor rated above 30 KW shall have on line greasing provision and for motor rated above 45 KW, grease outlet feature shall be provided.
- 8.6.17 All HV motors shall have safety factor not less than 1.1.
- 8.6.18 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.
- 8.6.19 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.
- 8.6.20 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.
- 8.6.21 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.
- 8.6.22 For all other specifications, refer PC183-TS-0810.
- 8.7 Rectifier-cum-Battery Charger**
- 8.7.1 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.)
- 8.7.2 The battery and charger combinations shall be such as to ensure continuity of D.C. supply at load terminals without even momentary interruption.
- 8.7.3 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.
- 8.7.4 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
- 8.7.5 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

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- 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).

8.7.6 For all other specifications, refer PC183-TS-0813.

8.8 **Battery Sets.**

8.8.1 These shall be Ni-Cd Battery Sets shall be rated to meet the total DC power requirement for 5 hour after complete power failure.

8.8.2 Spare capacity of 20% for future use shall be considered above the combined capacity required for LSTK Contractor and Owner use .

8.8.3 Battery shall be designed with minimum temperature as 5⁰C.

8.8.4 Load Test of all Battery to be done at site. Battery will be accepted based on load test only.

8.8.5 For all other specifications, refer PC183-TS-0814.

8.9 **Uninterruptible Power Supply System (UPS)**

8.9.1 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.

240 V AC UPS System shall be complete in all respects including Battery, UPS Distribution Board etc.

8.9.2 Separate 240 V AC UPS System complete with Battery Bank and UPS Distribution Board shall be provided at MRSS and O&UMSS.

8.9.3 Additional 50 KVA rating of 240 V AC UPS shall be considered for Owner's use while designing UPS System at OUSS.

8.9.4 70KVA, 115 V AC UPS System complete with Battery, UPS Distribution Board etc. shall be provided to feed shall be Inst. Loads of Offsite & Utilities and same shall be located at OUSS.



8.9.5 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.

8.9.6 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.

8.9.7 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).



8.9.8 UPS shall be suitable for 100% step load.

8.9.9 Battery Load cycle test shall be carried out by the vendor at site .

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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.

- 8.9.10 UPS Configuration shall be as per attached Block Diagram. The over load capacity of UPS shall be 200% for 10 cycles, 150% for 60sec & 125% for 10min.
- 8.9.11 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.
- 8.9.12 UPS shall be PWM based using IGBT. Each charger and SCVS shall have isolating transformer at the input.
- 8.9.13 The salient features of the UPS shall be as under:
- High Efficiency
 - Compatible to feed nonlinear, high crest factor loads
 - Microprocessor based monitoring system for UPS status and fault indications
 - High transient performance
 - Low audible noise
- 8.9.14 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.
- 8.9.15 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 :
- 8.9.16 In synchronism : No break transfer i.e. within 6 milliseconds (Maximum)
- 8.9.17 In asynchronous mode : Within 16 milliseconds (Maximum).
- 8.9.18 The technical parameters of UPS shall be as under:
- Input**
- Rated Voltage 415 V \pm 10%
 - Rated Frequency 50 Hz \pm 5%
- Output**
- Rated Voltage 240 V AC / 115 V AC
- Voltage regulation:
- Static (0-100% load) \pm 1%
- Dynamic for 100% load change: \pm 5%
- 8.9.19 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

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- 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

8.9.20 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.

8.9.21 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.

8.9.22 For all other specifications, refer PC183-TS-0802.



8.10 Variable Speed Drives (VSD/VFD)

8.10.1 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

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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.

- 8.10.2 System shall be highly reliable, efficient and shall provide high power factor, low harmonic distortion, low noise level etc.
- 8.10.3 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).
- 8.10.4 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%.
- 8.10.5 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.
- 8.10.6 The system shall be suitably designed with due care for long length of cables, output filters, chokes, motor insulation, cable voltage grades etc.
- 8.10.7 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.
- 8.10.8 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.
- 8.10.9 "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.
- 8.10.10 Preferably screened type cables or cables as recommended by VSD/VFD vendors shall be used for VSD/VFD systems.
- 8.10.11 The VSD/VFD panels to be supplied shall be of proven model.
- 8.10.12 Training of VSD/VFD shall be provided to owner personnel.
- 8.10.13 For all other specifications, refer PC183-TS-0820A and PC183-TS-0820B.
- 8.11 Local Control Stations**
- 8.11.1 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:
- 8.11.2 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).
- 8.11.3 Provision for pad locking in OFF position shall be provided.
- 8.11.4 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.
- 8.11.5 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

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KW and above. If required from process point of view, ammeter shall be provided for motors below 5.5 KW also.



- 8.11.6 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.
- 8.11.7 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.
- 8.11.8 All components shall be completely wired up to terminal block and also provided with earthing terminals.
- 8.11.9 Inscriptions on corrosion resistant metal strips giving drive description, mechanism number and functional requirement shall be provided.
- 8.11.10 Two numbers of LCS shall be provided for the motors, which are installed at elevated platforms, such as cooling tower fan etc. One shall be installed at ground level and the other near the motor.
- 8.11.11 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.
- 8.11.12 Complete Push Button along with its actuator mounted on the cover with wiring done through flexible cables with proper protection.
- 8.11.13 Preferably Ring Type lug and suitable TB to be used for connection, to avoid loose connection.
- 8.11.14 All spare hole to be plugged with suitable metal plugs.
- 8.11.15 For all other specifications, refer PC183-TS-0817.

8.12 **Switch Sockets**

- 8.12.1 Sufficient number of inter-locked type 125A/63A, 415V, 3 Ph and 16A, 240V, 1 Ph switch sockets shall be provided in various locations as per hazardous area classification to facilitate the maintenance work. Supply to switch-sockets shall be taken from ASPB through suitably rated RCCB.
- 8.12.2 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.
- 8.12.3 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 .
- 8.12.4 For all Other Specifications, Refer PC183-TS-0811.

8.13 **Conduits**

- 8.13.1 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.
- 8.13.2 Conduits entrances to pull boxes and switches shall have double lock nuts & insulating bushings. No running thread shall be used.

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8.13.3 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%

8.14 **Bus-Duct**

8.14.1 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.

8.14.2 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.

8.14.3 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.

8.14.4 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.

8.14.5 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.

8.14.6 Openings with cover at suitable locations shall be provided on bus duct for accessing the bus bars for maintenance.

8.14.7 Silica-gel breather shall be provided on both indoor and outdoor portions of the busduct. (shall not be required for pressurized busduct).

8.14.8 Proper sealing shall be done between Outdoor & Indoor section of the Bus Duct.



8.14.9 For all other specifications refer, PC183-TS-0807.

8.15 **Electrical Control & Monitoring System.**

8.15.1 A microprocessor based data acquisition and control system called as Electrical Control & Monitoring System (ECMS) intended for supervision, control, monitoring, data acquisition, data logging and printing of status of the electrical power distribution network of entire fertilizer complex shall be provided by EDS LSTK Contractor. The extent of coverage for ECMS system shall include all the breaker feeders and isolators) of 220 KV GIS, 33 KV GIS & all the breaker feeders of HV Switchboards and Air Circuit Breaker – ACBs of 415V LV Switchboards of the plant for their centralized monitoring and control. Some critical 415V LV contactor feeders which need reacceleration from process point of view are also envisaged to be monitored and controlled from ECMS system.

ECMS system shall be PLC (Programmable Logic Controller) / RTU (Remote Terminal Unit) based having self-diagnostic features with online card replacement facility. i.e. ECMS shall have provision of hot card swapping facility.

For the purpose of data acquisition, Programmable Logic Controllers (PLCs) / Remote Terminal Units (RTUs) based ECMS Cabinets with suitable I/O interfaces (such as Data Concentrator Panel / I/O Cabinets, Interposing Relay Cabinets, etc.) including furniture required for all ECMS equipments shall be provided at all the substations of Coal Gasification Plant, Ammonia-Urea Plant, Steam Generation Plant, Offsites & Utilities

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(OSBL) Plant and also at EDS Package Substations. These respective RTUs of different Substations shall be connected to the Central / Master RTU & Master Human-Machine Interface (HMI) Units located at EDS Package Substation by a suitable and redundant data highway.

The estimated & tentative I/O list (I/O counts) required at various substations shall be provided by respective Contractors of Coal Gasification Plant, Ammonia-Urea Plant & Steam Generation Plant, Offsite& Utilities (OSBL) Plant. The firm requirement of I/O list shall be finalized during detailed engineering after the receipt of final data from all these Contractors.



ECMS System shall be designed to carry out following functions:-

- Data acquisition and display of grid power import and distribution parameters and energy balance in every network configuration.
- Load Shedding
- Load sharing (kW & KVAR)
- Auto Synchronizing
- Capacitor Control
- NGR switching
- Larger Motor Start Inhibits
- Tap Changing of Transformers (OLTC in EDS Package Transformers)
- Power Factor Control

Supply, installation and commissioning of PLC / RTU based SCADA ECMS system consisting of Redundant CPUs & Racks, Redundant Power Supplies, Redundant communication network, Remote Data Concentrator Panels/ I/O Interface Panels / RTUs at various Substations, SOE Module, Redundant data bus, Engineering Workstations, Operator Workstations, Data acquisition system compatible with SCADA, historian server, printer, Data Cabling (suitable for the required communication protocol), furniture, cabling up to individual feeders and other hardware required to complete the successful operation of the system shall be in LSTK Contractor's scope. All required furniture, PC console with chairs for complete ECMS shall be in the scope of LSTK Contractor.

Engineering Work Station (EWS) and Operator Work Station (OWS) for monitoring / viewing purpose only with required furniture and cabling shall be installed in various Substations as below :



1. Man Receiving Substation : In separate engineering room 3 Nos. EWS and 3 Nos. OWS
2. Offsite & Utilities Substation : 1 Nos. EWS and 2 Nos. OWS
3. Coal Gasification Substation : 1 EWS & 3 Nos. OWS
4. Air Separation : 1 No. OWS
5. Purification Substation : 1 No. OWS
6. Cooling Tower Substation : 1 No. OWS
7. CMD Substation : 1 No. OWS
8. Ammonia Substation : 1 EWS & 3 Nos. OWS
9. Urea Substation : 1 No. OWS
10. Ammonia Storage Substation : 1 No. OWS

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11. Ammonia-Urea Cooling Tower Substation : 1 No. OWS
12. Steam Generation Plant :1Nos. OWS
13. WTP Substation : 1 No. OWS
14. DM + CPU Substation : 1 No. OWS
15. ETP Substation : 1 No. OWS
16. Bagging Substation : 1 No. OWS
17. Coal Handling Unit : 1 No. OWS
18. Ash Handling Unit : 1 No. OWS
19. Cooling Water Substation :
20. 132 kV Switchyard Substation : 1 No. OWS
21. Substation 2 :1 No. OWS

LSTK Contractor to provide server industrial grade PC with 32" LED screen with latest configuration and RAID 5 configuration (Make – HP / DELL) as Operator Work Station and Engineering Workstation. A single point 240 V normal power supply, 240 V AC UPS power supply shall be made available to the EDS contractor at each of the Substation. Further distribution of power to various equipments' (i.e. ECMS system cabinets / servers / PC / console / printers, etc.) through redundant shall be in contractor's scope of supply. The contractor shall consider the necessary auxiliaries like small distribution boards, switch sockets, cables, etc. Any other power supply / voltage, if required, shall be generated / derived by the contractor. The contractor shall indicate voltage & power requirement for ECMS system equipments installed in individual substation based on I/O count to be furnished by respective package LSTK contractor.

- 8.15.2 Centralized online energy management system shall be part of ECMS. The same shall have the following features:-
- Single Line Diagram of entire electrical system of the plant.
 - Measurement, display, recording & data logging of all electrical parameters of main electrical equipments.
 - Report Generation of Energy consumption & Loss in various plants/Units of Daily, Monthly & Yearly Basis.
- 8.15.3 ECMS shall be capable of interfacing with DCS, PLC and microprocessor based protection relays for motor and feeder protection, necessary hardware and software shall be provided for the same.
- 8.15.4 ECMS shall take reference of the power imported from OPTCL State Electricity Grid and shall accordingly send command to the switchboard feeders for tripping or starting the loads in preset sequence by implementing Load Shedding Scheme as per the recommendations of the system study report, process requirement and in consultation with Owner/Consultant. In addition to above, following features shall be considered in the design of ECMS system:-
- a) Start and Stop operation of all the equipments and feeders shall be hardwired.
 - b) ECMS system shall have interfacing facility with Plant DCS system through redundant soft link to display the parameters of ECMS at DCS for monitoring.
 - c) I/O Cabinets & Interposing Relay Cabinets shall be provided for hardwired signals.
 - d) ECMS shall send command to GIS / Switchboard feeders for tripping or starting the loads. GIS here is limited to 220 KV & 33 KV GIS and Switchboard here is limited to 11 KV, 3.3 KV & MV (415 V PMCC / EPMCC / MCC / ASPB / MLDB) Switchboard

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incomer, bus-tie and outgoing breaker feeders and contactor feeders which need reacceleration from process point of view.

- e) ECMS system shall be designed with 20% spare I/O racks in each Substation.
- f) ECMS system shall be extendable type and shall have provision of inclusion of inputs from HT panels and LT breaker panels of other units of the plant.
- g) ECMS shall also take care of the situation when Emergency Diesel Generator (EDG) is in line on outage of all normal supply sources. In such situation load shedding shall be planned in such a way that EDG shall cater to the critical emergency load only.
- h) System shall be designed in such a way that any board taken out for maintenance after removal shall not affect communication with other boards.
- i) Any other hardware & software required for the completeness of ECMS system even it is not specified in Technical Specification shall be in the scope of EDS Package LSTK Contractor.
- j) Fibre optic patch panels, as required, shall also be in the scope of ECMS vendor.

8.15.5 Load Shedding Requirements

8.15.5.1 Priority of load shedding shall be decided by LSTK Contractor in consultation with TFL.

8.15.5.2 Load shedding scheme shall be in dynamic mode as well as frequency mode as back up.

8.15.6 I/O Cabinets / Interposing Relay Cabinets

8.15.6.1 I/O cabinets shall be installed at different substations with redundancy at I/O cards.

8.15.6.2 I/O cabinets are meant only for hardwired signals mentioned below:-

- AI signals (CT / VT signals from 220, 33, 11, 3.3 and 0.415 KV systems, as required)
- 4-20 mA Analogue inputs (AI) from Transformers' OTI, WTI, Oil Level Indicator, etc. through signal transducers.
- DI signals (Status Signals) acquired from switchboard through potential free contacts.

8.15.6.3 Interposing Relay Cabinets are meant only for hardwired signals mentioned below:-



- DO signals (Control / Command Signals) hardwired through potential free type contacts of interposing relays.
- 4-20 mA analogue outputs (AO) for set point control of field equipments, as required hardwired through potential free contacts of interposing relays.

Interposing Relay Coil shall be suitable for 24 V DC control supply.

8.15.6.4 All the interface cabinets (I/O Cabinets & Interposing Relay Cabinets) shall be provided with forced cooling for uniform heat dissipation.

8.15.7 All the protection related data acquisition & alarm signals shall be acquired from numerical relays having redundant port for communication on IEC 61850 protocol in star topology as soft data.

8.15.8 All the metering and measurement related data acquisition shall be acquired from digital type multifunction meters (MFMs) having communication on Modbus RTU protocol via serial link in daisy chain topology as soft data. For non MFM feeder if any, necessary analogue type transducers and hardwired connection shall be considered. Analogue transducers shall be located within the switchboard itself and shall be considered by respective switchboard vendor. However, in case, if required transducers are not considered in the switchgear, necessary transducer panel, as deemed necessary, shall be considered by EDS Package LSTK Contractor.

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8.15.9 Processor Panel

8.15.9.1 Processor for Engineering / Programming and Operator Unit

- a) It shall be stand-alone type with all required accessories and own power supply arrangement.
- b) It shall be integrated with industrial grade advanced processor system with advanced communication capability with other processor and operator unit.
- c) Processor loading and memory utilization at all levels except bulk storage shall be limited to 60%.
- d) Out of 3 OWS at MRSS, One OWS dedicated type for load shedding scheme and one OWS capable of communicating with client's internal network for monitoring the data on Local Area Network shall be provided..

8.15.9.2 PLC / RTU for interfacing I/O cabinet & monitoring unit

- a) The panel shall be provided with redundant processor & power supply with hot back up module.
- b) It shall be incorporated with advanced control system with all required accessories with advanced network data transmission capability for remote I/O connectivity.

8.15.10 Software (Development Application)

8.15.10.1 The software shall collect all data recorded by the IED / numerical relays / remote RTU, etc. This will involve retrieving data from the various stored logs to include historical or trend logs, power quality logs and waveform logs. The power quality data collection program shall support more than one thread (a thread is a task within the program) so that data from more than one numerical / IEDs can be collected simultaneously.

8.15.10.2 The software shall be capable of controlling, monitoring, load management, data logging, overviews, data tables, bar charts, trends, close to alarm, sequence of events and alarms with date and time in printable output, etc. and printing of status of all important electrical parameters, equipment and feeders.

System should be capable of storing historical data minimum as follows in the system :-

Process Parameter (Electrical Quantity)

One minute data for 7 days

Hourly average data for 45 days

Daily average data for 400 days

Monthly average data of 18 months

Yearly data of 6 years

Alarm minimum 40,000 alarms with minimum 20 recent alarms per tag

Event history 30,000 events with minimum 20 recent events per tag

Alarm / Event recording with sorting facilities



Energy parameters recording

Daily maxima and minima values



Total energy date and time wise

Daily energy Data for 1 year

Provision for storing & retrieving Data in external medium for longer duration, if required.

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- 8.15.10.3 The supplier shall indicate time schedule for development of logic diagrams.
- 8.15.10.4 It shall be mandatory on part of the supplier to associate contractor / owner's engineers in software installation & testing work.
- 8.15.10.5 Mimic diagram shall be provided for complete 220 KV & 33 KV GIS, 11 KV Switchboards, 3.3 KV Switchboards and PMCC / EPMCC / MCC incomers indicating position of various breakers and load flowing through them of entire fertiliser complex..
- 8.15.11 Communication & Monitoring Requirements**
- 8.15.11.1 Redundant Communication bus arrangement shall be provided from main system to various I/O racks. 100% redundancy shall be provided for communication from Network Switch / Ethernet Switch to controller. Each Ethernet / Network Switch shall have Minimum 20% Spare Port Capacity.
- 8.15.11.2 Communication system shall support open network such as (Ethernet network, Control-net network, Device-net network etc.) Numerical relays shall communicate on IEC-61850 protocol in non redundant star topology and meter shall communicate on MODBUS RTU protocol in daisy chain topology.
- 8.15.11.3 System shall be capable of monitoring and displaying the status all critical EHV, HV and LV (415V) loads of the plant.
- 8.15.11.4 Software shall be capable of monitoring the entire system parameters through various display configuration on operator station i.e. overviews, tables, trend displays, bar charts etc. Also, system shall generate sequence of events and alarms with date and time in printable output.
- 8.15.11.5 The programming software provided shall be with user-friendly application software suitable for operation. All software (Windows, Anti-Virus, Application Software, Energy Reporting Software etc.) provided by the vendor shall be licensed software and shall provide the same in Original Licensed CDs for reloading the same as and when required.
- 8.15.11.6 Alarm sequencing and alarm history software shall be provided. Network OFC cables from field I/O cabinets to controller / RTU panel in redundant mode shall be in ring main configuration and shall be laid in HDPE conduits. Data highway cable from controller / RTU panel to operating work station shall be in redundant mode. The maximum scan time of 20ms shall be considered.
- 8.15.11.7 DI, DO and AI inputs from all GIS, HT panels and LT breaker panels are required to be interfaced. Power / Load flow online display in graphical SLDs.
- 8.15.11.8 All DI, DO Input from all the equipments shall be hardwired. Tripping from Relay shall be hardwired.
- 8.15.12 Training**
- ECMS supplier shall provide training on operation and maintenance of the system at their works on free of cost basis to 4 Nos. TFL engineers in the factory before factory acceptance test or during factory acceptance test / inspection and at Site, to make it effective and useful during execution.
- 8.15.13 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 provided by respective other LSTK Contractors. However, wiring / connection of Ethernet / FO Cables in I/O Racks shall be in EDS LSTK Contractor's scope.
- 8.15.14 Further cabling between the ECMS I/O Racks of various substations and up to centralized ECMS system shall be in the scope of EDS LSTK Contractor. However, cable tray &

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support for cable trays etc. for cables within individual battery limit of their respective plants shall be in respective other LSTK Contractor's scope.

8.15.15 The major items required in the system, their configuration architecture diagram, Software details etc. shall be submitted with bid for better understanding of System as well as during detail engineering for approval of Owner/Consultant.

8.15.16 For detailed specifications of ECMS refer PC183-TS-0833.

8.16 **220 KV GIS and 33 kV GIS**

8.16.1 All the equipment shall be suitable for continuous duty operation at specified rating under specified system details and ambient condition.

8.16.2 Both 220 KV GIS and 33 kV GIS shall have provision for future expansion on both the end accordingly the same shall be designed.

8.16.3 GIS Room shall have EOT Crane suitable for heaviest equipment.

8.16.4 The minimum fault level of 220 kV GIS shall be 50 kA for 3 Seconds. The minimum fault level of 33 kV GIS shall be 40 kA for 3 Seconds.

8.16.5 Separate redundant AC and 110 V DC control supply shall be provided for 220kV GIS and 33 kV GIS.

8.16.6 1 No. Local Control Cabinet/ BCU shall be provided for each Bay. Separate Control & Relay Panel shall be provided for each Bay.

8.16.7 For detailed specifications of 220 kV GIS refer PC183-TS-0832A and 33 kV GIS refer PC183-TS-0832B.

9.0 **CABLING**

9.1 **Cables**

9.1.1 All EHV, 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 EHV/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 LSTK Contractor (if required).



9.1.2 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.

Cables shall be sized considering ONAF Rating of Transformers.

9.1.3 All EHV/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.

Incomer Cables in 220 KV GIS and 33 KV GIS shall be of Single Core. Single core EHV/ HV Power cable shall be of copper conductor. The construction of same shall be as per above.

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9.4.1. 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

9.1.4 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.

9.1.5 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.

9.1.6 All cables shall be armoured and shall have extruded inner and outer sheath.



9.1.7 Cables connected in parallel shall be of the same type, cross section and terminations.

9.1.8 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.

9.1.9 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.

9.1.10 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)	EHV/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)

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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.

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- 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.

9.1.11 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 (MM ²)
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.

9.1.12 Design Criteria for Cables/Bus Duct & Short Circuit Withstand Time:

- a) Design criteria for cables/bus duct

Sr.No.	Design Criteria	220kV	33kV	3.3 kV / 11	415 V

				kV	
1.	Loads beyond 1000A rating and located near the transformer	1-core cable	Bus Duct / 1-core cable	Bus Duct / 1-core cable	Bus Duct / 1-core cable
2.	Loads located up to 200 M	1-core cable	Cable	Cable	Cable
3.	Loads located 200 - 1000 M	1-core cable	1-core cable / 3-core cable	1-core cable / 3-core cable	1-core cable / 3.5-core cable
4.	Loads located beyond 1 KM	Cable	Cable	Cable	Cable
5.	Recommended limiting size of multi-core cable (sq.mm) / Single Core (sqmm)	1C X 630 Sqmm.	3 Core x 300 / 1 Core x 630	3 Core x 400 / 1 Core x 630	3.5 Core x 300 / 1 Core x 630
6.	Insulation voltage grade	220 kV Unearthed	33 kV Unearthed	3.3 kV / 11 kV Unearthed	1100 V Earthed
6.	Type of cable insulation	XLPE	XLPE	XLPE	Power: XLPE Control: XLPE
7.	Power, Control & Earthing Cables	Armoured	Armoured	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 generator & transformer to switch board	1 sec
Incomer from other switchboard	0.6 sec

9.1.13 The minimum size of power cables shall be 2.5 sq. mm (Cu).

9.1.14 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.

9.1.15 Between 220 KV GIS & 220/34.5 KV Transformers, 1 additional Run of Cables per Phase (single core cables) shall be provided as spare.

9.1.16 For all other specifications, refer PC183-TS-0815.

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9.2 Cable Laying

9.2.1 The cables shall generally be laid on overhead racks. Pipe racks where available, shall be used to support the cable racks.

EHV cable shall be laid in buried RCC cable trenches. warning tape, protective tiles of minimum class designation 50 (50 kg./sq. cm.) cable protection covers for entire route, construction of jointing bays, cable route marker, backfilling of trenches and restoration etc. shall be in LSTK Contractor's scope. Minimum depth of laying shall be minimum 1.5 Mtrs. The bending radius shall be minimum 25 X D for Single Core cables.

HV power cable shall be laid on cable tray in single layer having 1D spacing between the cables. LV power and control cable shall be laid on cable tray in touching formation in single layer.

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 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 LSTK 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 LSTK Contractor.

9.2.2 The cable racks shall be ladder type, pre-fabricated from suitable hot dip galvanised steel/heavy duty FRP material. Cable racks around cooling tower areas shall be of heavy duty FRP (fire retardant and UV stabilized) material. Maximum cable tray size shall be 600mm wide. Maximum supporting span shall be 2 Mtrs. as per PDS Doc. No. PDS: E 530 attached with the NIT. 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.

9.2.3 FRP Cable Tray shall be as per NEMA FGI-198X. FRP Cable Tray shall be UV exposed as per ASTM G 154 for 1000 Hrs and the mechanical properties shall not be deteriorate more than 5%. Glass content shall be greater than 55%. The run spacing shall be 250m.

9.2.4 All FO cable shall be laid through HDPE pipe with all accessories(Connecting arrangement).

9.2.5 Cable Tray between MRSS and OUSS shall be in LSTK Contractor's scope. Support structure in owner pipe rack will be provided.



9.2.6 All cables shall be terminated using suitable cable lugs.

9.2.7 All EHV / HV terminations and joints shall be of RAYCHEM make only.

9.2.8 Bimetallic lugs shall be provided, as required.

9.2.9 In Control Room (excluding false ceiling) and Substation, lighting cable shall be laid in concealed conduit.

9.2.10 For all other specification of cable racks, refer PC183-TS-0816 & PDS attached.

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10.0 ILLUMINATION SYSTEM

10.1 General

10.1.1 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.

10.1.2 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.



10.1.3 The specified illumination level shall be maintained after considering maintenance factor 0.6 for plant & outdoor areas & 0.7 for indoor areas and utilisation factor as per manufacturer catalogues for size of room & type of fixture.

10.1.4 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.

10.1.5 Voltage drop at the fixture from the MLDB bus shall not exceed 3%.

10.1.6 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.

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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). In case 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.

- 10.1.7 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.
- 10.1.8 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.
- 10.1.9 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.
- 10.1.10 15A plug sockets shall be fed through separate circuit of lighting sub-distribution boards/junction box having ELCB of 30mA.
- 10.1.11 16A plug sockets shall be fed through separate circuit of lighting sub-distribution boards/junction box.
- 10.1.12 Illuminated exit sign shall be provided in substation / Control Room .
- 10.1.13 Power factor of complete fitting shall be 0.95 min. at 230 V.
- 10.1.14 Lights from LED's shall be soothing to eye and without any bright spots on the floor/objects illuminated by the luminaries.
- 10.1.15 The driver shall be mounted internally and be replaceable with the aid of commonly available hand tools.
- 10.1.16 The LED module or array shall be designed in such a way that the failure of one LED shall not affect additional LED's.
- 10.1.17 Life expectancy of LED Luminaries shall be minimum of 50000 hrs with greater than 70% of rated lumen output.
- 10.1.18 Min. efficiency of LED driver: The minimum efficiency of LED driver shall be 85% for driver power output rating $\leq 40W$ and 87% for driver power output rating $> 40W$.
- 10.1.19 Short circuit protection /Open load protection shall be required for LED fixtures.
- 10.1.20 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.
- 10.1.21 Color temperature of LED Luminaries: 5700K
- 10.1.22 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.
- 10.1.23 For more details, refer PDS attached.
- 10.1.24 For lighting fixtures and 16 Amp plug socket circuits, 3 core 2.5 sq. mm (Cu) cable shall be used.

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10.2 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%

10.3 **Street Lighting And Security Lighting**

10.3.1 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.

10.3.2 Hot dip GI octagonal poles of suitable mounting height shall be used for street light. However, for 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

10.3.3 Hot dip galvanized octagonal high mast lighting shall be used for yard and general area lighting. LED type fittings may be used.

10.3.4 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.

11.0 **EARTHING AND LIGHTNING PROTECTION**



11.1 **Earthing**

11.1.1 Complete earthing installation shall be done as per IS: 3043, IEEE-80,IE Rules and IEC recommendations. The earthing system shall be designed to:

- Provide a permanent & continuous path from equipment and conductor enclosures to earth from circuits for flow of fault current.
- Provide sufficient current carrying capacity to conduct safely any current liable to be imposed on it.
- Provide sufficient low resistance to earth to limit the potential between metalwork and earth within safe limits.
- Provide equal distribution of potential and minimum potential difference for safety of personnel.
- Ensure sufficient current in case of fault to facilitate the operation of relays, over current devices, fuses etc. provided in the circuit.

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- 11.1.2 In MRSS, earth mat shall be provided.
- 11.1.3 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.
- 11.1.4 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.
- 11.1.5 Earth pit shall be maintenance free type (chemical earth pit) considered.
- 11.1.6 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.
- 11.1.7 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 80-2000 Clause 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.
- 11.1.8 Anti-corrosive bituminous paint shall be provided at each joint of earth flat after necessary finishing and priming treatment .
- 11.1.9 Earthing grid/ring shall comprise of buried GI earth strips and GI pipes/electrodes.
- 11.1.10 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.
- 11.1.11 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.
- 11.1.12 As far as possible, the reinforcement rods inside concrete column shall be connected to the earthing grid/ring to reduce the overall earth resistance.
- 11.1.13 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.
- 11.1.14 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.
- 11.1.15 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.
- 11.1.16 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.
- 11.1.17 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:

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Equipment having diameter	Hazardous area	Non hazardous area
30 M	2	2
More than 30 M	3	2

11.1.18 Wherever process equipments are mounted on steel structures, the structures shall be earthed instead of earthing the individual equipment.

11.1.19 The pipe structures shall be earthed at not more than 25M apart.

11.1.20 For all equipment in hazardous area, in addition to external earthing one internal earthing shall be provided.

11.1.21 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.

11.1.22 The main ground grid shall be buried in earth at a minimum depth of 1000 mm below finished grade level unless stated otherwise.

11.2 Lightning Protection

11.2.1 All structure shall be protected against lightning strokes by suitable lightning protection system to be designed and installed as per IS/IEC-62305.



11.2.2 The number of down conductors shall be minimum two.

11.2.3 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.

11.2.4 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 except for chimney 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.

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The air terminal rods provided at the top of chimney/stack for lightning protection shall be 20 mm dia lead coated solid copper rod.

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 60degrees.

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) meters from the nearest roof conductor.

11.2.5 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.

11.2.6 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.

12.0 CAPACITOR BANKS

12.1 The LSTK 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.

12.2 For all other specifications, refer PC183-TS-0822.



13.0 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, angles, flats etc conforming to IS: 2066.



14.0 CCTV System .

14.1 CCTV System

LSTK Contractor shall provide 6 (minimum) nos. IP based CCTV camera with inbuilt IR to be installed at strategic location of each substation in & out. Provision shall be made in the CCTV system to connect total 20 nos. Of camera. The actual no shall be decided during detail engineering.

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- 14.2 Closed Circuit Television system for the substation shall consist of the following elements:
- a) High resolution charge coupled device (CCD) day & night, tamperproof color camera
 - b) Auto iris zoom lens, pan and tilt, near & far focus, screen wiper, ON/OFF control equipment, color monitor and video recorder system
 - c) Automatic computer based switching device including Quad splitter.
 - d) Ceiling hung CCTV monitors such that these can be suitably matched with control room aesthetics by dimensions appearance etc.
 - e) Coaxial cables, control cables, optical cables, connector etc. of required type & size.
 - f) video recorder located in Control Room.
- 14.3 The complete hardware and software shall be procured by LSTK Contractor. LSTK Contractor scope shall include:
- a) Identification of suitable location for mounting cameras. Contractor shall coordinate the locations, with PMC/ owner.
 - b) Installation of cameras and their associated accessories in the field shall be in the scope of contractor. This shall include any structure, support or stanchion required for installation and their accessories.
 - c) Cabling from respective camera to control room and termination of cables in the field, as per recommendations by CCTV manufacturer. This shall include any additional support or tray/tray space provision by contractor.
 - d) Coordinate with CCTV manufacturer/supplier during testing, pre-commissioning and commissioning of complete system.
 - e) Bidder to provide facility to connect FO cable from this CCTV network to main plant network. Laying of these FO cables will be in bidders scope.
 - f) Standard Specification of CCTV is attached in the Tender.
- 14.4 LOCAL AREA NETWORK (LAN) Switch FOR CCTV System
The LSTK Contractor shall lay the LAN required
BASIS OF DESIGN
The system shall have as a minimum the following :
1. Manageable L2 switch with 1G/10G port, Jack panel and cable manager. 50% spare port shall be kept in L2 switch.
 2. Switch shall have with 4 redundant Fibre optic port. One redundant Fibre Optic Port shall be used for connection to main Plant LAN switch/servers.
 3. Cabling shall be CAT6A cabling. UTP CAT6A cabling shall be done with one spare cable.
 4. 24 Nos 6 m/Cat6a patch cords for end user
 5. Cable and passive components shall be from AMP. I/O
- 14.5 For all other specifications refer PC183-TS-0837.

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15.0 SPARES

15.1 Commissioning Spares

LSTK 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. LSTK Contractor shall be responsible for the quantification of the commissioning spares for the smooth commissioning / package system. Item wise list of commissioning spares with recommended quantity shall be furnished for information. The same shall be Part of LSTK Price.

15.2 Mandatory/Insurance spares

Contractor shall supply Mandatory / Insurance spares for all equipments as per Section VI-7.0: Spare Parts of this bid package. The same shall be Part of LSTK Price.

15.3 2 Years Bidder's Recommended Operational Spares (Other than Mandatory / Insurance spares)

Bidder shall recommend 2 years Operational Spares 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 LSTK price.

15.4 All spare parts shall be identical to the parts used in the equipments.

15.5 Any other spare parts or special tools not specified, but required, shall also be quoted along with the offer.

16.0 VENDORS' SERVICES

16.1 The LSTK Contractor shall consider the services of major equipment suppliers during installation, testing and commissioning in their scope as required. The services of engineers of following equipments' (OEM)manufacturers are envisaged and required during installation, Testing and commissioning. LSTK contractor shall arrange for the same without any additional cost implication:

- GIS
- AC UPS
- DC Panels
- Variable Speed Drives
- Numerical relay
- MOV
- DG sets
- Transformers
- HV & LV Switchboard
- ECMS
- CCTV



16.2 Post commissioning supervisory service from OEM for 2 weeks for GIS , Transformer and ECMS.

16.3 Site Testing, parameterization and commissioning of the Numerical relays shall be done by OEM expert only.

17.0 TESTING & INSPECTION

17.1 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.



17.2 The LSTK 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

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Certificates shall not be older more than 5 years except GIS for which Maximum 10 years old Type test Certificates is acceptable subject to no change in Design.

- 17.3 The LSTK Contractor shall submit the certificates of routine and acceptance tests conducted on the purchased equipments.
- 17.4 All the routine/acceptance tests shall be performed at the manufacturer's works in the presence of owner's representative.
- 17.5 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.
- 17.6 The equipment shall be dispatched from works only after receipt of Owner written approval of the test reports.
- 17.7 The LSTK Contractor shall intimate the owner 4 weeks in advance of the tests and submit the detailed schedule of tests.
- 17.8 In addition, the equipment shall be inspected at site for final acceptance.
- 17.9 Certified reports of all the tests carried out at the works shall be furnished in six (6) copies for approval of the Owner.
- 17.10 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.
- 17.11 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.
- 18.0 **MAINTENANCE & TESTING EQUIPMENTS.**
- 18.1 Following minimum maintenance & testing equipments to be supplied along with any other special tools (on permanent basis) :

<u>Sl No.</u>	<u>Description</u>	<u>UOM</u>	<u>Quantity</u>
1	BDV Test Kit	No.	1
2	Automatic Transformer Turns Ratio Tester	No.	1
3	Transformer Dc Winding Resistance Measurement	No.	1
4	Automatic Capacitance and Tan Delta Kit	No.	1
5	Circuit Breaker Test Kit (Circuit Breaker analyzer with DCRM including transducer)	No.	1
6	Omicron Secondary Injection Kit	No.	1
7	Digital Micro ohm meter	No.	1
8	Primary Injection Kit	No.	1
9	5KV Digital Megohm meter	Nos.	2
10	Digital Multimeter	Nos.	2
11	Earth Resistance Tester	Nos.	2
12	Phase Sequence Meter	Nos.	2
13	Three Phase Variac	Nos.	2
14	Transformer Oil Filtration Plant	No.	1
15	Transformer Oil sampling Bottles	Nos.	10
16	Dew Point Kit for SF6 gas	No.	1
18	Electric Torque Wrench	Nos.	2
20	Hydraulic Crimping Tool	Nos.	2
21	Industrial Vaccum Cleaner	Nos.	2

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22	Arc Flash Suit for 33KV (As Per Arc Flash Study)	Nos.	2
22	Arc Flash Suit for 11 KV (As Per Arc Flash Study)	Nos.	4
23	Arc Flash Suit for 3.3KV & BELOW (As Per Arc Flash Study)	Nos.	5
24	Tong testers of suitable ranges (Make – Fluke).	Nos.	2

18.2 For all other specifications refer PC183-TS-0838.

19.0 DOCUMENTATION

19.1 The LSTK 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 LSTK 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 LSTK Contractor for electrical documentation.

19.6 The details of the documentation software shall be furnished in the technical offer.



19.7 LSTK 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 (LSTK 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, LSTK 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

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- (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

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19.12 The details of equipment layout and cable routing will be designed by the LSTK 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 LSTK 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 LSTK 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 LSTK 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 size 10 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.

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- 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:
- non-submission of drawings/ documents/ well before those are actually required and/ or
 - delay in incorporation of comments and/ or
 - non-incorporation of comments by contractor and/ or
 - 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**
- Training shall be imparted to owner's personnel at manufacturer's works as under:
- GIS : Four engineers for one week.
 - ECMS : Four engineers for one week.
 - AC UPS: Two engineers for one week .
 - Variable Speed Drive (if required): Two persons for 3 Days.
 - DC System: Two engineers for one week.
 - Numerical relay: Four engineers for one week.



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23.0 **VENDOR LIST**

- 23.1 Make of all electrical equipment shall be as per Section 10.0: 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 major equipments in their offer.
- 23.4 Any other item for which vendors are not mentioned in NIT, LSTK 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 LSTK 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 LSTK 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 LSTK Contractor shall furnish field inspection and test data sheets for all equipments for owner's approval.
- 24.4 The LSTK 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 LSTK 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

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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 GI cable trays shall be used for laying power cables.
- (c) Perforated type GI cable trays shall be used for laying control, signal, and communication etc. cables.
- (d) Cable racks around cooling tower areas shall be of heavy duty FRP (fire retardant and UV stabilized) material.
- (e) Coaxial cables for data transfer from/ to microprocessor based equipments shall be laid in HDPE conduits with pull boxes fixed to cable supporting racks.
- (f) Top tray shall be used/ left vacant for communication, signalling and fire alarm cables.
- (g) Cables shall be laid in separate trays according to voltage and noise classification. Fire proof partition shall be provided between HV and LV cables.
- (h) Power, control and lighting cables shall be laid in separate cable trays.
- (i) 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.
- (j) 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.
- (k) 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..
- (l) Support to cable trays shall be provided at intervals as required for proper support but at interval not more than 1000 mm.
- (m) Support to trays shall also be provided at each joint of tray irrespective of its distance from adjacent support.
- (n) GI 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.

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- (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.

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- (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 LSTK 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 LSTK 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 LSTK 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 LSTK 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 LSTK Contractor shall give at least 24 hours notice to Owner/ Consultant to enable them to witness the test.
- 25.8 The LSTK 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.

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- 25.10 Failure to submit test results as tests are completed may render the LSTK Contractor for carrying repeat tests.
- 25.11 The LSTK 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 LSTK 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 |



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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 LSTK 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

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- 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.
- Insulation Test
 - Continuity Test
 - High Voltage Test
 - Simulation Test
 - Earth Resistance Test

26.0 QUALITY ASSURANCE

- 26.1 All equipment, components, materials proposed to be supplied by LSTK 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 LSTK 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 LSTK 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 LSTK 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 LSTK 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 LSTK Contractor of ensuring complete conformance of the materials/ equipment supplied to relevant specification, standard, data sheets, drawings etc.

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- 26.12 The owner or their representative shall be allowed to visit the manufacturing works for stage inspection during manufacturing stage.
- 26.13 The LSTK Contractor shall intimate the owner 4 weeks in advance of the tests and submit the detailed schedule of tests.
- 26.14 LSTK Contractor s 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 LSTK 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 LSTK 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.

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ANNEXURE-I

ILLUMINATION LEVELS

Average illumination levels (Mean Lux) for various areas shall be as follows:

Sl. No.	AREA	LUX
1.0	<u>ROADS</u>	
1.1	Roads	20
2.0	<u>YARD</u>	
2.1	Marshalling yard	20
2.2	Loading/unloading areas	50
2.3	Open areas	20
3.0	<u>PLANT</u>	
3.1	Pump house/Pump bay	250
3.2	Air Conditioning Plant Room	200
4.0	<u>SUB-STATION</u>	
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	<u>CONTROL ROOMS</u>	
5.1	Front of panel	500
5.2	Back of panel	200
6.0	OFFICES	300
7.0	<u>STORES, BATH ROOM</u>	100
8.0	<u>STAIR CASES</u>	
8.1	Safe areas	100
8.2	Hazardous areas	100
9.0	<u>PANIC LIGHTING</u>	10

Lux level for A.C. Emergency lighting in Control Room shall be 250 lux.



 <p>पी डी आई एल PDIL</p>	<p>ELECTRICAL DISTRIBUTION SYSTEM TALCHER FERTILIZERS LIMITED TECHNICAL SPECIFICATION - UPS SYSTEM (PC183-TS-0802)</p>	PC183/E/4006/SecVI-3.1	0	 <p>Talcher Fertilizers</p>
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TECHNICAL SPECIFICATION

UNINTERRUPTED POWER SUPPLY

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ANNEXURE - I	DOCUMENTATION FOR UNINTERRUPTED POWER SUPPLY
ANNEXURE - II	METERING INDICATIONS AND ALARM SCHEDULE

	ELECTRICAL DISTRIBUTION SYSTEM TALCHER FERTILIZERS LIMITED TECHNICAL SPECIFICATION - UPS SYSTEM (PC183-TS-0802)	PC183/E/4006/SecVI-3.1	0	
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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

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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 $\pm 1.0\%$. 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 $\pm 1\%$ 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 of 1m from UPS panels shall not exceed 60 dB.

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- 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 $\pm 5\%$ 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.

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- 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 65°C 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 240°. 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.

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- 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 $\pm 3\%$.
 - ii) Maximum harmonic distortion shall be less than 5%.
 - iii) The output voltage shall be restored within $\pm 2\%$ 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.

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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)

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- 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

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ANNEXURE – II

METERING INDICATIONS AND ALARM SCHEDULE

A. METERING

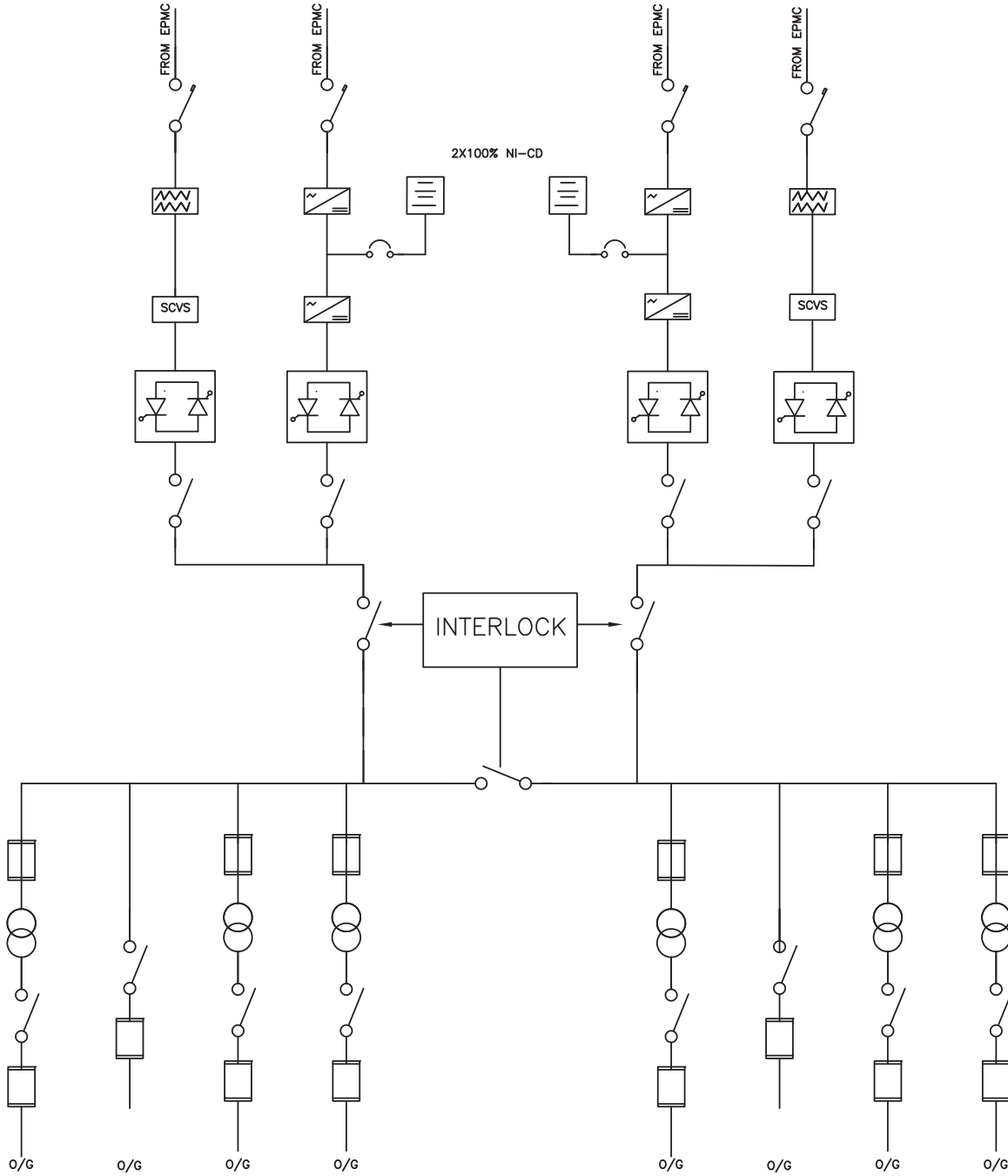
1. Incoming Voltmeter with selector switches for each incomer
2. Ammeter with selector switches for each incomer
3. Ammeter & Voltmeter at each inverter output and bypass output.
4. Frequency meter & power factor meter at one common point of output
5. Ammeter & Voltmeter at incoming of each UPS distribution 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



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.

0	26.03.2021	26.03.2021	ISSUED FOR ENQUIRY	AK	RK	SKB
REV	REV.DATE	EFF.DATE	PURPOSE	PREPD	REVWD	APPD

	ELECTRICAL DISTRIBUTION SYSTEM TALCHER FERTILIZERS LIMITED TECHNICAL SPECIFICATION – POWER TRANSFORMER (PC183-TS-0803)	PC183/E/4006/SecVI-3.1	0	
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TECHNICAL SPECIFICATION

POWER TRANSFORMERS



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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.
- 2.4 The following Codes and Standards shall, to the extent specified herein, form a part of this specification. Where a specific edition date is not indicated, it shall be taken that the most current edition (including addenda) in effect at the time of VENDOR'S proposal submittal shall apply.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 60044-1	Instrument Transformers
Part 1	Current Transformers
IEC60076	Power Transformers
IEC 60076-10	Power Transformers Part 10: Determinations of Sound Levels
IEC 60076-11	Power Transformers Part 11: Dry Type Transformers
IEC60085	Thermal Evaluations and Classification of Electrical Insulations
IEC 60099-1	Lightning Arresters
IEC 60137	Bushings for Alternating Voltages above 1000 V
IEC 62155	Hollow pressurized and un-pressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1000V
IEC 60214	On-load Tap-Changer
IEC 60214-2	Tap changes Part 2: Application Guide
IEC 60439	Low Voltage Switchgear and Control Gear Assemblies
IEC 60529	Classification of Degrees of Protection Provided by Enclosures

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 INSTRUCTIONS TO BIDDER

- 4.1 Supply of Transformers in conformity with enclosed specification.
- 4.2 The dimensions of the transformers shall be furnished with the bid.

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- 4.3 The bidder shall guarantee “No Load Loss” and “Load Loss” of the transformers.
- 4.4 For upto 2 MVA transformer losses shall be as per energy efficiency level-2 of latest IS 1180 and hence efficiency of transformer shall be based on the same.
- 4.5 For above 2 MVA transformer minimum guaranteed full load efficiency at 0.8 power factor shall be 99.4% (min).
- 4.6 The owner reserves the right to reject the transformers in the following cases:
- Actual no load / load losses exceed guaranteed value by 10%.
 - Actual impedance differs from the guaranteed value by 10%.



However, the vendor will be given opportunity to rectify the defects in reasonable time and transformer may be accepted if it successfully passes the tests after rectification.

5.0 OPERATING REQUIREMENTS



- 5.1 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.
- 5.2 The transformer shall also be capable of delivering rated current at a voltage equal to 105 % of the rated voltage.
- 5.3 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.
- 5.4 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.
- 5.5 The transformer shall be designed to be loaded as per IS 6600.
- 5.6 The transformer shall be so designed as to operate in parallel satisfactorily with similar transformers.

6.0 GENERAL DESIGN FEATURES



- 6.1 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.
- 6.2 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
- 6.3 The design of the transformers shall be in accordance with the latest practice.
- 6.4 **Rated Voltage, Frequency and Phase Connection**
These shall be as indicated in Design Philosophy – Electrical.
- 6.5 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.
- 6.6 **Radio Interference and Noise Level**
- 6.6.1 The transformers shall be designed with particular attention to the suppression of maximum harmonic voltage, especially the third and fifth so as to minimize interference with communication circuit.
- 6.6.2 The noise level of transformer, when energized at normal voltage and frequency with cooler equipments in operation shall not exceed, when measured under standard conditions, the values specified at relevant clause.
- 6.6.3 The transformers shall be capable of being loaded in accordance with IEC-60076-7. There shall be no limitation imposed by bushings, tap changers etc. or any other associated equipment.

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- 6.6.4 The transformer and all its accessories including CTs etc. shall be designed to withstand without injury, the thermal and mechanical effects of any external short circuit to earth and of short circuits at the terminals of any winding for a period of 3 secs. The short circuit level of the HV & LV System to which the subject transformers will be as per electrical design basis.
- 6.6.5 Transformer shall be capable of withstanding thermal and mechanical stresses caused by symmetrical or asymmetrical faults on any winding.
- 6.6.6 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
- 6.6.7 The Power Transformer shall be provided with On-line insulating oil drying system.
- 6.6.8 1 no 1.0 H.P pump shall be provided and installed for each transformer soak pit to evacuate oil/rain water from sump pit to nearest drain.
- 6.6.9 1 no 5.0 H.P pump shall be supplied and installed for each cable trench sump pit and drain sump pit.
- 6.7 Tap Changing Gear**
- 6.7.1 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.
- 6.7.2 The range of tap changer shall be as indicated and arranged in steps of 2.5%.
- 6.7.3 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.
- 6.7.4 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.
- 6.8 On-Load Tap-Changing Mechanism (O.L.T.C.)**
- 6.8.1 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.
- 6.8.2 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.
- 6.8.3 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.
- 6.8.4 The local electrical control switches shall be mounted in the outdoor cubicle.

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- 6.8.5 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.
- 6.8.6 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.
- 6.8.7 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.
- 6.8.8 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.
- 6.8.9 A five-digit counter shall be fitted to the tap changing mechanism to indicate the number of operations completed by the equipment.
- 6.8.10 A permanently legible lubrication chart shall be fitted within the driving mechanism chamber.
- 6.8.11 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.
- 6.8.12 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.
- 6.8.13 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.
- 6.8.14 The tap changer shall be capable of permitting parallel operation with other transformers for which necessary wiring and accessories, if any, shall be provided.
- 6.8.15 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.

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6.8.16 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.



6.8.17 Necessary interlock, blocking independent control when the units are in parallel, shall be provided.

6.8.18 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.

6.8.19 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.

6.8.20 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.

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- 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.

6.8.21 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

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- 6.8.22 The OLTC shall be provided on the conservator side of the Power Transformer and not in front of H.V. Bushings.
- 6.8.23 OLTC shall be suitable for bi-directional power flow.
- 6.9 **Impedance Voltage**
The impedance voltage of the transformer at 75°C shall be as per relevant IS / IEC. This shall be guaranteed within limits specified in relevant IS / IEC at principal tap position.
- 6.10 **Losses**
The losses under the full load condition, at the rated voltage and frequency shall be indicated by the vendor at 75°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.
- 6.11 **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.
- 6.12 **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.
- 6.13 **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.
- 6.14 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.
- 6.15 The short circuit test results for similar transformers shall be furnished.
- 6.16 On transformers for outdoor use water shedding metal sun/rain canopies with an overhang of at least 50 mm on all sides shall be fitted over all cable connecting boxes. An air space of at least 50 mm above the top cover shall be provided for ventilation.
- 6.17 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.
- 6.18 Due attention shall be given in the design for the suppression of harmonics.
- 6.19 **Cooling System**
- 6.19.1 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.
- 6.19.2 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..
- 6.19.3 Transformer shall have multiple cooling units with standby cooling units.
- 6.19.4 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



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remove the cooling fan with motors without disturbing and dismantling the cooler structural frame work.

- 6.19.5 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.
- 6.19.6 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.
- 6.19.7 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.
- 6.19.8 The coolers and theirs accessories shall be hot dip galvanized or corrosive resistant painted.
- 6.19.9 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.
- 6.19.10 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.
- 6.19.11 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.
- 6.19.12 Means shall be provided for pad locking of valves in the open and closed position.
- 6.19.13 Every valve shall be provided with indicator to show clearly the position of the valve whether open or closed.
- 6.19.14 All valves shall be provided with flanges having machined faces.
- 6.19.15 The drilling of valve flanges shall comply with the requirements of IS:3639.

6.20 CONTROL OF COOLER OPERATION

- 6.20.1 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.
- 6.20.2 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.
- 6.20.3 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.
- 6.20.4 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.
- 6.20.5 All contacts and other parts which may require renewal, adjustment or inspection shall be readily accessible.

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- 6.20.6 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.
- 6.20.7 Alarm indication for failure of group of fans and oil pump shall be provided.
- 6.20.8 Alarm indication shall be provided to indicate failure of power supply.
- 6.20.9 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.



7.0 CONSTRUCTIONAL FEATURES

7.1 Core

- 7.1.1 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.
- 7.1.2 The temperature of the core shall not exceed that permitted in IS.
- 7.1.3 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.
- 7.1.4 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.
- 7.1.5 All steel sections used for supporting the core shall be thoroughly sand blasted after cutting, drilling and welding.
- 7.1.6 Each core lamination shall be insulated with a material that will not deteriorate due to pressure and hot oil.
- 7.1.7 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.
- 7.1.8 Adequate lifting lugs will be provided to enable the core and windings to be lifted.
- 7.1.9 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.
- 7.1.10 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.
- 7.1.11 A drawing furnishing the details of the internal earthing design shall be included in the manual



7.2 Tank

- 7.2.1 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/cm², 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.

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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

- 7.2.2 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.
- 7.2.3 Guides shall be provided to facilitate tanking and unloading of the core with the coil assembly. The details of anchoring of core and coil assembly of the tank shall be furnished.
- 7.2.4 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.
- 7.2.5 Each tank shall be provided with:
- Lifting lugs suitable for lifting the equipment complete with oil.
 - 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.
 - Suitable haulage holes shall be provided.
- 7.2.6 The tank shall be designed in such a way that it can be mounted on the rollers.
- 7.2.7 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.
- 7.2.8 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.
- 7.2.9 The transformer shall be mounted on rollers, as per manufacturer's standard practice.
- 7.2.10 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.
- 7.2.11 The rail track gauge shall be 1676 mm.
- 7.2.12 To prevent transformer movement during earthquake, suitable clamping devices shall be provided for fixing the transformer to the foundation.
- 7.2.13 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.
- 7.2.14 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.
- 7.2.15 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

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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.



- 7.2.16 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.
- 7.2.17 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.
- 7.2.18 The maximum temperature on any metal part shall not exceed 130 deg. Celsius.
- 7.2.19 Seamless pipe shall be used upto 80mm conforming to IS 1978 & IS 1979, ERW mild steels pipes as per IS 1239 (Part 1) medium shall be used for ≥ 100 mm 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).

7.3 Windings

- 7.3.1 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.
- 7.3.2 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.
- 7.3.3 For transformers rated 20 MVA and above vapour phase drying shall be adopted.
- 7.3.4 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.
- 7.3.5 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-casters to prevent shocks and abnormal jerks.
- 7.3.6 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.

7.4 Insulating Oil

- 7.4.1 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.
- 7.4.2 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.
- 7.4.3 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)

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4. Interfacial tension : More than 0.004 N/m

7.4.4 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 : 6×10^{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.

7.5 Insulation Materials



- 7.5.1 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.
- 7.5.2 The mineral oil shall comply with IS: 335. 10% extra oil shall be supplied along with the transformer in non-returnable drums.
- 7.5.3 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.

7.6 Bushing

- 7.6.1 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.
- 7.6.2 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.

7.7 Conservator

- 7.7.1 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.
- 7.7.2 OLTC shall have conventional type conservator with prismatic oil level gauge.

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- 7.7.3 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.
- 7.7.4 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.
- 7.7.5 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.
- 7.7.6 Pipe work connections shall be of adequate size for their duty and as short and direct as possible. Only radiused elbows shall be used.
- 7.7.7 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.
- 7.7.8 This pipe shall rise towards the oil conservator, through the Buchholz relay, at an angle of not less than 5 degree.
- 7.7.9 Contact of the oil with atmosphere is prohibited by using a flexible air cell of nitrile rubber reinforced with nylon cloth.
- 7.7.10 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.
- 7.7.11 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.
- 7.7.12 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.
- 7.7.13 The connection of air cell to the top of the conservator is by air proof seal preventing entrance of air into the conservator.

7.8 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 Employer's grounding mat.

8.0 FITTINGS

- 8.1 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.
- 8.2 All fittings shall conform to relevant Indian Standard Specifications.
- 8.3 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.
- 8.4 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.
- 8.5 All opening shall be provided with gasketted metallic covers for protection during transportation.

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- 8.6 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.
- 8.7 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.
- 8.8 All terminals shall be anti loosening type and complete with connectors of required size. The earthing terminals shall have identification marks.
- 8.9 All valves in oil line shall be suitable for continuous operation with transformer oil at 115 deg C.
- 8.10 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.
- 8.11 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

8.12 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 Employer'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 Employer'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).



8.13 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

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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.

8.14 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.

8.15 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. 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.

8.16 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 I_{mag} for these CTs shall be furnished at the order stage.

8.17 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.



8.17.1 All bought out items shall be of reputed make to be approved by Consultant/ Purchaser.

8.17.2 On-line insulating oil drying system: The system should be based on the re-generable adsorbent material for absorption of ageing by-products and acidic elements from insulation along with moisture.



8.17.3 Dehydration system should not use any vacuum or heating to preserve the quality of insulation oil.

8.17.4 System should remove carboxylic acids from transformer insulation along with moisture from transformer paper insulation.

8.17.5 The system should have the moisture absorption capacity of 12 liters (minimum) over and above the removal of carboxylic acids.

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- 8.17.6 The system should bring the oil parameters such as BDV, water content, specific resistivity, DDF and acidic properties in conformity with IEC 60422.
- 8.17.7 The system should have the low flow rate to avoid turbulences inside the transformer.
- 8.17.8 Material of construction should be SS 304 grade.
- 8.17.9 The system should be able to work under nominal work pressure of 2 bars and rated pressure of 4 bars.
- 8.17.10 System should measure and display inlet and outlet moisture and temp and record the data for minimum of 01 years and communicate the same to ECMS in IEC 61850.
- 8.17.11 System should be provided with additional module for measurement of moisture in winding and have provision of Automatic Start/Stop based on the moisture in winding. It should not be based on spontaneous value of PPM in oil.
- 8.17.12 System should mandatorily have additional module for continues assessment of moisture in thin insulation structure of transformer winding and should give alarm and prevent over-drying of thin insulation structure.
- 8.17.13 Moist cylinder can be removed while the transformer is running and operational.
- 8.17.14 Moist cylinder can be re-generated to new at a nominal cost.
- 8.17.15 Re-generation cost per cylinder to be quoted along with the bid and the same will be valid for 2 years.
- 8.17.16 20% spare set of cartridge/ cylinder to be supplied.
- 8.18 NITROGEN INJECTION FIRE PREVENTION AND EXTINGUISHING SYSTEM**
- 8.18.1 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.
- 8.18.2 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 141⁰C 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.
- 8.18.3 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.

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v. Brackets for fixing signal box at a suitable location on top cover or tank size wall.

8.19 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 too 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.

8.19.1 Auto Mode

- | | | |
|---------------------------|---|---|
| a) For Prevention of Fire | : | <ul style="list-style-type: none"> 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 | : | <ul style="list-style-type: none"> 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. |

8.19.2 Manual Mode (Local/Remote): Tripping of all connected breakers is a pre-requisite for initiation of system activation.

8.19.3 Manual Mode (Mechanical): Tripping of all connected breakers is a pre-requisite for initiation of system activation.

8.19.4 General Description of NIFPES



8.19.5 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 in control room for system activation signals.

8.19.6 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 from conservator tank, thus isolating it & preventing aggravation of fire.

8.19.7 System Components

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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.

8.19.8 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.

8.20 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

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- 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.

8.21 **Pre-stressed Non Return Valve (PNRV)**

PNRV is to be fitted in the conservator pipe line between conservator & Buchholz 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.

8.22 **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).

8.23 **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.

8.24 **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.

8.25 **Pipes**

Pipes, complete with connections, flanges, bends, tees etc. shall be supplied alongwith the system.

8.26 **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.

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8.27 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..

8.28 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.

8.29 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 ⁰ C
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

8.30 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.

9.0 PAINTING

- 9.1 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.
- 9.2 All steel surfaces in contact with insulating oil shall be painted with heat resistant oil insoluble insulating varnish.
- 9.3 All steel surfaces exposed to outside shall be painted with suitable anti-rust and anticorrosive paints. Epoxy paints shall be used.

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- 9.4 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.
- 9.5 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.
- 9.6 Unless otherwise specified, the finishing shade shall be light grey Shade No. 631 as per IS 5.
- 9.7 1 litre of paint per transformer shall be supplied for touch up at Site.

10.0 TESTS AND INSPECTION

In addition to the routine tested as per IS 2026. Transformer oil shall be tested as per IS 335 following testes shall be done in all transformers.

10.1 ROUTINE TESTS

- a) Measurement of winding resistance (IEC 60076-1)
- b) Measurement of voltage ratio and check of voltage vector relationship (IEC 60076-1)
- c) Measurement of impedance voltage (principal tapping), short-circuit impedance and load loss (IEC 60076-1)
- d) Measurement of no-load loss and current (IEC 60076-1)
- e) Dielectric tests: Induced over voltage withstand test and separate-source voltage withstand test (IEC 60076-3)
- f) Tests on-load tap changers, where appropriate (oil-immersed transformers only) (IEC 60076-1)
- g) Partial discharge test (IEC 60726)
- h) A heat run test shall be carried out for one transformer of each type for each rating.

10.2 TYPE TESTS

- a) Temperature-rise tests (IEC 60076-2)
- b) Dielectric tests: Full-wave impulse-voltage withstand test (IEC 60076-3)

10.3 SPECIAL TESTS

- a) Dielectric tests: Impulse-voltage withstand tests including chopped waves (IEC 60076-3)
- b) Measurement of zero-sequence impedance on three-phase transformers (IEC 60076-1)
- c) Short-circuit test (IEC 60076-5)
- d) Measurement of acoustic sound level (IEC 60551)
- e) Measurement of the harmonics on the no-load current (IEC 60076-1)
- f) Measurement of the power taken by the fan and oil pump motors (IEC 60076-1)

10.4 Additional tests, wherever specified, shall be carried out on one transformer of each rating.

10.5 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.



10.6 These inspections shall, however, not absolve the Vendor from their responsibility for making good any defect which may be noticed subsequently.

11.0 DRAWINGS AND DOCUMENTS

11.1 The drawings and documents as per Annexure-III shall be furnished, unless otherwise specified.

11.2 All drawings and documents shall have the following descriptions written boldly:

- Name of Client

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- Name of Consultant
- Enquiry / order number with plant / project name
- Equipment Code No. and Description

11.3 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.

11.4 The packing box shall contain a copy of the installation, operation and maintenance manual.

11.5 All loose pieces shall be separately wrapped in moisture resistant paper and marked with identification mark of the corresponding transformer.

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 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

12.5 All spare parts shall be identical to the parts used in the equipment

13.0 PACKING

13.1 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.



13.2 The packing box shall contain a copy of the installation, operation and maintenance manual.

13.3 All loose pieces shall be separately wrapped in moisture resistant paper and marked with identification mark of the corresponding transformer.

13.4 The Contractor shall be responsible to select and verify the route, mode of transportation and make all necessary arrangement with the appropriate authorities for the transportation of the equipment. The dimension of the equipment shall be such that when packed for transportation, it will comply with the requirements of loading and clearance restrictions for the selected route. It shall be the responsibility of the contractor to coordinate the arrangement for transportation of the transformer for all the stages from the manufacturer's work to site.

13.5 The Contractor shall dispatch the transformer filled with oil or in an atmosphere of nitrogen or dry air. In the former case the contractor shall take care of the weight limitation on transport and handling facility at site. In the latter case, necessary arrangement shall be ensured by the contractor to take care of pressure drop of nitrogen or dry air during transit and storage till completion of oil filling during erection. A gas pressure testing valve with necessary pressure gauge and adaptor valve shall be provided.

13.6 Transformer shall also be fitted with at least one Electronic impact recorder (on returnable basis) during transportation to measure the magnitude and duration of the impact in all three directions. The acceptance criteria and limits of impact in all three directions which can be withstood by the equipment during transportation and handling shall be submitted by the contractor during detailed engineering. The recording shall commence in the factory before dispatch and must continue till the unit is installed on its foundation. The data of electronic impact recorder(s) shall be down loaded at site and a soft copy of it shall be handed over to Engineer-in-charge. Further, within three weeks the contractor shall communicate the interpretation of the data. In the unlikely event of impact recorder output not available at site, the equipment shall be thoroughly internally inspected by the manufacturer's representative before erection at site to ensure healthiness of the equipment. Contractor shall mount Vehicle

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tracking system (GPRS/ GPS/ GSM based) to track the exact position of the vehicle on which the equipment is being loaded for transportation in order to ensure traceability and safety during transportation.

14.0 DEVIATIONS

Deviations, if any, from this standard shall be clearly indicated in the offer with reasoning.



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**SPECIFICATION SHEET
220 / 34.5 KV TRANSFORMERS**

PROJECT: Coal Based Fertilizer Plant		PLANT: Electrical Distribution System	
ISSUED FOR : PROPOSAL <input checked="" type="checkbox"/> ENQUIRY <input type="checkbox"/> ORDER <input type="checkbox"/> FINAL <input type="checkbox"/>			
GENERAL			
Item No. :	Ref. Stds. :	IS-1180, IS-2026, IEC-60076	
Quantity :	Encl. Docs. :	<input checked="" type="checkbox"/>	
Description :	Make :		
Code No. :	Maker's Type. :		
TESTS : Routine <input checked="" type="checkbox"/> Heat Run <input checked="" type="checkbox"/> Impulse <input type="checkbox"/> Others :			
SERVICE CONDITIONS			
SYSTEM DETAILS (PRI. / SEC.)		AMBIENT CONDITIONS	
Nom. Voltage with + % :	220/34.5KV	Temp.- Max./Min./Design Ref. :	46 / 1 / 50°C
Highest System Voltage :	245KV / 36 KV	Rel. Humidity :	100% Alt. above Sea < 1000M
Number of phases :	Three	Atmospheric Pollution	Dusts : Coal Dust & Urea Dust
Rated Voltage with + % :	220 KV ± 12.5%		Dusts : Coal Dust & Urea Dust
Rated Frequency with + % :	50 Hz ± 5%	Location	Indoor : <input type="checkbox"/> Outdoor : <input checked="" type="checkbox"/>
Combined (V & F) Variation :	± 12.5%		
Fault MVA :	19000 MVA /2300 MVA	AUX. POWER SUPPLY	
Fault Level (HV/L :	50kA for 3 Sec./40kA for 3 sec.	System Data	A.C. : 415 V ±10 %, 50Hz ± 5 %
Earthing Mode : N.A.(220 kV side) / Grounded through NGR (34.5kV side)			D.C. : 110V ±10 %
Duty :	Continuous	Instrument Contact Rating	A.C. : 240V ±10 %, 50Hz ± 5 %
No of Windings :	Two		D.C. : 110V ±10 %
Type of Cooling :	ONAN/ONAF		
BASIC DATA			
RATING		Terminal Location	
Rated Capacity :	125/150 MVA	HV Side	Bushing
No Load Voltage Ratio :	220/34.5 KV	LV Side	180 ° w.r.t. HV side
Highest Voltage for Eqpt. :	245 KV / 36 KV	Terminal Connection	
INSULATION LEVEL (Pri. / Sec.)	Impulse : 1050kVp/170kVp	HV Side	Bushing
	Power Freq. : 460/70 kV	LV Side	Cable Box
	Insulation Class : A		
TERMINAL CONNECTIONS			
Impedance at 75 °C:		PRI.	O/H bushing : <input type="checkbox"/>
Vector Group : Dyn11 (To be checked with OPTCL)			Bus Duct : <input type="checkbox"/>
Cooling System : ONAN/ONAF		SEC.	Cable : <input type="checkbox"/>
Largest Motor I Start & T Start : --A & 10Sec			Type : EHV Cables
TAP CHANGER		Arrangement	No. & Size :
Type of Taps	On Load : <input checked="" type="checkbox"/> Off Ckt. : <input type="checkbox"/>		O/H bushing : <input type="checkbox"/>
Location :	HV winding	Bus Duct : <input type="checkbox"/>	
Range of Taps :	+12.5%	Cable : <input checked="" type="checkbox"/>	
No. of Taps :	20 @1.25% / 21 position	Type : -- Conductor , XLPE insulated Armoured cable	
RTCC Panel :	Required	No. & Size :--RX –CX sq.mm	
AVR relay :	Required	Type	
Master-follower sys. :	Required	No. & Size :	
C.T. REQUIREMENTS		Control Cable	
Differential Protection 87T	3 nos. on Trf. : <input type="checkbox"/>	Earth Conductor	Body :
	3 nos. loose : <input type="checkbox"/>		No. & Size :
Restricted earth fault Protection 64R	400/1 CL PS,15VA	Temp rise at extreme tap having max. losses	Oil 50 °C
	1 nos. on Trf. : <input type="checkbox"/>	Power Flow	Winding 55 °C
	3 nos. loose : <input type="checkbox"/>	Explosion protection	Bidirectional
	HV Side :--/1 PS Class,15VA	Cable Gland Type & Material	PRV
	Vk : By Contractor		Primary :
	Im at Vk/2 : 30mA	Secondary :	
	Rct : By Contractor	Control :	
	LV Side :---/1 PS Class,15VA	Normal Load	
Vk : By Contractor	Bidirectional roller type	Flat	
Im at Vk/2 : 30mA	Min.Guarantee eff. At	Min. 99.5	
Rct : By Contractor	100%ONAF rating 0.8pf	(Inclusive of tolerance)	
Standby earth fault Protection51G	1 nos. on Trf. : <input checked="" type="checkbox"/>	Load at which max. Eff Occurs:	
HV Side :--/1,5P20,15VA			
LV Side :--/1,5P20,15VA			

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Winding Insulation Type		Additional loose supply	
Hv Winding	Uniform	Tap position Indicator	No
LV Winding	Uniform	Raise/lower push buttons	NA
HV Phase sequence	UVW	Transducers	Yes
LV Phase sequence	To suit switchgear as	OLTC accessories Single float Buchholz/ oil surge relay	Yes
	IS:8623		
Creepage Distance		Rate for copper loss Rs./kW:	
HV Winding	Total As per IS/CBIP	Rate for iron loss Rs./kW:	
	Protected As per IS/CBIP	Rate for aux. loss Rs./kW	
LV winding	Total As per IS/CBIP	PAINTING	
	Protected As per IS/CBIP	Type	Epoxy
Clearances	Ph-Ph As per IS/CBIP	Shade	632
	Ph- N As per IS/CBIP	Applicable Specification	
LMS interface		Accessories requirement	
Digital o/p from RTCC:	Required	Sampling valve	Yes
Tap changer out of step	Required	Conservator drain valve	Yes
Tap changer stuck	Required	Top oil filter valve	Yes
Tap changer status signal	Required	PRV with contacts	Yes
Supply failure	Required	(with resettable contacts)	
Individual/Parallel mode set	Required	Air bag for conservator	Yes
Raiser/Lower control	Required	Dial type thermometer	Yes
Digital o/p from cooling	Required	& contacts for OTI & WTI	
control panel	Required	Drain valve	Yes
Fan 'ON' (for each fan)	Required	Marshalling box(IP-55)	Yes
Fan 'Tripped' (for each fan)	Required	Double float Buchholz	Yes
Auto manual mode	Required	Channels & towing lugs :	Yes
Analogue Outputs from Transformer marshalling box:		Rollers	Yes
Oil temp. (4-20 mA)	Required	Neutral bushing	Yes
Winding temp. (4-20 Ma)	Required	outside terminal box with	Yes
Oil Level	Required	connector assembly	Yes
Tests requirements		Inspection cover	Yes
Impulse test:	Required	Disconnecting chamber	Yes
Heat run test	Required	WTI & OTI	Yes
Vacuum test on tank:	Required	Bus duct flange on LV	No
Short circuit test:	Required	Lugs and cable glands	Yes
Pressure test on Tank	Required		

Note:

- Losses shall be inclusive of positive tolerance and shall be at nominal tap. Value of X & R shall be furnished.
- No negative tolerance shall be considered in impedance voltage. Same shall be calculated by contractor after carrying out system study at detailed engineering stage. Min. value has been mentioned here.
- Damage curve for primary side & secondary side shall be submitted for review/approval.
- Transducers for providing 4-20mA signal for OTI & WTI for owner's interface shall be provided.
- Based on IEC-600076 Part: 5, calculation for thermal stress for through fault current & mechanical stress for peak current shall be submitted for review/approval purpose. X/R ration shall be considered as per IEC-60076 Part: 5 only for Category: 2 transformers. Time for through fault shall be considered as 3 sec.
- Test certificates shall be furnished for similar rating & identical design.
- Min. requirement of test certificates are mentioned. Others certificates may be asked as per IEC: 60076.
- Due to large rating, SFRA test shall be carried out at manufacturer's workshop i.e. before dispatch & same test shall be performed again at site after installation. Results shall be compared to check design values.
- 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.

Note: Specification Sheet shall be filled by the bidder and submitted with the bid.



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**SPECIFICATION SHEET
33 / 11.5 KV TRANSFORMERS**

PROJECT: Coal Based Fertilizer Plant		PLANT: Electrical Distribution System	
ISSUED FOR : PROPOSAL <input checked="" type="checkbox"/> ENQUIRY <input type="checkbox"/> ORDER <input type="checkbox"/> FINAL <input type="checkbox"/>			
GENERAL			
Item No. :	Ref. Stds. :	IS-1180, IS-2026, IEC-60076	
Quantity :	Encl. Docs. :	<input checked="" type="checkbox"/>	
Description :	Make :		
Code No. :	Maker's Type. :		
TESTS : Routine <input checked="" type="checkbox"/> Heat Run <input checked="" type="checkbox"/> Impulse <input type="checkbox"/> Others :			
SERVICE CONDITIONS			
SYSTEM DETAILS (PRI. / SEC.)		AMBIENT CONDITIONS	
Nom. Voltage with + % :	33/11.5KV	Temp.- Max./Min./Design Ref. :	46 / 1 / 50°C
Highest System Voltage :	36KV /12 KV	Rel. Humidity :	100% Alt. above Sea < 1000M
Number of phases :	Three	Atmospheric Pollution	Dusts : Coal Dust & Urea Dust
Rated Voltage with + % :	33 KV ± 12.5%		Dusts : Coal Dust & Urea Dust
Rated Frequency with + % :	50 Hz ± 5%	Location	Indoor : <input type="checkbox"/> Outdoor : <input checked="" type="checkbox"/>
Combined (V & F) Variation :	± 12.5%		
Fault MVA :	2300 MVA / 750 MVA	AUX. POWER SUPPLY	
Fault Level (HV/L :	40kA for 3 Sec./40kA for 3 sec.	System Data	A.C. : 415 V ±10 %, 50Hz ± 5 %
Earthing Mode : N.A.(33 kV side) / Grounded through NGR (11.5kV side)			D.C. : 110V ±10 %
Duty :	Continuous	Instrument Contact Rating	A.C. : 240V ±10 %, 50Hz ± 5 %
No of Windings :	Two		D.C. : 110V ±10 %
Type of Cooling :	ONAN/ONAF		
BASIC DATA			
RATING		Terminal Location	
Rated Capacity :	45/50 MVA	HV Side	Bushing
No Load Voltage Ratio :	33/11.5 KV	LV Side	180 ° w.r.t. HV side
Highest Voltage for Eqpt. :	36 KV /12 KV	Terminal Connection	
INSULATION LEVEL (Pri. / Sec.)	Impulse : 170kVp/75kVp	HV Side	Bushing
	Power Freq. : 70/28 kV	LV Side	Cable Box
	Insulation Class : A		
TAP CHANGER		TERMINAL CONNECTIONS	
Impedance at 75 ° C: 15% (Min.)		PRI.	O/H bushing : <input type="checkbox"/>
Vector Group : Dyn11			Bus Duct : <input type="checkbox"/>
Cooling System : ONAN/ONAF			Cable : <input checked="" type="checkbox"/>
Largest Motor I Start & T Start : ---A & 10Sec		SEC.	Type :
			No. & Size :
			O/H bushing : <input type="checkbox"/>
		Bus Duct : <input type="checkbox"/>	
		Cable : <input checked="" type="checkbox"/>	
		Type : ---Cond., XLPE insulated Armoured cable	
		No. & Size :--RX-CX ----sq.mm	
		Control Cable	
		Type	
		No. & Size :	
C.T. REQUIREMENTS		Earth Conductor	
Differential Protection 87T	3 nos. on Trf. : <input type="checkbox"/>	Body :	
	3 nos. loose : <input type="checkbox"/>	No. & Size :	
	400/1 CL PS,15VA	Temp rise at extreme tap having max. losses	
Restricted earth fault Protection 64R	1 nos. on Trf. : <input type="checkbox"/>	Oil 50 ° C	
	3 nos. loose : <input type="checkbox"/>	Power Flow	
	HV Side :--/1 PS Class,15VA	Bidirectional	
	Vk : By Contractor	Explosion protection	
	Im at Vk/2 : 30mA	PRV	
	Rct : By Contractor	Cable Gland Type & Material	
	LV Side :--/1 PS Class,15VA	Primary :	
Vk : By Contractor	Secondary :		
Im at Vk/2 : 30mA	Normal Load		
Rct : By Contractor	Bidirectional roller type		
	Flat		
	Min.Guarantee eff. At		
	Min. 99.5		
	100%ONAF rating 0.8pf		
	(Inclusive of tolerance)		
Standby earth fault Protection51G	1 nos. on Trf. : <input checked="" type="checkbox"/>	Load at which max. Eff Occurs:	
	HV Side :--/1,5P20,15VA		
	LV Side :--/1,5P20,15VA		

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Winding Insulation Type		Additional loose supply	
Hv Winding	Uniform	Tap position Indicator	No
LV Winding	Uniform	Raise/lower push buttons	NA
HV Phase sequence	UVW	Transducers	Yes
LV Phase sequence	To suit switchgear as	OLTC accessories Single float Buchholz/ oil surge relay	Yes
	IS:8623	Loss Capitalization	
Creepage Distance		Rate for copper loss Rs./kW:	
HV Winding	Total As per IS/CBIP	Rate for iron loss Rs./kW:	
	Protected As per IS/CBIP	Rate for aux. loss Rs./kW	
LV winding	Total As per IS/CBIP	PAINTING	
	Protected As per IS/CBIP	Type	Epoxy
Clearances	Ph-Ph As per IS/CBIP	Shade	632
	Ph- N As per IS/CBIP	Applicable Specification	
LMS interface		Accessories requirement	
Digital o/p from RTCC:	Required	Sampling valve	Yes
Tap changer out of step	Required	Conservator drain valve	Yes
Tap changer stuck	Required	Top oil filter valve	Yes
Tap changer status signal	Required	PRV with contacts	Yes
Supply failure	Required	(with resettable contacts)	
Individual/Parallel mode set	Required	Air bag for conservator	Yes
Raiser/Lower control	Required	Dial type thermometer	Yes
Digital o/p from cooling	Required	& contacts for OTI & WTI	
control panel	Required	Drain valve	Yes
Fan 'ON' (for each fan)	Required	Marshalling box(IP-55)	Yes
Fan 'Tripped' (for each fan)	Required	Double float Buchholz	Yes
Auto manual mode	Required	Channels & towing lugs :	Yes
Analogue Outputs from Transformer marshalling box:		Rollers	Yes
Oil temp. (4-20 mA)	Required	Neutral bushing	Yes
Winding temp. (4-20 Ma)	Required	outside terminal box with	Yes
Oil Level	Required	connector assembly	Yes
Tests requirements		Inspection cover	Yes
Impulse test:	Required	Disconnecting chamber	Yes
Heat run test	Required	WTI & OTI	Yes
Vacuum test on tank:	Required	Bus duct flange on LV	No
Short circuit test:	Required	Lugs and cable glands	Yes
Pressure test on Tank	Required		

Note:

- Losses shall be inclusive of positive tolerance and shall be at nominal tap. Value of X & R shall be furnished.
- No negative tolerance shall be considered in impedance voltage. Same shall be calculated by contractor after carrying out system study at detailed engineering stage. Min. value has been mentioned here.
- Damage curve for primary side & secondary side shall be submitted for review/approval.
- Transducers for providing 4-20mA signal for OTI & WTI for owner's interface shall be provided.
- Based on IEC-600076 Part: 5, calculation for thermal stress for through fault current & mechanical stress for peak current shall be submitted for review/approval purpose. X/R ration shall be considered as per IEC-60076 Part: 5 only for Category: 2 transformers. Time for through fault shall be considered as 3 sec.
- Test certificates shall be furnished for similar rating & identical design.
- Min. requirement of test certificates are mentioned. Others certificates may be asked as per IEC: 60076.
- Due to large rating, SFRA test shall be carried out at manufacturer's workshop i.e. before dispatch & same test shall be performed again at site after installation. Results shall be compared to check design values.
- 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.

Note: Specification Sheet shall be filled by the bidder and submitted with the bid.



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**SPECIFICATION SHEET
11 / 3.45 KV DISTRIBUTION TRANSFORMERS**

PROJECT: Coal Based Fertilizer Plant		PLANT: Electrical Distribution System	
ISSUED FOR : PROPOSAL <input type="checkbox"/> ENQUIRY <input checked="" type="checkbox"/> ORDER <input type="checkbox"/> FINAL <input type="checkbox"/>			
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 : <input checked="" type="checkbox"/> Heat Run : <input type="checkbox"/> Impulse : <input type="checkbox"/> Others : <input type="checkbox"/>			
SERVICE CONDITIONS			
SYSTEM DETAILS (PRI. / SEC.)		AMBIENT CONDITIONS	
Nom. Voltage with \pm % : 11KV \pm 10% 3.3 kV \pm 10%		Temp.- Max./Min./Design Ref. : 46 / 1 / 50°C	
Highest System Voltage : 12 / 3.6 KV		Rel. Humidity : 100 % Alt. above Sea < 1000M	
Number of phases : 3 Ph / 3 W + N		Atmospheric Pollution	
Rated Frequency with \pm : 50 Hz \pm 5%		Dusts : Coal Dust & Urea Dust	
Combined V & F Variation : \pm 10 %		Vapour : Ammonia & Highly Corrosive	
Fault MVA : 750 MVA / 150 MVA		Location	
Earthing Mode : Non-Effectively earthed Through NER.		Indoor : <input type="checkbox"/> Outdoor : <input checked="" type="checkbox"/>	
		AUX. POWER SUPPLY	
		System Data	
		A.C. : 415V \pm 10%, 3P & N, 50Hz \pm 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 : 5000KVA		W	
No Load Voltage Ratio : 11 KV / 3.45 KV		X Z	
Highest Voltage for Eqpt. : 12 KV / 3.6 KV		Y	
Insulation level		Impulse : 75 KV / 40 KV	
Pri.-/ Sec		Power Freq. : 28 KV / 10 KV	
Impedance at 75° C: 6.5% (without negative tolerance)		Shall be provided later.	
Vector Group : Dyn 11		TERMINAL CONNECTIONS	
Cooling System : ONAN		PRI. Arrangement	
Motor I Start & T Start : Shall be informed later		O/H bushing : <input type="checkbox"/>	
		Bus Duct : <input type="checkbox"/>	
		Cable : <input checked="" type="checkbox"/>	
		Cable cond.	
		Type : 11 KV XLPE-A-FRLS-PVC (Al) UE	
		No. & Size :	
		SEC. Arrangement	
		O/H bushing : <input type="checkbox"/>	
		Bus Duct : <input type="checkbox"/>	
		Cable : <input checked="" type="checkbox"/>	
		Bus cond.	
		Type : 3.3 KV XLPE-A-FRLS-PVC UE	
		No. & Size: --- R---Cx mm ² (Cu)	
		Control Cable	
		Type : 1.1 kv XLPE-A-FRLS PVC (ST2) (Cu)	
		No. & Size : 19X2.5 mm ² , 2CX10 mm ² , 5X2.5 mm ²	
		Earth Conductor	
		Body : 2-75X10 GI strip	
		Neutral : 2-1CX185 mm ² XLPE-UA-FRLS PVC (Al), 1.1 kv	
		Cable Gland Type & Material	
		Primary : } Double	
		Secondary } compression	
		Control : } Rolled Al	
ADDITIONAL FITTINGS			
1. LV Neutral terminal box			
2. Thermometer pocket with cover			
3. Tank magnetic oil level gauge			
4. Bi-directional roller			
PAINTING			
Type : EPOXY BASED			
Shade : 631 OF IS : 5			
SPARE PARTS			
Reqd. : <input checked="" type="checkbox"/> For a period of 2 Years			

Note:

- Losses shall be inclusive of positive tolerance and shall be at nominal tap. Value of X & R shall be furnished.
- No negative tolerance shall be considered in impedance voltage. Same shall be calculated by contractor after carrying out system study at detailed engineering stage. Min. value has been mentioned here.
- Damage curve for primary side & secondary side shall be submitted for review/approval.
- Test certificates shall be furnished for similar rating & identical design.
- Min. requirement of test certificates are mentioned. Others certificates may be asked as per IEC: 60076.

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15. 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.

Note: Specification Sheet shall be filled by the bidder and submitted with the bid.



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**SPECIFICATION SHEET
11 / 0.433 KV DISTRIBUTION TRANSFORMERS**

PROJECT: Coal Based Fertilizer Plant		PLANT: Electrical Distribution System	
ISSUED FOR : PROPOSAL <input type="checkbox"/> ENQUIRY <input checked="" type="checkbox"/> ORDER <input type="checkbox"/> FINAL <input type="checkbox"/>			
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 : <input checked="" type="checkbox"/> Heat Run : <input type="checkbox"/> Impulse : <input type="checkbox"/> Others : <input type="checkbox"/>			
SERVICE CONDITIONS			
SYSTEM DETAILS (PRI. / SEC.)		AMBIENT CONDITIONS	
Nom. Voltage with \pm % : 11KV \pm 10% / 0.433KV \pm 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	
Rated Frequency with \pm : 50 Hz \pm 5%		Dusts : Coal Dust & Urea Dust	
Combined V & F Variation : \pm 10 %		Vapour : Ammonia & Highly Corrosive	
Fault MVA : 750 MVA / 36 MVA		Location	
Earthing Mode : Solidly Earthed		Indoor : <input type="checkbox"/> Outdoor : <input checked="" type="checkbox"/>	
		AUX. POWER SUPPLY	
		System Data	
		A.C. : 415V \pm 10%, 3P & N, 50Hz \pm 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		Impulse : 75 KV / --	
Pri.-/ Sec		Power Freq. : 28 KV / 3 KV	
Impedance at 75 ° C: As per IS (without negative tolerance)		Shall be provided later.	
Vector Group : Dyn 11		TERMINAL CONNECTIONS	
Cooling System : ONAN		O/H bushing : <input type="checkbox"/>	
Motor I Start & T Start : Shall be informed later		Bus Duct : <input type="checkbox"/>	
		Cable : <input checked="" type="checkbox"/>	
		Type : 11 KV XLPE-A-FRLS-PVC (Al) UE	
		No. & Size :	
TAP CHANGER		O/H bushing : <input type="checkbox"/>	
Type of Taps		Bus Duct : <input type="checkbox"/>	
On Load : <input type="checkbox"/> Off Ckt. : <input checked="" type="checkbox"/>		Cable : <input checked="" type="checkbox"/>	
Range of Taps : -5% TO +5%		Type : 1.1 KV XLPE-A-FRLS-PVC ()	
No. of Taps : 5 @ 2.5 %		No. & Size: ---R x 3.5 C x--- sqmm	
C.T. REQUIREMENTS		Control Cable	
Differential Protection		Type : 1.1 kv XLPE-A-FRLS PVC (ST2) (Cu)	
3 nos. on Trf. : <input type="checkbox"/>		No. & Size : 19X2.5 mm ² , 2CX10 mm ² , 5X2.5 mm ²	
3 nos. Loose : <input type="checkbox"/>		Earth Conductor	
Restricted earth fault Protection		Body : 2-75X10 GI strip	
1 no. on Trf. : <input checked="" type="checkbox"/> CI-PS		Neutral : 2-1CX185 mm ² XLPE-UA-FRLS PVC (Al), 1.1 kv	
3 nos. Loose : <input checked="" type="checkbox"/>		Primary : Double	
Standby earth fault Protection		Secondary : } compression	
1 no. on Trf. : <input checked="" type="checkbox"/> CI-5P10		Control : } Rolled Al	
		Cable Gland Type & Material	
ADDITIONAL FITTINGS			
1. LV Neutral terminal box		PAINTING	
2. Thermometer pocket with cover		Type : EPOXY BASED	
3. Tank magnetic oil level gauge		Shade : 631 OF IS : 5	
4. Bi-directional roller			
SPARE PARTS			
Reqd. : <input checked="" type="checkbox"/>		For a period of 2 Years	

Note:

- Losses shall be inclusive of positive tolerance and shall be at nominal tap. Value of X & R shall be furnished.
- No negative tolerance shall be considered in impedance voltage. Same shall be calculated by contractor after carrying out system study at detailed engineering stage. Min. value has been mentioned here.
- Damage curve for primary side & secondary side shall be submitted for review/approval.
- Test certificates shall be furnished for similar rating & identical design.
- Min. requirement of test certificates are mentioned. Others certificates may be asked as per IEC: 60076.
- 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.



**ELECTRICAL DISTRIBUTION SYSTEM
TALCHER FERTILIZERS LIMITED
TECHNICAL SPECIFICATION – POWER TRANSFORMER
(PC183-TS-0803)**

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**TECHNICAL PARTICULARS
TRANSFORMERS**

PROJECT: Coal Based Fertilizer Plant		PLANT: Electrical Distribution System	
ISSUED FOR : PROPOSAL <input type="checkbox"/>		ENQUIRY <input checked="" type="checkbox"/>	
		ORDER <input type="checkbox"/>	
		FINAL <input type="checkbox"/>	
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			

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Cooling Fans / Current Transformers	
OLTC	
Control Panels	
Pressure Release Device	



Note: Technical Particulars shall be filled by the bidder and submitted with the bid.

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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

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ANNEXURE - II
DOCUMENTATION FOR TRANSFORMERS

Sl. No.	Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheet	Y	Y	Y
2.	Technical Particulars	Y	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 with bid.
2. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
3. 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 DISTRIBUTION SYSTEM
TALCHER FERTILIZERS LIMITED
TECHNICAL SPECIFICATION - NEUTRAL EARTHING
RESISTORS (PC183-TS-0804)**

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TECHNICAL SPECIFICATION NEUTRAL EARTHING RESISTOR



CONTENTS

SECTION NUMBER	DESCRIPTION
1.0	SCOPE
2.0	STANDARDS TO BE FOLLOWED
3.0	SERVICE CONDITIONS
4.0	OPERATING REQUIREMENTS
5.0	GENERAL DESIGN AND CONSTRUCTIONAL FEATURES
6.0	ACCESSORIES
7.0	PAINTING
8.0	TESTS AND INSPECTION
9.0	DRAWINGS AND DOCUMENTS
10.0	SPARES
11.0	PACKING
12.0	DEVIATIONS
ANNEXURE - I	DOCUMENTATION FOR NEUTRAL EARTHING RESISTORS



**ELECTRICAL DISTRIBUTION SYSTEM
TALCHER FERTILIZERS LIMITED
TECHNICAL SPECIFICATION - NEUTRAL EARTHING
RESISTORS (PC183-TS-0804)**

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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 350°C.

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 40°C.

5.0 GENERAL DESIGN AND CONSTRUCTIONAL 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.



**ELECTRICAL DISTRIBUTION SYSTEM
TALCHER FERTILIZERS LIMITED
TECHNICAL SPECIFICATION - NEUTRAL EARTHING
RESISTORS (PC183-TS-0804)**

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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.

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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 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



**ELECTRICAL DISTRIBUTION SYSTEM
TALCHER FERTILIZERS LIMITED
TECHNICAL SPECIFICATION - MEDIUM VOLTAGE SWITCH
BOARDS (PC183-TS-0805)**

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TECHNICAL SPECIFICATION MEDIUM VOLTAGE SWITCH BOARDS



CONTENTS

SECTION NUMBER	DESCRIPTION
1.0	SCOPE
2.0	STANDARDS TO BE FOLLOWED
3.0	SERVICE CONDITIONS
4.0	OPERATING REQUIREMENTS
5.0	DESIGN AND CONSTRUCTIONAL FEATURES
6.0	COMPONENT DETAILS
7.0	ACCESSORIES
8.0	PAINTING
9.0	TESTS AND INSPECTION
10.0	DRAWINGS AND DOCUMENTS
11.0	SPARES
12.0	PACKING
13.0	DEVIATIONS
ANNEXURE - I	DOCUMENTATION FOR MEDIUM VOLTAGE SWITCH BOARDS



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.



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- 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:



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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 200°C 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 bus duct shall be similar to the main bus-bars of the switchboard and as specified above.
- 5.8.3 Bus 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 properly 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.



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- 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.



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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 resettable 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 80°C. 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 0-90° 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.



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- 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.



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- 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 Spares for 2 Years operation (Mandatory), as specified shall be supplied.



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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

SI.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:

- 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
- 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



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**SPECIFICATION SHEET
415V SWITCHBOARD**

PROJECT: Coal Based Fertilizer Plant		PLANT: Electrical Distribution System	
ISSUED FOR : PROPOSAL <input type="checkbox"/> ENQUIRY <input checked="" type="checkbox"/>		ORDER <input type="checkbox"/> FINAL <input type="checkbox"/>	
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 Corrosive	
		Location Indoor <input checked="" type="checkbox"/> Outdoor <input type="checkbox"/>	
		Gr. Floor <input type="checkbox"/> 1 st floor <input checked="" type="checkbox"/>	
Addl. Scope :	Incoming Bus Duct <input checked="" type="checkbox"/>	Tie Bus Duct <input type="checkbox"/>	
	Erection & Comm. <input checked="" type="checkbox"/>	Supervision of Erection Comm. <input type="checkbox"/>	
TESTS: Routine <input checked="" type="checkbox"/> Type <input type="checkbox"/> Others <input type="checkbox"/>			
BASIC DATA			
TAG NO.	Item No.		
	Description		
	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	
		Short Time for 1 sec.	50 KA
	Bare / Insulated		Insulated
	Type of Insulation		Heat Shrinkable PVC sleeved
EXECUTION	Breaker	I/C: ST / DT	ST
	Feeders	Others: ST / DT	DT
	Other	Single front / Double front	Front
	Feeders	Fixed / Drawout	Drawout
	Cable Entry : Top / Bottom		Bottom
	Bus Duct Entry : Top / Bottom		--
CONTROL SUPPLY	Breaker	Closing & Indication	110V DC
		Tripping	110V DC
	Contactors		240 V AC
	Space Heater		240 V AC
	MISC. DATA	Painting	Type	Epoxy
Shade			631 of IS: 5
Period for which Spares required		2 Years	

Note: All unfilled data shall be filled and shall be furnished after award of order for owner/consultant approval before commencement of manufacturing.



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**TECHNICAL PARTICULARS
415V SWITCHBOARD**

PROJECT: Coal Based Fertilizer Plant		PLANT: Electrical Distribution System	
ISSUED FOR : PROPOSAL <input type="checkbox"/> ENQUIRY <input checked="" type="checkbox"/>		ORDER <input type="checkbox"/> FINAL <input type="checkbox"/>	
GENERAL			
Manufacturer's Type			
Ref. Standards			
Rated Operational Voltage with \pm %			
Rated Insulation Voltage			
Rated Voltage of Aux. Circuits with \pm %			
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			



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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		



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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 I²T 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	

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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.



**ELECTRICAL DISTRIBUTION SYSTEM
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TECHNICAL SPECIFICATION HIGH VOLTAGE SWITCH BOARDS



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3.0	SERVICE CONDITIONS
4.0	OPERATING REQUIREMENTS
5.0	DESIGN AND CONSTRUCTIONAL FEATURES
6.0	COMPONENT DETAILS
7.0	ACCESSORIES
8.0	PAINTING
9.0	TESTS AND INSPECTION
10.0	DRAWINGS AND DOCUMENTS
11.0	SPARES
12.0	PACKING
13.0	DEVIATIONS
ANNEXURE - I	DOCUMENTATION FOR HIGH VOLTAGE SWITCHBOARDS

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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,

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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

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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 250°C 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

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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.



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- 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

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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.

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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/scraping 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:

<u>Application</u>	<u>Class of Accuracy as per IS: 2705</u>
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.

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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 0-90° 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.

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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 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.

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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 with bid.
2. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
3. 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



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**SPECIFICATION SHEET
11 KV SWITCHBOARD**

PROJECT: Coal Based Fertilizer Plant		PLANT: Electrical Distribution System		
ISSUED FOR : PROPOSAL <input type="checkbox"/> ENQUIRY <input checked="" type="checkbox"/>		ORDER <input type="checkbox"/> FINAL <input type="checkbox"/>		
GENERAL		AMBIENT CONDITION		
Ref. Stds. : IS <input checked="" type="checkbox"/> IEC <input checked="" type="checkbox"/>	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 <input checked="" type="checkbox"/>	Outdoor <input type="checkbox"/>	
		Gr. Floor <input type="checkbox"/>	1 st floor <input checked="" type="checkbox"/>	
	Incoming Bus Duct <input checked="" type="checkbox"/>	Tie Bus Duct <input type="checkbox"/>		
	Erection & Comm. <input checked="" type="checkbox"/>	Supervision of Erection & Comm. <input type="checkbox"/>		
TESTS:	Routine <input checked="" type="checkbox"/>	Type <input type="checkbox"/>	Others <input type="checkbox"/>	
BASIC DATA				
	Description	11KV Switchboard at MRSS		
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	75 kVp/ 28kV BIL		
	Fault Level	750 MVA for 3 sec.		
Earthing Mode	Non effectively earthed through resistor			
BUS BARS	Rating	Continuous	4000A	
		Short Time for 3 sec.	40KA for 3 sec.	
	Type of Insulation	Raychem Insulating heat shrinkable Sleeved		
CIRCUIT BREAKER	Type	Vacuum Circuit Breaker		
	Breaking Capacity	Symmetrical	40KA for 3 sec.	
		% DC Component	20% (Min.)	
	Making Capacity (peak)	2.55 times Breaking Capacity		
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 Req'd. Yes / No	As required		
	Width of Dummy Panel	--		
	No. of Dummy Panel	--		
	PAINTING	Type	Epoxy Based	
		Shade	631 of IS: 5	
Spares Parts Req'd. for a Period of	2 Years			

Note: Specification Sheet shall be filled by the bidder and submitted with the bid.



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11 KV SWITCHBOARD**

PROJECT: Coal Based Fertilizer Plant		PLANT: Electrical Distribution System		
ISSUED FOR : PROPOSAL <input type="checkbox"/> ENQUIRY <input checked="" type="checkbox"/>		ORDER <input type="checkbox"/> FINAL <input type="checkbox"/>		
GENERAL		AMBIENT CONDITION		
Ref. Stds. : IS <input checked="" type="checkbox"/> IEC <input checked="" type="checkbox"/>	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 <input checked="" type="checkbox"/>	Outdoor <input type="checkbox"/>	
		Gr. Floor <input type="checkbox"/>	1 st floor <input checked="" type="checkbox"/>	
ADDL. SCOPE	Incoming Bus Duct <input type="checkbox"/>	Tie Bus Duct <input checked="" type="checkbox"/>		
	Erection & Comm. <input checked="" type="checkbox"/>	Supervision of Erection & Comm. <input type="checkbox"/>		
TESTS:	Routine <input checked="" type="checkbox"/>	Type <input type="checkbox"/>	Others <input type="checkbox"/>	
BASIC DATA				
	Description	11KV Switchboard at OUSS		
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	75 kVp/ 28kV BIL		
	Fault Level	750 MVA for 3 sec.		
BUS BARS	Rating	Continuous	4000A	
		Short Time for 3 sec.	40KA for 3 sec.	
	Type of Insulation	Raychem Insulating heat shrinkable Sleeved		
CIRCUIT BREAKER	Type	Vacuum Circuit Breaker		
	Breaking Capacity	Symmetrical	40KA for 3 sec.	
		% DC Component	20% (Min.)	
	Making Capacity (peak)	2.55 times Breaking Capacity		
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: Specification Sheet shall be filled by the bidder and submitted with the bid.



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**TECHNICAL PARTICULARS
11 KV SWITCHBOARD**

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ISSUED FOR : PROPOSAL <input type="checkbox"/> ENQUIRY <input checked="" type="checkbox"/>		ORDER <input type="checkbox"/> FINAL <input type="checkbox"/>	
GENERAL			
Make / Maker's Type :			
Ref. Standards			
Rated Operational Voltage with \pm %			
Rated Insulation Voltage			
Rated Voltage of Aux. Circuits with \pm %			
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			



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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 SF₆	SF ₆ Gas Pressure	
	Wt. Of SF ₆ Gas per Breaker	
DETAILS FOR SF₆	Gas Leakage Detector Provided	
	Gas Density Monitor Provided	
DETAILS	Pressure inside the Interrupter	



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FOR VCB	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		



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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: Technical Particulars shall be filled by the bidder and submitted with the bid.



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**SPECIFICATION SHEET
3.3 KV SWITCHBOARD**

PROJECT: Coal Based Fertilizer Plant		PLANT: Electrical Distribution System		
ISSUED FOR : PROPOSAL <input type="checkbox"/> ENQUIRY <input checked="" type="checkbox"/>		ORDER <input type="checkbox"/> FINAL <input type="checkbox"/>		
GENERAL		AMBIENT CONDITION		
Ref. Stds. : IS <input checked="" type="checkbox"/> IEC <input type="checkbox"/>		Temp. Max./Min./Design Ref. : 46 / 1 / 50°C		
Encl. Docs. :		Relative Humidity: 100% | Alt. above sea <1000 M		
Make :		ATMOSPHERIC POLLUTION		
Maker's Ref. No. :		Dusts : Coal Dust & Urea Dust		
		Vapour : Ammonia & Highly Corrosive		
		LOCATION		
		Indoor <input checked="" type="checkbox"/> Outdoor <input type="checkbox"/>		
		Gr. Floor <input type="checkbox"/> 1 st floor <input checked="" type="checkbox"/>		
ADDL. SCOPE	Incoming Bus Duct <input type="checkbox"/>	Tie Bus Duct <input type="checkbox"/>		
	Erection & Comm. <input checked="" type="checkbox"/>	Supervision of Erection & Comm. <input type="checkbox"/>		
TESTS: Routine <input checked="" type="checkbox"/> Type <input type="checkbox"/> Others <input type="checkbox"/>				
BASIC DATA				
TAG NO. & QTY.	Item No.			
	Switch board No.			
	Description		3.3KV Switch Board at OUSS	
REFERENCE DRAWINGS	Single Line Diagram			
	Feeder Details			
	Auto Trip Alarm Scheme			
	Non Trip Alarm Scheme			
	Trip Ckt. Supervision Scheme			
	Auto C/O Scheme			
	P.T. Bus Arrangement			
SYSTEM DETAILS	Rated Voltage with Variation		3.3 KV ± 10%	
	Rated Frequency with Variation		50Hz ± 5%	
	Highest System Voltage		3.6KV	
	Combined V & F Variation		± 10%	
	No. of Phases & Wires		3 Phase, 3 Wire	
	Insulation Level		40KV	
	Fault Level		150MVA	
	Earthing Mode		Non effectively earthed through resistor	
BUS BARS	Rating	Continuous	1250A	
		Short Time for 3 sec.	26.24KA	
	Type of Insulation		Heat Shrinkable Raychem Sleeved	
CIRCUIT BREAKER	Type		Vacuum Circuit Breaker	
	Breaking Capacity	Symmetrical	26.24KA	
		% DC Component	20%	
	Making Capacity (peak)		66.81KA	
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 Req'd. Yes / No		No	
	Width of Dummy Panel		--	
	No. of Dummy Panel		--	
	PAINTING	Type	Epoxy Based	
		Shade	631 of IS: 5	
	Spares Parts Req'd. for a Period of		2 Years	

Note: Specification Sheet shall be filled by the bidder and submitted with the bid.



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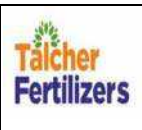
**TECHNICAL PARTICULARS
3.3 KV SWITCHBOARDS**

PROJECT: Coal Based Fertilizer Plant		PLANT: Electrical Distribution System	
ISSUED FOR : PROPOSAL <input type="checkbox"/> ENQUIRY <input checked="" type="checkbox"/>		ORDER <input type="checkbox"/> FINAL <input type="checkbox"/>	
GENERAL			
Make / Maker's Type :			
Ref. Standards			
Rated Operational Voltage with \pm %			
Rated Insulation Voltage			
Rated Voltage of Aux. Circuits with \pm %			
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			



**ELECTRICAL DISTRIBUTION SYSTEM
TALCHER FERTILIZERS LIMITED
TECHNICAL SPECIFICATION - HIGH VOLTAGE
SWITCHBOARDS (PC183-TS-0806)**

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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 SF₆	SF ₆ Gas Pressure	
	Wt. Of SF ₆ Gas per Breaker	
DETAILS FOR SF₆	Gas Leakage Detector Provided	
	Gas Density Monitor Provided	
DETAILS	Pressure inside the Interrupter	



**ELECTRICAL DISTRIBUTION SYSTEM
TALCHER FERTILIZERS LIMITED
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FOR VCB	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		



**ELECTRICAL DISTRIBUTION SYSTEM
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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: Technical Particulars shall be filled by the bidder and submitted with the bid.



ELECTRICAL DISTRIBUTION SYSTEM
TALCHER FERTILIZERS LIMITED
TECHNICAL SPECIFICATION - BUS DUCT (PC183-TS-0807)

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TECHNICAL SPECIFICATION

BUS DUCT



CONTENTS

SECTION NUMBER	DESCRIPTION
1.0	SCOPE
2.0	STANDARDS TO BE FOLLOWED
3.0	SERVICE CONDITIONS
4.0	OPERATING REQUIREMENTS
5.0	GENERAL DESIGN AND CONSTRUCTIONAL FEATURES
6.0	ACCESSORIES
7.0	LAYOUT
8.0	PAINTING
9.0	TESTS AND INSPECTION
10.0	DRAWINGS AND DOCUMENTS
11.0	SPARES
12.0	PACKING
13.0	DEVIATIONS
ANNEXURE - I	DOCUMENTATION FOR BUS DUCT



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.



**ELECTRICAL DISTRIBUTION SYSTEM
TALCHER FERTILIZERS LIMITED
TECHNICAL SPECIFICATION - BUS DUCT (PC183-TS-0807)**

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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 hardware 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 200°C. 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/cm². 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 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



**ELECTRICAL DISTRIBUTION SYSTEM
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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:

- 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
- 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 DISTRIBUTION SYSTEM TALCHER FERTILIZERS LIMITED TECHNICAL SPECIFICATION - SHEET STEEL DISTRIBUTION BOARDS (PC183-TS-0808)	PC183/E/4006/SecVI-3.1	0	
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TECHNICAL SPECIFICATION

SHEET STEEL DISTRIBUTION BOARDS



CONTENTS

SECTION NUMBER	DESCRIPTION
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3.0	SERVICE CONDITIONS
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5.0	DESIGN AND CONSTRUCTIONAL FEATURES
6.0	COMPONENT DETAILS
7.0	ACCESSORIES
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9.0	TESTS AND INSPECTION
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ANNEXURE - I	DOCUMENTATION FOR SHEET STEEL DISTRIBUTION BOARDS

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	TECHNICAL SPECIFICATION - SHEET STEEL DISTRIBUTION BOARDS (PC183-TS-0808)	Document No.	Rev	
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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

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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 90°C. The bus-bars shall also be designed to withstand the system fault current for 1 second without



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exceeding the temperature of 200°C for bare aluminium and 250°C 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.

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- 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.

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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.

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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 resettable 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 - 240° 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.

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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.

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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 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.

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13.0 DEVIATIONS

13.1 Deviations, if any, from this standard shall be clearly indicated in the offer with reasoning.

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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

 पी डी आई एल PDIL	ELECTRICAL DISTRIBUTION SYSTEM TALCHER FERTILIZERS LIMITED TECHNICAL SPECIFICATION - LIGHTING SUB DISTRIBUTION BOARDS (PC183-TS-0809)	PC183/E/4006/SecVI-3.1	0	 Talcher Fertilizers
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TECHNICAL SPECIFICATION

LIGHTING SUB DISTRIBUTION BOARDS

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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.

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- 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.

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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.
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- 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 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.

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DOCUMENTATION FOR LIGHTING SUB DISTRIBUTION BOARDS

SL.N O.	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



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TECHNICAL SPECIFICATION INDUCTION MOTOR

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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.

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- 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.

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- 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.

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- 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 90°C for grease lubricated bearings and 70°C 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.

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- 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.

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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 10°C 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 200°C.
- 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 - 300°C
 - 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 $\pm 66\%$ 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.

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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

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- 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 0°C 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.

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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

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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 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.

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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:

- 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
- 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 DISTRIBUTION SYSTEM
TALCHER FERTILIZERS LIMITED**
TECHNICAL SPECIFICATION - INTERLOCKING SWITCH SOCKET
AND PLUG (PC183-TS-0811)

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TECHNICAL SPECIFICATION INTERLOCKING SWITCH SOCKET AND PLUG



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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.

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- 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.

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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.

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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 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

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TECHNICAL SPECIFICATION

BATTERY CHARGER



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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 $\pm 5\%$ of the rated value manually.

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- 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 $\pm 2\%$ 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.

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- 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.

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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.

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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.

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- 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

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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) along with 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



**ELECTRICAL DISTRIBUTION SYSTEM
TALCHER FERTILIZERS LIMITED
TECHNICAL SPECIFICATION - BATTERY CHARGER
(PC183-TS-0813)**

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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 ii) Solid State facia annunciator for : -- 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 iv) Battery under voltage relay v) Battery earth fault relay vi) DC Contactor	Yes Yes	Yes	Yes Yes Yes Yes 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



**ELECTRICAL DISTRIBUTION SYSTEM
TALCHER FERTILIZERS LIMITED
TECHNICAL SPECIFICATION – BATTERY (PC183-TS-0814)**

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TECHNICAL SPECIFICATION BATTERY



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SECTION NUMBER	DESCRIPTION
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2.0	STANDARDS TO BE FOLLOWED
3.0	SERVICE CONDITIONS
4.0	OPERATING REQUIREMENTS
5.0	GENERAL DESIGN AND CONSTRUCTIONAL FEATURES
6.0	ACCESSORIES
7.0	TESTS AND INSPECTION
8.0	DRAWINGS AND DOCUMENTS
9.0	SPARES
10.0	PACKING
11.0	DEVIATIONS
ANNEXURE - I	DOCUMENTATION FOR BATTERY

	ELECTRICAL DISTRIBUTION SYSTEM TALCHER FERTILIZERS LIMITED TECHNICAL SPECIFICATION – BATTERY (PC183-TS-0814)	PC183/E/4006/SecVI-3.1	0	
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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.

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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

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- 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 Spares for 2 Years operation (Mandatory), as specified shall be supplied.
- 9.3 Recommend 2 years Operational Spares (other than mandatory spare) along with 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:

- 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
- 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 DISTRIBUTION SYSTEM TALCHER FERTILIZERS LIMITED TECHNICAL SPECIFICATION - CABLES (PC183-TS-0815)	PC183/E/4006/SecVI-3.1	0	
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TECHNICAL SPECIFICATION

CABLES

CONTENTS

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3.0	SERVICE CONDITIONS
4.0	OPERATING REQUIREMENTS
5.0	GENERAL DESIGN AND CONSTRUCTIONAL FEATURES
6.0	SPECIAL PURPOSE CABLES
7.0	CABLE DRUM
8.0	TESTS AND INSPECTION
9.0	DRAWINGS AND DOCUMENTS
10.0	DEVIATIONS
ANNEXURE - I	DOCUMENTATION FOR CABLES

	ELECTRICAL DISTRIBUTION SYSTEM TALCHER FERTILIZERS LIMITED TECHNICAL SPECIFICATION - CABLES (PC183-TS-0815)	PC183/E/4006/SecVI-3.1	0	
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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.

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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 $\pm 5\%$ 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 - 250°C

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- 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 $\pm 2.5\%$. 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

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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

	ELECTRICAL DISTRIBUTION SYSTEM TALCHER FERTILIZERS LIMITED TECHNICAL SPECIFICATION - PREFABRICATED LADDER TYPE CABLE RACKS (PC183-TS-0816)	PC183/E/4006/SecVI-3.1	0	
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TECHNICAL SPECIFICATION

PREFABRICATED LADDER TYPE CABLE RACKS

	ELECTRICAL DISTRIBUTION SYSTEM TALCHER FERTILIZERS LIMITED TECHNICAL SPECIFICATION - PREFABRICATED LADDER TYPE CABLE RACKS (PC183-TS-0816)	PC183/E/4006/SecVI-3.1	0	
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3.0	GENERAL DESIGN AND CONSTRUCTIONAL FEATURES
4.0	MARKING
5.0	TESTS AND INSPECTION
6.0	DRAWINGS AND DOCUMENTS
7.0	DEVIATIONS
ANNEXURE - I	DOCUMENTATION FOR PREFABRICATED LADDER TYPE CABLE RACKS

	ELECTRICAL DISTRIBUTION SYSTEM TALCHER FERTILIZERS LIMITED TECHNICAL SPECIFICATION - PREFABRICATED LADDER TYPE CABLE RACKS (PC183-TS-0816)	PC183/E/4006/SecVI-3.1	0	
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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 10° .
- 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.

	ELECTRICAL DISTRIBUTION SYSTEM TALCHER FERTILIZERS LIMITED TECHNICAL SPECIFICATION - PREFABRICATED LADDER TYPE CABLE RACKS (PC183-TS-0816)	PC183/E/4006/SecVI-3.1	0	
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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.

	ELECTRICAL DISTRIBUTION SYSTEM TALCHER FERTILIZERS LIMITED TECHNICAL SPECIFICATION - PREFABRICATED LADDER TYPE CABLE RACKS (PC183-TS-0816)	PC183/E/4006/SecVI-3.1	0	
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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.

	ELECTRICAL DISTRIBUTION SYSTEM TALCHER FERTILIZERS LIMITED TECHNICAL SPECIFICATION - PREFABRICATED LADDER TYPE CABLE RACKS (PC183-TS-0816)	PC183/E/4006/SecVI-3.1	0	
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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



**ELECTRICAL DISTRIBUTION SYSTEM
TALCHER FERTILIZERS LIMITED**
TECHNICAL SPECIFICATION - LOCAL CONTROL STATION
(PC183-TS-0817)

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TECHNICAL SPECIFICATION

LOCAL CONTROL STATION



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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

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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.

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- 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 180°. 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 0-240°. 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**

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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 mm². 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 Spares for 2 Years operation (Mandatory), as specified shall be supplied.

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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:



- 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
- 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 DISTRIBUTION SYSTEM TALCHER FERTILIZERS LIMITED TECHNICAL SPECIFICATION - JUNCTION BOX (PC183-TS-0818)	PC183/E/4006/SecVI-3.1	0	
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TECHNICAL SPECIFICATION

JUNCTION BOX

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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.

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- 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.

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- 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 Spares for 2 Years operation (Mandatory), as specified shall be supplied.

	ELECTRICAL DISTRIBUTION SYSTEM TALCHER FERTILIZERS LIMITED TECHNICAL SPECIFICATION - JUNCTION BOX (PC183-TS-0818)	PC183/E/4006/SecVI-3.1	0	
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- 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.

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DOCUMENTATION FOR JUNCTION BOXES

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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

	ELECTRICAL DISTRIBUTION SYSTEM TALCHER FERTILIZERS LIMITED TECHNICAL SPECIFICATION - ELECTRICALS FOR OVERHEAD CRANES & HOISTS (PC183-TS-0819)	PC183/E/4006/SecVI-3.1	0	
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TECHNICAL SPECIFICATION

ELECTRICALS FOR OVERHEAD CRANES & HOISTS

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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.

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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.

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- 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

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- 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

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be provided over the coil. The maximum temperature of the coil for continuous operation shall be limited to 140° 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.

5.6.3 The rating of the transformers shall be at least 2.5 times the continuous load.

5.7 **Junction Box**

Junction boxes shall be of cast aluminium construction and adequately sized to enable easy termination of cables.

5.8 **Hand Lamps**

5.8.1 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.

5.8.2 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.

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- 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.

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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 Spares for 2 Years operation (Mandatory), as specified shall be supplied.

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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

DOCUMENTATION 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:

- 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
- 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

- The tenderer shall also quote for any other spares as deemed necessary to be kept in stock for stipulated time.



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TECHNICAL SPECIFICATION

HIGH VOLTAGE VARIABLE FREQUENCY DRIVE SYSTEM

CONTENTS

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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 11000V 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:60 146-1-3Semiconductor 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.

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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 REQUIREMENTS



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 $\pm 10\%$ and frequency variation of $\pm 3\%$. 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

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- 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 $\pm 1\%$ of rated maximum speed and steady state regulation of $\pm 0.5\%$ 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

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- 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.

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- 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 mm², 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 1.5mm² size wire shall normally be used provided the control fuse rating is 10 Amps or less and 2.5 mm² size for control fuse rating above 16 A for electrical circuits and 0.5mm² 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.

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- 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:

- The motor shall be suitable for operation with a solid-state power supply consisting of an adjustable frequency inverter for speed control.
- The motor shall be suitable for the current waveforms produced by the power supply including the harmonics generated by the drive.
- 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.
- 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.

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- 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 V_{peak} 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 of the 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 output 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.

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- 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

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- 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.

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- 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

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- 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

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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 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

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long periods before installation. The packing shall be completely suitable for outdoor storage, in areas with heavy rains/high ambient temperature.



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TECHNICAL SPECIFICATION

MEDIUM VOLTAGE VARIABLE FREQUENCY DRIVE SYSTEM

CONTENTS

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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:60 146-1-3Semiconductor 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:

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- 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 REQUIREMENTS

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 $\pm 10\%$ and frequency variation of $\pm 3\%$. 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

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- 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 $\pm 1\%$ of rated maximum speed and steady state regulation of $\pm 0.5\%$ 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.
- 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.

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- 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.
- 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.
 - 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.
 - 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, I/O 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.

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- 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 mm² 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/II 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 1.5mm² size wire shall normally be used provided the control fuse rating is 10 Amps or less and 2.5 mm² size for control fuse rating above 16 A for electrical circuits and 0.5mm² for electronic circuits. All wires shall be ferruled and terminals shall be properly numbered, minimum 20% spare terminals shall be provided.

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- 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.

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- 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 V_{peak} 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 $\pm 5\%$ off circuit taps in steps of $\pm 2.5\%$.

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.

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- 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.

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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:

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- 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

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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 speed and motor current in DCS unless otherwise specified for other parameters.
- XI.

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

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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.

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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 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.

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TECHNICAL SPECIFICATION

CAPACITOR BANK & ASSOCIATED EQUIPMENT

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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 IEC:593/IS 12672	Voltage Transformers 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.

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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 45°C. 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.

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- 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 +5°C as per IS-13925 part-1. Only 5°C temperature rise is permissible above the design temperature of 45°C. So maximum temperature in any case shall not exceed 50° C {i.e. 45°C (design) +5°C (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



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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.

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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 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.

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- 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 0-240⁰ 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 handles.
- 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 be 16A. 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.

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- 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**

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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 handling.

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 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.

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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

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TECHNICAL SPECIFICATION

AUXILIARY SERVICE TRANSFORMER

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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

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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 $\pm 2.5\%$ and $\pm 5\%$.

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 75°C 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

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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.

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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

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TECHNICAL SPECIFICATION

DIESEL GENERATOR SET

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1.0 SCOPE



- 1.1 This standard covers the technical requirements of design, engineering, manufacture, assembly, testing at works and delivery in well packed condition of diesel generator set (D.G. Set) complete with all required accessories and control equipment to supply continuous electrical power.
- 1.2 This standard is applicable for D.G. set having rating more than 500 KVA.
- 1.3 The control panel for DG set shall be provided with Auto/manual starting/stopping facilities.
- 1.1 This standard shall be read in conjunction with relevant part of Design Philosophy – Electrical.
- 1.4 The scope of supply shall include, but not limited to the following:
- a) Diesel engine, complete with all the required accessories and components.
 - b) Generator set, for operation with the above diesel engine, complete with all the required accessories and components.
 - c) Drive coupling between diesel engine and generator set complete with guard.
 - d) Engine flywheel, if required, with starter ring and guard.
 - e) Fuel oil system comprising of fuel oil tank, supply pump, filter, piping, valves, fittings etc.
 - f) Air intake system comprising of air blower, air filter, turbo charger etc.
 - g) Lubrication oil system comprising of lube oil pump, filter, cooler, piping, valves, fittings etc.
 - h) Jacket cooling system comprising of radiator, water circulation pump, necessary piping and fittings etc.
 - i) Starting system complete with battery, battery charger, starter motor, control system etc.
 - j) All inter connecting piping, valves and fittings up to the battery limits.
 - k) Torsional vibration damper at the free end of the crank shaft.
 - l) Speed regulation system.
 - m) Provision for hand barring of the engine along with the hand barring tool.
 - n) "Emergency-off" Push Button shall be provided on the enclosure if the DG set is provided with Acoustic enclosure. Emergency-off" Push Button' near DG set shall be provided even if acoustic enclosure is not provided
 - o) Platforms, walkways, stairs and hand racks, as required, for adequate access during operation and maintenance.
 - p) A common base frame suitable for assembly of engine, radiator and alternator with there accessories. Anti, vibration mounting and foundation bolts shall also be supplied. Base frame shall be designed for transportation of above items duly assembled on it.
 - q) Exhaust manifold complete with silencers, asbestos lagging, metallic expansion bellows and piping
 - r) All necessary instruments for monitoring and safe starting, running and stopping of the D.G. set their auxiliaries complete with tubing and cabling.
 - s) Control panel.

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- t) Cabling material between control panel and all equipment within the battery limit including cables, racks, earthing terminating materials etc.
 - u) All safety and protective devices.
 - v) Electrically operated Turning Gear Motor (DC powered).
 - w) All other items not specified here but, necessary for safe, satisfactory and uninterrupted operation of D.G. set.
 - x) Set of special tools and tackles required for installation and maintenance.
 - y) Spare parts for the specified duration.
 - z) All other services as required.
 - aa) These DGs shall feed to Main DG Power Supply Board. Emergency Power Distribution Switchboard shall have 2 Nos. incomers from Main DG Power Supply Board and shall feed emergency load of CPP, Coal Gasification Plant and other Offsite & Utilities of entire fertiliser complex.
- 1.5 Offered DG set shall also comply with CPCB/State Pollution Control Board norms/standards regarding emission & Noise. Necessary certificate regarding this shall be furnished by LSTK Contractor.
- 1.6 DG Set shall be designed to cater the non-linear loads i.e. VFD driven pump therefore effects of harmonics on DGs shall be considered while designing.
- 1.7 Erection and commissioning of the above shall be carried out by LSTK Contractor.

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 codes and other relevant Indian standard specifications unless otherwise specified. Equipment complying with equivalent IEC standards shall also be acceptable.
- i) BS 649 - Diesel engines for general purpose.
 - ii) IS:7451 - Reciprocating internal combustion engines
IS: 4691 - Degree of protection provided by enclosures for rotating electrical machines.
 - iii) IS-10000 - Methods of test for internal combustion engine.
 - iv) IS: 13364 - Specifications for A.C. Generator
 - v) IS:12065 - Permissible limits of noise levels for rotating electrical machine
 - vi) IS:12075 - Mechanical Vibration of rotating electrical machine with shaft heights 56 mm and higher-measurements, evaluation and limits of vibration severity.
 - vii) ISO:8528 - Reciprocating IC Engine driven AC generating sets
 - viii) ASME codes.
 - ix) IS/IEC:60034 - Rotating Electrical Machines - Specification.
 - x) Oil coolers as per TEMA class "C"
 - xi) Any other standards/codes (BS, IS & equivalent International Standards) applicable.

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2.2 Equipment designed and manufactured to other national standards shall be acceptable provided they are in no way inferior to the above mentioned standards. The Contractor shall supply English version of the relevant standard in such case.

2.3 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 statutory regulations. The Contractor shall, wherever necessary, make suitable modification in the equipment to comply with the above.

2.4 Wherever any requirement, laid down in this standard, differs from that in Indian standard / IEC, 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.

4.0 OPERATING REQUIREMENTS

4.1 The D.G. set shall be suitable for “black start” operation. The equipment offered shall be suitable for operating at their rated capacity continuously under the ambient conditions and voltage & frequency variations indicated in Design Philosophy – Electrical, without exceeding the temperature rise limits specified in relevant standards and without any detrimental effect on any part.

4.2 The D.G. set shall be designed for continuous operation at full load or partial load and have the capability to run at 110% of the MCR for one hour in every 12 hrs.

4.3 The D.G. set covered under this standard shall be meant to supply power in one of the following modes.

Type A - Emergency power i.e. to provide reliable power due to failure or outage of normal supply automatically within a specified time to critical devices and equipment of the installation.



Type B - Stand by power i.e. to provide reliable power due to failure or outage of the normal supply to all devices and equipment of the installation.

Type C - Backup power i.e. to provide reliable power due to restriction imposed by the supply authorities of the normal supply to some section of the installation.

4.4 The D.G. set meant to supply emergency power (Type A) should start automatically and quickly on receipt of starting impulse from owner’s remote panel. Under such conditions, the auxiliary power and cooling water shall not be available. The starting and lubrication system shall be suitably designed to take care of these conditions and allow easy, safe and quick starting. The loading sequence and its duration are as specified by Owner elsewhere.

4.5 An electronic tri-vector meter with maximum demand indicator shall be provided in generator control panel to measure KWH, KVARH, KVAH and maximum demand in KVA.

4.6 The D.G. set meant to supply standby power (Type-B) shall be started automatically and conditions mentioned above shall also apply. However, the loading sequence is not automatic and hence need not be defined by Owner.

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4.7 The D.G. set meant to supply backup power (Type-C) shall be manually controlled and started manually. Idle period may not be long and the requirement of auxiliary power and cooling water can be ensured due to the availability of the normal supply.

5.0 DIESEL ENGINE

5.1 General Design Feature

5.1.1 The diesel engine shall be of multistroke, multicylinder with mechanical fuel injection arrangement and complete with all the required accessories.

5.1.2 The engine output shall be at least 25% greater than the power required for the loads (including internal consumption by D.G. set) and loading sequence as required.

5.1.3 The engine shall be suitable for trouble free operation with high speed diesel conforming to IS: 1460.

5.1.4 The unbalance force transmission to the foundation shall be minimum. Critical speed of the assembly shall be sufficiently higher than the rated speed of the engine.



5.1.5 The engine shall be provided with turbo charger, filter and silencer mounted suitably on the engine frame and complete with necessary ducts work for air intake.

5.1.6 The engine shall be provided with exhaust silencer, necessary ducts, minimum 2 nos. expansion bellows and supporting arrangement from ceiling for exhausting the gases to outside.

5.1.7 The diesel engine shall be totally enclosed continuous duty, turbo charged system.

5.1.8 The engine shall consist of the following items:

- Radiator Cooling
- Radiator fan with guard
- Suitable flywheel
- Flywheel housing complete with starter gearing
- Flexible coupling, suitable to match flywheel, with safety guard
- Pneumatic starting systems with compressors (1R+1S) and air receiver and other accessories shall be provided.
- Electronically controlled Governor
- Fuel Pump/ Fuel Solenoid - PT fuel system
- Lube Oil Pump
- Fuel & Lube Oil Filters
- Lube Oil Cooler
- Air Cleaner, dry type
- Residential Silencer
- Flexible pipe for silencer, with necessary flanges.
- Suitable Turbocharger, driven from exhaust gas.
- In built safety controls against following:
 - Over speed shutdown
 - High coolant temperature warning / shutdown
 - Low coolant temperature warning / shutdown
 - Low coolant level warning / shutdown
 - Low and high battery voltage warning
 - Weak battery warning
 - Over crank shutdown
 - Fail to crank shutdown
 - Over current
 - High voltage
 - Low voltage

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- Under / over frequency
- Phase sequence
- Reverse power (kVA & kVAr)
- Low Lube Oil Pressure shutdown
- One No. 2 pole, AC/DC type, on-off switch, mounted on suitable frame, shall be provided and connected between the Battery and Engine (Starter) in order to isolate the battery supply to the engine when required.

5.2 Fuel Oil System

- 5.2.1 The system shall comprise of gravity fed oil tank, unless otherwise specified.
- 5.2.2 The gravity tank shall be complete with the provision of filling up by Motor driven pump and Hand Pump from the standard drums. The motor driven pump and associated hose pipe shall be provided by the Contractor.
- 5.2.3 Relief/bypass valve to regulate pressure in the fuel supply line, return excess fuel to a return line and prevent the build-up of excessive pressure in the fuel system shall be provided.
- 5.2.4 The gravity fed oil tank shall be located at a height from floor and near the wall of the engine room. Suitable brackets / structure shall be provided by the Contractor for this purpose. The tank shall be fabricated out of M.S. plates in cylindrical construction. The capacity of the tank shall be adequate for 24 hours continuous running of the engine at full load. . It shall be complete with valves for filling & draining, vent connection, level gauge glasses, level switches for low level alarm.

5.3 Jacket Cooling System



- 5.3.1 The engine shall be provided with radiator type air cooling system.
- 5.3.2 All the necessary items for the system such as water pump, radiator, fan, piping and fittings shall be provided to make the system complete in all respects.
- 5.3.3 Head tanks, if required, shall be included in the scope of supply for make up water as well as taking care of the expansion of the jacket water.

5.4 Lube Oil System

- 5.4.1 Proper lube oil system shall be provided for all lubricating points of the engine. The system shall be automatic pressure feed type and provided with a gear type pump driven from the crank shaft. The system shall be complete with fine wire mesh duplex strainer, valves, tank, oil cooler, header and branch piping suitably mounted on bed plate. Necessary accessories like pressure gauge, temperature and pressure switches for alarm and controls shall be provided.
- 5.4.2 The cooler shall be shell and tube type and connected to the engine cooling water system.



5.5 Starting System

- 5.5.1 The Electrical starting system shall be provided up to 1000 KVA DG set. However, for more than 1000 KVA DG set electrical / pneumatic starting shall be provided.
- 5.5.2 Both manual and automatic starting scheme shall be provided. The manual starting system shall be local while automatic starting system shall be suitable for impulses from owner's remote panel.
- 5.5.3 The starting system shall be such that the D.G. set shall start & come up to rated speed and be ready to accept full load within the period as per the process requirement.
- 5.5.4 Starting time of the DG set should be minimum, but not exceeding 15 seconds, to start, accelerate and build up the desired voltage and frequency. If the first starting operation

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is not successful, 2 more attempts to start with preset time intervals should be made. If all the three attempts fail, the set shall be locked out, alarm shall be given.

- 5.5.5 The electric starting system shall comprise of starter motor, battery, battery charger, necessary cabling, required instruments and accessories.
- 5.5.6 The Ni-Cd battery shall be heavy duty type and suitable for 20 successive starting attempts of the engine without draining. The charger shall have both float / boost charging facilities. The battery shall be complete with suitable stand and other required accessories.
- 5.5.7 The pneumatic starting system may comprise of a camshaft driven rotary air distributor admitting air to a series of automatic air starting valves fitted on individual cylinder heads or an air cranking motor operating through a ring gear on the engine fly wheel. The pneumatic starting system shall consist of:
- a) One 100% capacity A.C. motor driven air compressor, additional engine driven air compressor shall be provided, as required.
 - b) One air receiver of adequate capacity to supply air for minimum six (6) starts of engine.
 - c) Solenoid operated valves.
 - d) Pressure switches for automatic starting and stopping of the compressor.
 - e) After-coolers for compressor, if required, suitable for raw cooling water.
- 5.5.8 The compressor for charging the starting air receiver shall be driven by an A.C. motor. The starting and stopping of this motor driven compressor shall be controlled automatically by suitable pressure switches so that the air receiver remains charged always.
- 5.5.9 Contractor shall provide all necessary devices including solenoid valves so that with an impulse for starting of the engine received from emergency equipment or manual start push button, the entire operation of starting of the diesel set shall take place automatically.
- 5.6 **Governing System**
- 5.6.1 The speed governing system of the diesel engine shall satisfy the following requirements:
- a) Steady state speed regulation shall be adjustable between 0 to 5% manually.
 - b) Steady state speed regulation once fixed, shall not vary beyond + 0.5%.
 - c) Transient speed regulation shall not exceed 4.5% of rated speed. Momentary under speed and over speed shall not exceed 2% and 8% respectively.
 - d) Recovery time shall be within 3 seconds.
- 5.6.2 The governor system shall be electronic type and provided with adequate scheme to control the speed in the event of failure of power to the governor.
- 5.6.3 The governor should have automatic start fuel limit feature so that fuel is limited during start up to prevent excess start up smoke and start up over speed. The automatic fuel limit should be adjustable.
- 5.6.4 A mechanical over speed trip device shall be provided to operate at 110% of rated speed.
- 5.6.5 An engine mounted emergency push button shall be provided to trip the engine in case of emergency.
- 5.6.6 Separate Tachometer shall be provided to indicate the speed of the engine locally.

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6.0 GENERATOR

6.1 General Design Features

- 6.1.1 The generator shall be directly coupled to the engine.
- 6.1.2 The ingress protection class of the enclosure shall be IP44 as per IS/IEC:60529.
- 6.1.3 The generator and its accessories shall be capable of withstanding electrical, mechanical and thermal stresses while meeting the performance requirements.
- 6.1.4 The generator shall be synchronous A.C. Generator; star connected and shall have C.M.R. of specified output at 0.8 lag p. f. at rated voltage and frequency.

6.2 Winding and Insulation



- 6.2.1 The stator and rotor coils shall be made out of electrolytic grade copper conductors. Successive coils shall be connected by accessible and well brazed joints.
- 6.2.2 The coils shall be class F insulated and treated with tropical and fungicidal treatments.
- 6.2.3 The windings shall be dried, properly impregnated with suitable varnish to withstand the site conditions and properly baked. At least two additional impregnations and baking shall be applied to the assembled coil making a total of three impregnations and baking. Finally the windings shall be painted with special anti-acid and anti-alkali paint to withstand the site condition.
- 6.2.4 The leading wire between the windings and the outside terminals shall be through bushings.

6.3 Performance Requirement

- 6.3.1 The generator and the diesel engine shall match properly to deliver the rated load under the specified ambient and system conditions.
- 6.3.2 DG set shall be capable of starting from cold condition, taking up full load without undue wear and stress on equipment under the specified ambient and system condition. Also DG set shall be stopped manually using Emergency Stop push button, irrespective of the position of Auto/ manual selector switch located in Generator Control Panel.
- 6.3.3 The specified rating of the D.G. set indicated are net electrical power output required for owner's use and does not include the power required by the auxiliaries of the diesel set. The actual output rating of the generator to be offered by Contractor shall take into account the power requirement of the auxiliaries, 15% extra margin.
- 6.3.4 The generator shall have an overload capacity of 10% for 1 hour in any consecutive period of 12 hours after having attained the thermal equilibrium corresponding to the rated load. The terminal voltage shall be equal to the rated value. At the time of switching 'ON' the emergency loads, restarting or reacceleration of squirrel cage motors shall be required, in addition to switching 'ON' of the lighting loads, which will be six times the rated load at power factor of 0.35 lagging. The generator and its accessories shall be capable of supplying this load at the above mentioned low power factor. Limitations, if any, shall be clearly indicated by the Contractor.
- 6.3.5 The transient reactance shall be as low as possible to limit the voltage drop to 10% due to above loading conditions.

6.3.6 Largest Motor Starting Requirement

The D.G. set shall be designed such that it can start squirrel cage induction motor of specified rating by D.O.L. starting method when already loaded up to 80% of its rated load. The voltage dip at the generator terminal shall not exceed 10% of its rated voltage

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during the entire starting period which will not exceed 5 seconds.

Limitations of the engine size offered by the bidder, if any, shall be indicated clearly by the bidder.

Supporting calculation shall be supplied by the successful bidder for approval of the owner.

6.3.7 The short circuit ratio, of the generator at rated KVA and rated voltage shall not be less than 0.5.

6.3.8 The generator shall withstand 20% over speed for 2 minutes without any damage to any part.

6.3.9 The generator shall be capable of withstanding the three phase short circuit at its terminals while operating at its voltage without sustaining any damage.

6.3.10 The temperature rise of stator windings, exciter and other parts shall not exceed the limits specified in relevant IS.

6.4 **Excitation System**

6.4.1 The generator shall be provided with static brushless excitation system comprising of shaft driven rotor exciter, thyristor and other associated items.

6.4.2 The armature and field windings shall be class F insulated similar to that of generator.

6.4.3 The capacity of the system shall be adequate to meet the performance and largest motor starting requirement of the generator.

6.4.4 The AVR shall maintain the generator steady state terminal voltage within $\pm 1\%$ of nominal voltage for load variation from no load to full load at 0.8 P.F. (Lag) and for speed variation of 4.5%. Manual voltage trim facility for voltage adjustment of $\pm 5\%$ shall be provided for the AVR.

6.5 **Voltage Regulator**

6.5.1 The generator shall have static type voltage regulators to be mounted on the control panel. The regulator system shall be suitable to meet the following requirements:

- a) Allow the generator to meet the performance requirements.
- b) Both auto and manual control.
- c) Prevent automatic rise of field voltage in the event of excitation supply failure.
- d) Transfer to manual mode in the event of control circuit failure in auto mode.
- e) Operated by the output current and voltage of the generator.



6.6 **Space Heater**

6.6.1 Space heaters rated for 240V A.C. shall be provided to keep the winding dry during idle conditions.

6.6.2 The location of the space heaters shall be such as to allow easy access for inspection, maintenance and replacement.

6.7 **Embedded Temperature Detectors**

6.7.1 The generators shall be provided with 6 nos. of embedded resistance temperature detectors for measurement of winding temperature. Three of these shall be provided between the coils, one in each phase and the other three at the base of the slots, one in each phase, placed 120° apart.

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6.7.2 The ETD's shall be of platinum having 100 ohm resistance at 0°C and temperature coefficient as 3.85×10^{-5} .

6.7.3 The ETD's shall be 3 lead type having power frequency insulation level of 2 KV.

6.7.4 The temperature indicator with selector switches shall be provided in the control panel.

6.8 Terminal Boxes

6.8.1 All the terminal boxes shall have IP-54 degree of protection.

6.8.2 The power and control terminal boxes shall be separate. All the six leads of the generator stator shall be taken out, three to one side and three to the other side to separate power terminal boxes.

6.8.3 The power terminal box shall be spacious and have adequate clearance between the terminals and the cable gland for proper termination of required nos. of aluminium cables.

6.8.4 The power terminal boxes shall be provided with tinned copper sockets suitable for crimping.

6.8.5 The control terminal boxes shall be provided with pressure type terminal blocks.

6.8.6 All terminal boxes shall be complete with heavy duty double compression type aluminium cable glands suitable for the cable sizes required.

7.0 CONTROL PANEL BOARD

7.1 Requirements

7.1.1 The control panel board shall comprise of control & instrument section, power & protection section and distribution section for satisfactory and trouble free operation of the set. Each section shall be a complete panel.



7.1.2 The control and instrument panel shall house the following:

- a) All the required controlling elements for the engine, generator and exciter control, for both manual and automatic operations.
- b) Panel mounted instrument
- c) The required protective devices for the engine.
- d) The audiovisual annunciation system indicating abnormal operating conditions.
- e) Control switches and indicating lamps.
- f) Automatic voltage regulator.
- g) All other items, as required.

7.1.3 The power and protection panel shall house the following:

- a) Circuit breaker in draw out execution suitable for local/remote operation and provided with protective relays, C.T.s Ammeters, Voltmeters, KWH meters, Frequency meters, ON/OFF/Trip indicating lamps, control switches etc. for the control of generator.
- b) M.W.S. operated A.C.B. in draw-out execution suitable for local remote operation and provided with protective relays, C.T.s, Ammeters, ON/OFF/Trip indicating lamps, control switches etc. for the control of outgoing power feeders, as indicated else where.

7.1.4 The distribution panel shall house the following:

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- a) Necessary feeder circuit outlets complete with switches, fuses, contactors, overload devices, ON/OFF/Trip indicating lamps, Ammeters etc. for the D.G. set auxiliaries, if required.
- b) D.C. battery charging equipment required for the start up and control of the D.G. set. The charger shall be complete with float and boost charging arrangement both in auto and manual mode.

7.2 General Design Features

- 7.2.1 The panels shall be free standing, floor mounting, identical, metal clad cubicle type in construction and placed side by side to form a compact assembly in dust/ damp and vermin proof type equivalent to IP-54 as per IS-13947 Part-1.
- 7.2.2 The thickness of sheet steel members shall not be less than 2 mm for cold rolled steel. Suitable reinforcement, wherever necessary, shall be provided. The base channel shall be more than 3 mm thick.
- 7.2.3 The door hinge shall be concealed type. All threaded screws in the removable parts shall be provided with retaining rings.
- 7.2.4 All the components shall be accessible for checking and taking off without the necessity of removing the adjacent ones. Their mounting shall be accessible and ensure the necessary degree of safety.
- 7.2.5 The relays, meters, switches and lamps shall be flush mounted type. Their minimum mounting height shall be 900 mm from the base of the panel.
- 7.2.6 The bus bars shall be for three phase and neutral and made of electrolytic copper or aluminium of required cross section and PVC sleeved. These shall be amply sized to carry the rated continuous current under the specified ambient temperature without exceeding the total temperature of 90°C. The thermal rating of the bus bars shall be designed to withstand the system fault current for one second without exceeding the temperature of 250°C for bare copper.
- 7.2.7 The clearances and creepage distance shall not be lower the values specified below:

7.3 Control Wiring



- 7.3.1 The panel board shall be completely factory wired and ready for external connections.
 - 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.
- 7.3.2 The wiring shall be carried out with flexible stranded PVC insulated copper conductor cables for 1100 volts grade.

The size of wires shall be as follows:



C.T. Circuit - 2.5 sq. mm copper

V.T. & Control circuits - 1.5 sq. mm copper
- 7.3.3 All wiring shall be marked in accordance with IS-375. 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.

7.4 Circuit Breakers

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- 7.4.1 The circuit breakers shall generally comply with the requirements of IS: 13947, having P2 category, capable of carrying the specified current at the site conditions and making/breaking of the system fault current.
- 7.4.2 Type test certificates from an independent testing authority shall be furnished along with the offer, for each circuit breaker rating, which shall clearly prove the capability of circuit breakers and include the short circuit tests, temperature rise test, electrical overload tests and endurance test (both electrical and mechanical).
- 7.4.3 The circuit breakers shall be provided with motor wound spring closing mechanism and electrically and mechanically trip free and have anti pumping features.
- 7.4.4 The circuit breakers shall have three positions for service, test and isolated with the cubicle door closed, and position indicators provided to indicate the positions of the breaker. Stoppers shall be provided to prevent excessive movement of the breaker cradle than desired, for each position. Each position of the breaker shall have monitoring switch having 1 NO + 1 NC contacts.
- 7.4.5 Provision shall be made for testing the circuit breaker in test position.
- 7.4.6 Automatic safety shutters shall be provided to screen the cable and the bus bars spouts when the circuit breaker is withdrawn from the cubicle.
- 7.4.7 The circuit breakers shall be provided with an emergency manual trip device, mechanical 'ON' 'OFF' and 'ISOLATED' position indicators and operation counter.
- 7.4.8 Mechanical safety interlock shall be provided for safe operation movement of the breaker.
- 7.4.9 The closing coil and other associated auxiliary relays shall operate satisfactorily at all voltages between 85 to 110% of the rated control voltage. The tripping coil and other associated relays shall operate satisfactorily at all voltages between 70 to 110% of the rated control voltage.
- 7.5 **Control Fuses**
- The fuses shall be of non-deteriorating HRC cartridge link type and conform to IS: 2208. They shall be suitable for the load and the service required in the circuit.
- 7.6 **Current Transformers**
- 7.6.1 C.T's shall be cast resin emulated, accuracy class as per IS-2705, 1 for metering and SP/PS for protection.
- 7.6.2 All the C.T's shall be provided with terminals and shorting links. One of the terminals of the C.T.s shall be earthed. The polarity of the C.Ts shall be clearly marked.
- 7.7 **Voltage Transformer**
- The V.T. shall be cast resin insulated having secondary terminal voltage of 110V unless specified otherwise and accuracy class of shall be 1 as per IS: 3155 and provided with primary / secondary fuses.
- 7.8 **Relays**
- All protective relays shall be provided in drawout and dust proof cases and shall be flush mounted type. They shall be fully tropicalised. Relays shall be of make and type as approved.
- The following protective relays shall be provided.
- i) IDMTL over current and Residual earth fault.

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- ii) IDMTL standby earth fault.
- iii) Over voltage or under voltage
- iv) Reverse power
- v) Hand reset tripping relay

7.9 **Battery Charger**

The charger shall be float cum boost, 415V, 3ph with fully controlled full wave rectifier type. The battery charger is required to provide 24V DC control supply and to charge the boost / float 24V Ni-Cd / SMF batteries. DG set battery (Ni-Cd/ SMF) shall be dedicatedly used for DG related power & auxiliary supply. Ampere hours shall be worked out with at least 30% spare capacity and 1 hours backup time.

- 7.9.1 The AMF control panel shall be complete with necessary control circuit fuses, nameplates, internal wiring, control terminals and cable glands & lugs.
- 7.9.2 The AMF control panel shall have provision for receiving starting impulse for the DG set from DG Power Distribution Board as well as to send out tripping impulses from AMF panel to the DG incomer breaker on DG Power Distribution Board.
- 7.9.3 All cable entries to the AMF panel shall preferably be from the bottom.
- 7.9.4 Automatic shutdown feature shall be provided for faults such as low lube oil pressure/ over speed/ high water temperature.



7.10 **Instruments and Metering**

- 7.10.1 All instruments shall be flush mounting type with square face of 96 sq. mm. They shall be tropicalised and dust tight. Make and type of instruments shall be as approved.
- 7.10.2 Marking of the scale shall be black on white background and suitable for direct reading.
- 7.10.3 Zero adjusters shall be provided for operation from the front of the cases.
- 7.10.4 All indicating instruments shall be moving iron spring controlled type of class 1.5 accuracy as per IS: 1248.
- 7.10.5 The KWH meter shall be as per relevant IS and provided with test blocks for current and voltage coils for testing them at site without interrupting their recording while in service.
- 7.10.6 The following instruments shall be provided.
 - i) Voltmeter with selector switch
 - ii) Ammeter with selector switch
 - iii) Frequency meter
 - iv) KW meter
 - v) KWH meter

7.11 **Signal Lamps**

LED type signal lamps shall be provided to indicate the various circuit conditions and these shall be placed at suitable height. The colour of the lamps for various functions shall be as follows:

Red	-	Circuit breaker 'ON'
Green	-	Circuit breaker 'OFF'
White	-	Trip circuit healthy
Amber	-	Alarm and auto trip fault
Blue	-	Non trip fault

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7.12 **Name Plate**

7.12.1 The panel board shall have a large name plate on the top to indicate its name and designation. Each feeder shall be provided with name plates. Each panel shall have name plates both in front and back.

7.12.2 All control switches, push buttons, lamps etc. shall have function identification labels.

7.13 **Cable Termination**



Necessary cable glands and lugs for power and control cables shall be provided.

8.0 INSTRUMENTATION

8.1 The instrumentation requirement shall include field / panel mounted instruments, push buttons, lamps, audio-visual alarm system and other accessories as required.

8.2 The provision required in the control panel board shall include the followings:

- i. Multipoint electronic self balancing temperature indicator with selector switch for generator winding.
- ii. Tachometer for engine speed.
- iii. Fuel oil day tank level indicator.
- iv. Audio-visual alarm system for:
 - a) Low lube oil pressure
 - b) Over speed of engine
 - c) High jacket water temperature
 - d) Low jacket water pressure
 - e) Winding temperature high
 - f) All shutdown condition
 - g) Other abnormal conditions, as required
- v. Shutdown system for:
 - a) Maximum jacket water temperature
 - b) Engine over speed
 - c) Minimum lube oil pressure
 - d) High winding temperature
 - e) Generator faults
 - f) Faults in the excitation system
 - g) Failure of engine to start after a preset time
 - h) Other faults, as required
- vi. Excitation control system complete with:
 - a) Rheostat for manual control
 - b) Automatic voltage regulator
 - c) Field discharge resistance
 - d) Diodes / Rectifiers
 - e) All other items, as required

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vii. Engine control system complete with:

- a) Auto / manual switch
- b) Control equipment and circuitry for Auto Mains Failure starting other than for type 'C' sets.
- c) Push buttons and other control equipment for manual start.
- d) Equipment and circuitry for pre-start priming, if required.
- e) Equipment and circuitry for repeated attempt to start.
- f) Indicating lamps for fail to start.
- g) Audio visual alarm as specified and required.
- h) Instrumentation as specified and required
- i) Operation hour counter
- j) All other items, as required

8.3 The field mounted instruments shall include the followings:

- a) Pressure gauge for lube oil
- b) Dial type thermometer for jacket water and various bearings.
- c) Tachometer for engine speed.
- d) Fuel oil day tank level indicator.
- e) Other items, as required.

8.4 The supply shall be complete with all instrument erection materials with 10% extra provision.

8.5 All instruments, shall be suitable for site maximum ambient temperature, All electrical and electronic instruments shall be tropicalised and fungus proof.

9.0 ACCESSORIES

The D.G. set shall be complete with all required accessories, whether indicated or not, to make the installation complete in all respects and to ensure its safe and proper operation.

10.0 PAINTING

The enclosures, after suitable pre-treatment, shall be painted with two coats of anti rust paint followed by two coats of anti-corrosive epoxy based paints.

11.0 TOOL KIT

Special tool kit for the DG Set required for operation & maintenance of DG set shall also be supplied along with DG set.



12.0 TESTS AND INSPECTION

12.1 All routine tests as per relevant standards shall be carried out in the presence of Owner's representative.

12.2 The D.G. set shall be tested for output, general performance, overloads and other tests sufficient to prove the correctness of the design both at works and at site.

12.3 The tests to be carried out on various items are given below.

- a) Diesel Engine

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- Routine test as per relevant Indian / British / National standards.
- Test for speed regulation with a sudden loading of 50% of rated capacity with zero base load.
- Starting time of the engine from zero to full speed from the instant of start command.
- Operation check for satisfactory operation of the DG set.
- Over speed test at 120% rated speed and over speed trip.
- Load test and measurement of fuel oil consumption.
 - 100% load for 4 hrs.
 - 110% load for 1 hr.
 - 75% load for 1/2 hr.
 - 50% load for 1/2 hr.

All parameters such as jacket water temp., lube oil pressure and temperature will be checked.

b) GENERATOR

- Routine test as per IS 4722.
- Voltage regulation from no load to full load.
- Voltage trimming facility check.

c) Control Panel

- Routine tests as per IS 3623.
- Operation tests for AMF operation, operation of various devices and meters etc.

12.4 In addition, the equipment shall be subjected to stage inspection during process of manufacture at works and site inspection.

12.5 These inspections shall, however, not absolve the Contractor free from his responsibility for making good any defect which may be noticed subsequently.

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 Spares for 2 Years operation (Mandatory), as specified shall be supplied.



13.3 Recommend 2 years Operational Spares (other than mandatory spare) along with 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 PACKING

14.1 The equipment shall be properly packed before despatch to avoid damage during transport, storage and handling.

14.2 The equipment shall be wrapped in polythene to make it water proof. Bags of silica gel shall be kept inside to absorb moisture present during transport and storage. An additional wrapping with bitumen paper shall also be provided before the equipment is packed in wooden crates.

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14.3 A sign indicating the position of the equipment placed during transport and storage shall be clearly marked. Also proper arrangement shall be provided to handle the equipment.

15.0 DRAWING AND DOCUMENTS

15.1 Drawings and documents as per Annexure-I shall be supplied unless otherwise specified.

15.2 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

16.0 DEVIATIONS

16.1 Deviations, if any, from this standard shall be clearly indicated in the offer with reasoning.

ANNEXURE – I



DOCUMENTATION FOR DIESEL GENERATOR SET

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	General arrangement and foundation drg. for all the equipment.	N	Y	Y
4	Civil scope drawings	N	Y	Y
5	Earthing layout	N	Y	Y
6	Terminal arrangement drg. and Interconnection.	N	Y	Y
7	Sectional view of D.G. Set	N	N	Y
8	Illustrative and descriptive literature.	N	N	Y
9	Catalogue for bought out accessories.	N	N	Y
10	Installation operation & maintenance manual	N	N	Y
11	Type test certificates for engine, alternator and circuit breaker	N	N	Y
12	Guarantee certificate	N	N	Y
13	Spare parts list with identification	N	N	Y
14	Calculations for justifying DG set size offered with respect to load and starting of largest load.	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



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**TECHNICAL SPECIFICATION
ELECTRICAL POWER SYSTEM STUDIES**

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2.6	STUDY REPORT
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1. GENERAL

1.1. Purpose

The purpose of this document is to identify the scope of work for Power System Study work for Talcher Fertilizers complex at Anugul, Odisha.

1.2. Scope

POWER SYSTEM STUDY shall also provide a list of recommendations for equipment selection and operation configuration. The recommendations will be reflected in the detailed engineering design by Electrical LSTK Contractor.

1.3. Abbreviations



OPTCL	-	Odisha Power Transmission Company Ltd.
TPCODL	-	TP Central Odisha Distribution Ltd
BIL	-	Basic Insulation Level
COP	-	Code of Practice
CRS	-	Comment Resolution Sheet
EMTP	-	Electro Magnetic Transient Program
EPC	-	Engineering, Procurement and Construction
ETAP	-	Electrical Transient & Analysis Program
FMS	-	Fault Monitoring System
HSE	-	Health Safety and Environment
IEC	-	International Electro-technical Commission
IEEE	-	Institute of Electrical and Electronics Engineers
NER	-	Neutral Earthing Resistor
NET	-	Neutral Earthing Transformer
OHL	-	Overhead Transmission Line
RFI	-	Request For Information
SCMS	-	Substation Control and Monitoring System
SLD	-	Single line diagram
SOW	-	Scope of Work
SWG/SWGR	-	Switchgear

2. CODES AND STANDARDS TO BE FOLLOWED

2.1. Practices, Codes and Standards

Studies shall be carried out as per the latest revision of IEC and IEEE standards. Standards mentioned below are the minimum to be followed.

Standard/Practice No	Description
IEEE Std. 399	IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis
IEC 60909	Short-circuit currents in three-phase a.c. systems
IEEE 1584	IEEE Guide for Performing Arc-Flash Hazard Calculations

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IEC 60071	Insulation coordination
IEEE Std. 519	IEEE Recommended Practices & Requirements for Harmonic Control in Electrical Power Systems
IEEE C37.011	IEEE Application Guide for Transient Recovery Voltage for AC High Voltage Circuit Breakers
IEEE Std 142	IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems

2.2. General

The section describes the understanding of different studies and general methodology to be applied for each study. It is the POWER SYSTEM STUDY's responsibility to perform the studies and provide recommendations as per industry standards and best engineering practices, such that the overall system proposed is safe, reliable to operate and to the satisfaction of COMPANY.



The system study has to be carried out in 02 Phases. In First Phase, broad study has to be done viz. Load Flow study, Short Circuit Study, Motor Starting study, etc. to finalise the sizing of various Electrical equipments & their Fault Level, etc.

In second or final study complete system study to be done as listed below:

- Load flow studies (includes recommendations for transformer tap settings).
- Short circuit studies for 3 phase and single phase faults.
- Transient motor starting studies for critical and large motors including support required for the drive motor starting selection
- Motor re-acceleration studies (Including motor on EDG Bus when motors are started on EDG power supply)
- Transient stability studies
- Harmonic study and recommendation of filter if required
- Power factor correction requirement
- Arc flash studies
- Insulation coordination studies
- Protection relay coordination
- Cable temperature rise simulation.
- Voltage profile
- Operation philosophy
- Adequacy of all protection functions in the complete electrical network.
- Recommendation for equipment parameters & operational restriction in the electrical network, if any.
- Lighting Risk Assessment Study & mitigation methodology.

Also, Power system study consultant shall carry out study for the modifications of relay settings:

- at the modified feeders and

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- at all upstream and downstream interface points of the existing switchgear assemblies

The POWER SYSTEM STUDY's scope also includes required Data collection from various sources and verification of the collected data. May need to do site visit, if require to collect the data.

POWER SYSTEM STUDY's detailed scope of services is as described in the following sections.

2.3. Power System Studies

The POWER SYSTEM STUDY shall provide the following study reports for the facility under consideration and include appropriate recommendations:

2.3.1. Load Flow Study

The objective of the load flow study shall be to calculate voltages in the network and power (MW/MVAR/MVA) flows in normal operating steady state condition. Also the study shall analyse the behaviour of the electrical network under different operating and loading conditions. It shall reveal the voltage profile across the network, power flow in branches that are useful for checking the rating of various equipments and also reveal the loading behaviour of the various equipments in the network.

This study will be used for checking transformer sizing to ensure that steady state voltage is maintained within acceptable limits and equipment will operate within design rating. The study shall also include the recommendations for transformer tap settings.

Load flow study shall determine the load flows in the system, specifically voltage, current, active and reactive power, power factor in the system for all probable operating conditions.

2.3.2. Short Circuit Study

The short-circuit calculations shall be performed according to IEC 60909-2000, with consideration of the motor contribution and the decaying DC, as well as sub transient and transient components of the generator currents.

The objective of the short circuit study shall be to determine the performance of the electrical system under short circuit conditions. The fault level calculation at various locations in the electrical network shall provide basis for sizing the electrical equipment short circuit rating and check the suitability.

The analytical short circuit study covers the fault level at main buses in electrical distribution system for all probable operating conditions.



2.3.3. Motor re-acceleration studies

Shall conduct a motor starting study for starting the largest motor on Normal & Emergency Bus at all Voltage level of each unit along with its selected cable for verifying voltage drop at the motor terminals is within limit.

2.3.4. Transient stability studies

The transient stability analysis shall be carried out to check the effects of three-phase short circuits at various locations on the operation of generators and motors in the OPTCL's power system. The transient stability performance shall be quantified by the Critical Fault Clearing Time (CFCT), which is the maximum permissible fault duration without generator unit synchronism loss. For industrial networks with a high share of motor load, the transient stability performance includes also a criterion related to the maximum fault duration after which a re-acceleration of process-essential motors.

Shall conduct transient stability analysis for all probable operating conditions.

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2.3.5. Harmonic study and recommendation of filter if required

The objective of this study shall be to verify the suitability of harmonic filter selected to be connected at the 220kV, 33 kV & 11KV level at all substations designed to limit the influence of parallel resonances and to absorb harmonic currents from the non-linear loads at Mender.

Shall conduct the Harmonic study for all probable operating conditions .

2.3.6. Power factor correction requirement

This study shall be conducted the power factor correction requirement for the target power factor for entire plants on the 33 kV & 11KV bus is within $0.95 \leq \cos \phi \leq 1.0$ under normal operating conditions with final power system configuration and loads and for all probable operating conditions.

2.3.7. Arc flash studies

The Arc Flash Hazard Analysis to be performed for all HV and LV switchboards to provide the calculated arc flash hazard of the particular equipment as installed and to provide labels for the use of maintenance personnel in determining the proper protective equipment to wear.

Shall submit Arc Flash PPE Purchase advisory report along with the Power System Study report with full Compliance of NFPA 70E and OSHA 1910 Arc Flash Regulations.

2.3.8. Insulation coordination studies

The Insulation coordination study shall assess the required insulation level for the 220KV, 33 kV & 11KV of all substation and to consider any route or configuration change in OHL during detailed engineering.

Over voltages simulation shall be performed for the new 220 kV OPTCL lines and substation and the study shall confirm the selection criteria for the 220 kV surge arresters.

For 33 kV voltage level, the standard rated short-duration power frequency and the lightning impulse withstand voltages shall be as specified in IEC standard 60071-1.

The selection of the insulation level shall be based on procedure explained in IEC 60071-2 and requires the determination of the representative over voltages values.

2.3.9. Protection relay coordination studies

Protective Device Coordination Studies shall be carried out for the entire Fertilizer Complex starting from 220KV to 415V to provide correct discrimination between all breakers & Protective devices .

Appropriate settings shall be calculated for each relay and the characteristics of the protective devices on the circuit branch under consideration compared to ensure the required discrimination.



The protective relays on EHV, HV & LV Switchboards shall be micro-processor based Numerical type.

The final electrical system co-ordination study shall be done during detail engineering stage utilizing all final vendor data of corresponding Switchboards.

Has to submit a separate report for Relay coordination study which includes protection settings and related coordination Graphs, as applicable for all protection functions as mentioned in respective Single Line diagrams of all the EHV, HV & LV Switchboards (220 kV, 33 kV, 11KV, 3.3KV and 415V).

2.4. Software

Latest versions of ETAP softwares shall be used for Electromagnetic switching transients and Neutral Earthing system study

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As part of the report, descriptive bulletins and technical brochures shall be provided for the software used. Each calculation module of the software shall be identified and appropriate information provided.

Data collection

This task comprises the collection, compilation and verification of network data required for the studies in LSTK Contractor's scope. Certain details of the data requirements and data collection process will be discussed and agreed during the Sytem Study.

Contractor has to provide a detailed list comprising all data items and their need dates required for successful completion of the studies.

2.5. Basis and assumptions

The rationale behind the use of pertinent data and / or assumptions made in developing the calculations shall be incorporated in the introductory remarks of the study.

2.6. Study report

Study report shall extensively cover the following as a minimum:

- Introduction
- Executive summary
- Objectives
- Relevant standards and references
- Basic theory, study methodology and background of the studies performed
- Assumptions, including basis of assumptions
- Software used
- Input data for modelling
- Study criteria model and calculation methods
- Different operating cases/scenario analysed
- Study results summarized - Tabulation of calculated quantities
- Recommendations and Conclusion for implementation of study results
- Software outputs

2.7. Submittals for Record

Contractor shall provide the native file, including editable System Model (without password protection) along with all the calculation at all the three stages i.e. preliminary, intermediate and final.

The final report shall also be provided in native file as well as PDF format on 2 Nos. USB Drive.



**ELECTRICAL DISTRIBUTION SYSTEM
TALCHER FERTILIZERS LIMITED
TECHNICAL SPECIFICATION – 220 kV GIS (PC183-TS-0832A)**

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TECHNICAL SPECIFICATIONS 220KV GAS INSULATED SWITCHGEAR



CONTENT

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1.0 SCOPE

- 1.1 The specification covers scope of design, engineering, fabrication, manufacturing, inspection and testing before supply, transportation, delivery at destination, unloading & storage at site, site erection, site testing, commissioning and putting in to successful operation of Gas Insulated Switchgear (GIS) complete with all materials and accessories.
- 1.2 This specification shall be read in conjunction with attached specification sheet /data sheet.

2.0 CODES AND STANDARDS

- 2.1 The GIS equipments / components used shall comply with the requirements of latest revision of the following standards and also the other Indian and International Standards as applicable, unless otherwise specified:

IEC 60060	High voltage test techniques
IEC 60071	Insulation coordination
IEC 60255	Electrical Relays
IEC 60099 – 4	Metal-oxide surge arresters without gaps for a.c. systems
IEC 60137	Bushings for alternating voltages above 1000 V
IEC 60114	Recommendation for heat treated Aluminium Alloy busbar material of the aluminium-magnesium-silicon type
IEC 60255	Electrical Relays
IEC 60270	High-voltage test techniques - Partial discharge measurements
IEC 60376	Specification of technical grade sulphur hexafluoride (SF ₆) for use in electrical equipment
IEC 60480	Guidelines for the checking and treatment of sulphur hexafluoride (SF ₆) taken from electrical equipment and specification for its re-use
IEC 60529	Degrees of protection provided by enclosures (IP Code)
IEC 60694	Common specifications for high-voltage switchgear and controlgear standards
IEC 61128	Alternating current disconnectors, Bus transfer current Switching by disconnectors
IEC 61634	Use and handling of SF ₆ Gas
IEC 61869-1	Instrument transformers — General requirements
IEC 61869-2	Additional requirements for current transformers
IEC 61869-3	Additional requirements for inductive voltage transformers
IEC 62271-4	Handling procedures for sulphur hexafluoride (SF ₆) and its mixtures
IEC 62271-100	Alternating current circuit-breakers
IEC 62271-102	Alternating current disconnectors (isolators) and earthing switches
IEC 62271-104	Alternating current switches for rated voltages of 52 kV and above
IEC 62271-110	High-voltage switchgear and control gear - Inductive load switching

IEC 62271-203 Gas Insulated metal-enclosed switchgear for rated Voltages above 52kV

IEC 62271-209 Cable connections for gas-insulated metal-enclosed switchgear for rated voltages above 52kV-Fluid filled and extruded insulation cables-Fluid filled and dry type cable terminations

IEC 62271-211 High-voltage switchgear and controlgear - Part 211: Direct connection between power transformers and gas-insulated metal-enclosed switchgear for rated voltages above 52 kV

IEEE 80 Standard for station grounding

IEEE std. C37.122.1-1993 IEEE guide for Gas Insulated substations

IEEE STD 693 Guidelines to ensure functional adequacy under Seismic disturbance

2.2 The equipment shall also conform to the provisions of CEA regulations and other statutory regulations currently in force in the country.

2.3 In case of any contradiction between various referred standard/ specification/ data sheet and statutory regulation, most stringent requirements shall prevail. However, Owner's decision in this regard will be final and binding.

2.4 Item not covered and required shall confirm to the latest issue of IS/IEC.

3.0 SERVICE CONDITIONS

3.1 Ambient Condition

3.1.1 The 220kV GIS and the accessories to be supplied against this technical specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

Max /Design ambient temperature	: 50 deg C
Min. ambient temperature	: 1 deg C
Max daily average ambient temperature	: 46 deg C
Max relative Humidity (%)	: 100%
Max altitude above M.S.L (meters)	: < 1000
Condensation	: Occasional
Induced electromagnetic disturbance	: 1.6 kV
Pollution class	: IV
Creepage distance	: 31 mm/kV
Seismic Zone	: Zone IV

3.1.2 The EHV GIS shall be suitable for installation and satisfactory operation in a pressurised substation or in a substation with restricted natural air ventilation in a tropical, humid and corrosive atmosphere.

3.2 System Details

3.2.1 The required overall parameters of GIS shall be as follows:

Parameter	Unit	Value
Rated System Voltage	KV	220 ± 12.5%

Highest System/Equipment Voltage	KV	245
One min. Power frequency withstand Voltage	KVrms	460
One min. Power frequency withstand Voltage across Isolating contact	KVrms	530
Rated Lightning Impulse withstand voltage	KVp	1050
Rated Lightning Impulse withstand voltage across Isolating contact	KVp	1200
Rated Frequency Hz 50	Hz	50 ± 5%
Rated Continuous current at 50 deg C	Amp	1600
Feeder and Transformer Bay	Amp	1600
Rated Short circuit Withstand current for 3 sec	KA	50
Rated dynamic withstand current	KA	128
System Neutral earthing	-	Solidly Earthed
Maximum SF6 Gas leakage rate per year	% per year	As per IEC

3.2.2 Auxiliary supply voltage.

For Operation, control and signalling 110 Volts DC (+10% & -20%)

For other loads 415 / 230 Volts (+/-10 %), AC 50 Hz

4.0 Operational Requirement

4.1 All equipments shall be suitable for continuous duty operation at the specified rating under the specified ambient conditions and system detail and operating condition including sudden change of load and voltage without exceeding permissible limit of temperature as per relevant standard.

4.2 The assembled equipment shall be capable of withstanding the electrical, mechanical and thermal ratings of the specified system. All joints and connections shall be required to withstand the forces of expansion, vibration, contraction, and specified seismic requirements without deformation or malfunction and leakage. The apparatus shall be capable of withstanding the specified environment.

5.0 General Requirement of Design, Construction and Performance

5.1 GIS shall consist of line bays and transformer bays as indicated in the Conceptual single line diagram attached. Provision shall also be made for additional bays one on each side (without equipments) over and above bays shown in SLD.

5.2 Enclosures

5.2.1 The switchgear shall be of the free-standing, self-supporting, dead-front, double bus design with all high-voltage equipment installed inside gas-insulated metallic grounded enclosures and suitably sub-divided into individual arc and gas-proof compartments.

5.2.2 The SF6 GIS shall be of INDOOR type. The degree of protection shall be at least IP65 for gas compartments and IP4X for low voltage and other compartments as specified in IEC-60529.

- 5.2.3 The metal enclosures for the SF6 gas insulated equipment modules shall be made of non magnetic material i.e. Aluminium alloy. The enclosure shall be suitable for 3 Nos. Single Phase encapsulation. The busbar can be single phase/three phase encapsulated as per type tested design and Type Test Certificate shall be submitted. The external fixtures should be made of corrosion resistant material and should be capped where required. Bellow compensators shall be made of Stainless steel to preserve the mechanical strength of the equipment at the connection portions under all condition.
- 5.2.4 Suitable anti corrosive paint shade RAL 7035 shall be used with satin mat finish having high scratch resistance. Sufficient quantities of all paints and preservatives required for touching up at sites shall be furnished
- 5.2.5 Gas section barriers including seals to the conductor and enclosure wall shall be gas-tight and shall be capable of withstanding the maximum pressure differential that could occur across the barrier. These shall also not contain any substances which could contaminate the enclosed gas or affect its insulating properties over a period of time.
- 5.2.6 The enclosure shall be designed to practically eliminate the external electromagnetic field and thereby electro-dynamic stresses even under short circuit conditions.
- 5.2.7 The switchgear shall have earth bus for connection to the plant earth grid.
- 5.2.8 The SF6 gas insulated metal enclosed switchgear shall be totally safe against inadvertent touch of any of its live constituent part.
- 5.2.9 Whenever possible, the complete feeders or major assembly of components should be shipped as transport units.
- 5.3 Modular Design**
- 5.3.1 The GIS switch gear shall be of modular design offering high degree of flexibility. Each module shall be complete with SF6 gas circuit breaker, Disconnectors, Maintenance Grounding switches, fast Earthing switches, voltage transformers, Current transformers, bus & elbow sections, cable end enclosures, L.A., local control cubicle and all necessary components required for safe & reliable operation and maintenance.
- 5.3.2 Bus bars are partitioned at each bay with an objective to isolate Busbar compartment for the purpose of extension and at the same time avoid damage to adjacent bays in the event of fault. Bus bar extensions shall be possible with the offered arrangement without a shutdown of the substation.
- However, if the bus bar compartment does not contain any disconnect switches in it, gas barriers are not required in between two bays in the busbar section and busbar arrangements should be formed in such a manner that extension works are possible without a shutdown of the substation.
- 5.3.3 Arc faults caused by external reasons shall be positively confined to the originating compartment and shall not spread to other parts of the switchgear. In case of any internal arc fault in a busbar, busbar disconnector or circuit breaker, of double bus system, repair works shall be possible without shutting down complete substation and at least one busbar and the undisturbed bays must remain in operation.
- 5.3.4 Each bay module should be equipped with suitable arrangement for easy dismantling and refitting during maintenance without disturbing other units.
- 5.3.5 There shall not be any kind of interference to the connected & nearby equipment and system, when the equipment is operated at maximum service voltage.
- 5.3.6 All the operating mechanisms of CB, DS, ES & HSES shall be mounted on the individual equipment for better reliability.

5.4 **Maintenance and repair of a circuit breaker:**

The positioning of the circuit breaker in the GIS shall be such that it shall be possible to access the circuit breaker of any feeder from the front side for routine inspection, maintenance and repair without interfering with the operation of the adjacent feeders. The GIS shall be so designed that any component of the GIS can be removed easily.

Internal components shall be maintenance free for at least 10 years. Routine replacement of insulating gas shall not be required in less than ten years.

5.5 **Interchangeability**

As much as possible, all the parts shall be of standard manufacture with similar parts and assemblies being interchangeable.

5.6 **Future Extension**

The modular design of GIS switch gear shall be capable of extension in the future on either end by the addition of extra feeders, bus couplers, busbars, circuit breakers, Disconnectors, and other switch gear components without drilling cutting, welding or dismantling any major part of the equipment.- The arrangement shall be such that expansion of the original installation can be accomplished with minimum GIS down time. In case of extension, the interface shall incorporate facilities for installation and testing of extension to limit the part of the existing GIS to be re-tested and to allow for connection to the existing GIS without further dielectric testing.

5.7 **Physical arrangement**

5.7.1 The layout shall be properly designed by the bidder to completely accommodate the present & future requirements of the sub-station as per the furnished single line diagram. These may be adjusted as necessary to suit the manufacturer's standard design.

5.7.2 The arrangement of the switchgear offered must provide adequate access for checking and maintenance.

5.7.3 Optimized arrangements are required so as to reduce installation time, minimize maintenance & repair cost, provide ease of operation and facilitate future expansions.

5.7.4 The number of transport/shipping splits shall be minimized to keep installation time of GIS to a minimum. The arrangement shall afford maximum flexibility for routine maintenance. Equipment removal and SF6 handling should be accomplished with ease. The ease of operation shall be ensured.

5.8 **Gas Sectionalisation**

5.8.1 The switch-gear gas enclosures must be sectionalized, with gas tight barriers between sections or compartments.

5.8.2 The sections shall be so designed as to minimize the extent of plant rendered inoperative when gas pressure is reduced either by excessive leakage or for maintenance purposes and to minimize the quantity of gas that has to be evacuated and then recharged before and after maintaining any item of equipment.

5.8.3 The arrangement of gas sections or compartments shall be such that it is possible to extend existing bus-bars without having to take out of service another section of the bus-bar at a time.

5.8.4 For limitation of any internal arc to the concerned bay and to reduce the extent of necessary gas works of each section of the bus-bar must be sectionalized bay by bay.

To reduce the possibilities of any internal arc, the bus bar chamber should not house in it any switching devices such as disconnect switches.



5.8.5 Sectionalisation shall ensure that circuit breaker enclosure will not include any other equipment in its gas compartment.

5.9 Expansion Joints and Flexible Connections

5.9.1 The layout shall sufficiently take care to the thermal expansion / contraction of the assembly by the provision of expansion joints. Expansion joints shall be placed in between any bay section of the busbar.

5.9.2 The number and position of expansion joints or flexible connections shall be determined by the manufacturer to ensure that the complete installation will not be subject to any expansion stresses which could lead to distortion or premature failure of any piece of the SF6 equipment, support structures or foundations. Bracing shall be provided for all mechanical components against the effects of short circuit currents specified under system parameter. The design calculations for all the supports shall be submitted.

5.9.3 The continuity of service during thermal expansion / contraction and vibrations shall be ensured. Expansion joints, flexible connections and adjustable mountings shall be provided to compensate for reasonable manufacturing and construction tolerances in the associated equipment to which the GIS may be connected. Required sliding plug-in contacts for conductors shall be provided.

5.9.4 Metallic bellows (preferably of stainless steel) shall be provided over expansion joints.

5.10 Barrier and Non-Barrier Insulators

5.10.1 Support insulators shall be used to maintain the conductors and enclosure in proper relation. These support insulators may be of two types. Barrier insulators which are employed to isolate gas compartments and non-barrier insulators which allow the gas pressure to equalize.

5.10.2 The gas barrier insulators sealing to the conductors and the enclosure wall shall be provided as per requirement.

5.11 Gas seals, Gas Density & pressure and other requirements.

5.11.1 O -ring shall be used for sealing the connections between the switch-gear modules. The leakage rates shall be kept to an absolute minimum under all normal pressure, temperature, electrical load and fault conditions.

5.11.2 Piping and fittings for gas monitoring and gas supply shall be made of copper or brass.

5.11.3 All gas compartments shall be fitted with filter material which absorbs the residual moisture and moisture entering inside the High-voltage enclosure.

5.12 Gas Treatment Requirements

Under normal operating conditions it shall not be necessary to treat the insulating SF6 gas between major overhauls..

5.13 Gas Monitoring Devices

Gas density or pressure monitoring devices shall be provided for each gas compartment. The devices shall provide continuous and automatic monitoring of the state of the gas. The SF6 gas monitoring device shall have two supervision and alarm settings. The gas monitoring device shall monitor at least the following, locally and on remote.

i. "Gas Refill" Level- This will be used to annunciate the need for gas refilling.

ii."Breaker Block" Level- This is the minimum gas density at which the manufacturer will guarantee the rated fault interrupting capability of the breaker. At this level the device contact shall trip the breaker and block the closing circuits.

iii. Over pressure alarm level- This alarm level shall be provided to indicate abnormal pressure rise in the gas compartment.

5.14 **Conductors**

The conductors shall be made of aluminium alloy suitable for specified voltage and current ratings. The electrical connections between the various gas sections shall be made by means of multiple contact connectors (plug-in type) so that electrical connection is automatically achieved when bolting one section to another. Field welding of conductor is not acceptable. The surface of the connector fingers and conductor on such connections.

5.15 **Gas filling and Evacuating Plant/Gas reclaimer for 132 kV GIS unit.**

5.15.1 All apparatus necessary for filling, evacuating, and recycling the SF₆ gas into and from the switch-gear equipment shall be supplied to enable any maintenance work to be carried out.

5.15.2 The apparatus for filling, evacuating and recycling all gases to be used shall be provided with all necessary pipes, couplings flexible hoses, tubes and valves for coupling to the switch-gear equipment.

5.15.3 The gas compartments shall preferably be fitted with permanent vacuum couplings through which the gas is pumped into or evacuated from the compartments.

5.15.4 The initial gas filling of the entire switch-gear including the usual losses during commissioning shall be supplied over and above the 20% quantity of spare gas.

5.16 **Support Structures**

All supporting structures necessary for the support of the GIS equipment including associated parts such as anchor bolts, beams etc. shall be supplied. Any scaffolding or a movable platform required for maintenance shall also be supplied.

All steel structure members shall be powder coated. Thickness of coating shall be 100 micron. . All field assembly joints shall be bolted. Field welding shall not be acceptable.

5.17 **Safety Precautions**

5.17.1 The switch-gear must provide a maximum degree of safety for the operators and others in the vicinity of the switch gear under all normal and fault conditions. The safety clearances of all live parts of the equipment shall be as per relevant standards.

5.17.2 It must be made impossible to touch any live part of the switch-gear unwillingly, i.e. without use of tools or brute force.

5.17.3 An operator standing in the normal operating position should not be endangered by any moving external part of the switch-gear.

5.17.4 **INTERLOCKS:**

Mechanical or electrical interlocks shall be provided to ensure absolute and reliable protection against potentially harmful Mal-operation of the switchgear. All interlocks that prevent potentially dangerous mal operations shall be so constructed such that these cannot be defeated easily.

1) Specifically the following conditions shall be impossible to reach:

a) Electrically and manually closing or opening of the disconnector / earthing switch while the breaker is closed.

b) Electrical closing of disconnector switch, while the earthing switch at the remote end is closed.

- c) Electrical closing of earthing switch while the remote end disconnecter/circuit breaker is in closed position.
- d) Electrical & manually closing of busbar disconnectors of any circuit while the busbar earthing switch is closed.
- 2) 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.
- 3) Bus-bar disconnectors of any circuit shall not close electrically or manually while a Bus-bar Earthing Switch is closed.
- 5.17.5 If in spite of all possible safety measures if any arc occurs, the following is required.
- 5.17.5.1 The effects of an internal arcing fault must be limited to the related gas compartment.
- 5.17.5.2 Each gas compartment must have its own automated external pressure relief device to provide instant and safe discharge of accidental overpressure.
- 5.17.5.3 The set points for the pressure relief device shall be lower than pressure withstanding capability of the enclosure with sufficient margin.
- 5.17.5.4 To limit the effects of an internal arc the switch gear shall be suitably subdivided into individual arc and gas-proof compartments, at least for
- Bus-bar
- Isolator and earthing switch
- Circuit breaker
- Line isolators and earthing switch, (Line, transformer)
- 5.17.6 The following requirements are to be followed.
- 5.17.6.1 The bracing/welding of all components subject to mechanical forces caused by short circuit currents shall be capable so as to withstand the effects of at least 2.5 times the rated symmetrical short time withstand current.
- 5.17.6.2 The thermal rating for all current carrying parts and insulating materials shall be a minimum of three seconds for the rated short time withstand current.
- 5.17.6.3 All components of the switch gear which are on ground potential shall be electrically interconnected and effectively earthed.
- 5.18 **Grounding of GIS:**
- 5.18.1 All grounding connections must remain operational during and after an arc fault. Proper grounding for mitigating over voltages during disconnecter operation shall be included. Viewing windows shall be provided at the Disconnectors and earthing switches to ensure that each contact position can be inspected easily from the floor level.
- 5.18.2 GIS will be housed on GIS floor. The bidder shall provide under-ground mat below the substation. The bidder shall also provide adequate number of Galvanized steel risers to be connected to grounding mat, as per relevant standards.
- 5.18.3 The bidder shall supply entire material for ground bus of GIS such as conductor, clamps, joints, operating and safety platforms etc. to be laid / embedded in GIS floors. All required grounding connectors and associated hardware material shall be in bidder scope.
- 5.18.4 The grounding arrangement of GIS shall ensure that touch and step voltages are limited to safe values as per IEEE std. 80-2000. Calculation for sizing of grounding conductors including ground mat for step & touch potential shall be furnished.



6.0 GAS INSULATED SWITCHGEAR COMPONENTS

6.1 Circuit Breaker:

6.1.1 General:

- i. The GIS circuit breakers shall comply with the following general requirements for circuit breakers and the latest revisions of the relevant IEC-62271-100 specifications
- ii. Circuit – breakers shall be of single pressure, single break, self compression self blast / auto puffer type with SF6 as arc quenching & insulation medium and with a minimum-maintenance contact system
- iii. These shall be of single phase encapsulated type.
- iv. These should be shipped as a completed three-phase unit within a complete bay module.
- v. Each circuit-breaker shall have Spring – Spring drive mechanism ensuring proper closing and opening, and shall permit checking of adjustments and opening/closing characteristic. The ON/OFF latches shall be mechanically interlocked with each other. The circuit breaker shall be completely factory assembled, adjusted and tested.
- vi. The total break time from energizing the trip coil at rated control voltage to final arc extinction shall be as short as possible, but in any event not greater than 3 cycles i.e. 60 ms.
- vii. The breakers shall be restrike-free.
- viii. The circuit-breakers shall be capable of tripping and re-closing (Auto reclose) according to the specified duty cycle without derating: O – 0.3 s – CO – 3 min. – CO. • Short line faults.

The circuit breakers shall be complied to mechanical endurance class M2 & shall be capable of being operated locally or from remote. Local operation shall be by means of an open/close control switch located in the bay control cabinet. The minimum guaranteed nos. of maintenance free operations of complete GIS shall be 30000 Nos.

- ix. The Drive shall have sufficient stored energy for completing O-C-O with auxiliary power switched off.

6.1.2 Closing Devices

The closing coils shall be suitable for operation at any voltage between 110% and 80%-of the nominal control voltage measured at the device terminals

6.1.3 Tripping Devices

- i. All electrical tripping coils shall be suitable for operation at any voltage between 110% and 70% of the nominal control voltage measured at the device terminals.
- ii. Each circuit-breaker shall be equipped with two shunt trip system. The one shunt trip system shall be electrically separated from the other system.
- iii. An emergency hand tripping (mechanical) device shall be provided in the operating mechanism.

6.1.4 Anti-Pumping

The circuit-breaker mechanism shall be provided with anti pumping device.

6.1.5 Operating Mechanism

The operating mechanism shall be in a dust proof (IP 55) box for this INDOOR installation of Gas Insulated Switchgear. One vermin-proof, sheet steel cabinet of



adequate size shall be provided for housing the operating mechanism, aux relays, control and auxiliary equipment and for terminating all control, alarm and auxiliary circuits in suitable terminal boxes. The control cabinet shall be provided with hinged doors with provision for locking and removable cable gland plates for bottom cable entry. Viewing windows shall be provided for observation of the instruments without opening the cabinet. Suitably engraved nameplates shall be provided to identify all equipment in the control cabinet.

The breakers shall have at least 4 normally open (NO) and 4 normally closed (NC) spare auxiliary contacts for Owner's use. If these are not available, auxiliary relays shall be used to multiply the auxiliary contacts of the breakers.

6.1.6 Spring operated Mechanism

- i. Closing action of circuit breaker shall compress the opening spring ready for tripping.
- ii. When closing springs are discharged after closing a breaker, closing springs shall automatically be charged for the next operation and an indication of this shall be provided in the LCC.
- iii. Provisions shall be made to prevent a closing operation of the breaker when the springs in the partial charged condition.
- iv. A mechanical indicator shall be provided to indicate the status of the spring.
- v. Mechanical interlocks shall be provided in the operating mechanism to prevent discharging of closing springs when the breaker is in closed position.
- vi. The spring operating mechanism shall have adequate energy stored in the operating spring to close and latch the circuit breaker against the rated making current and also to provide the required energy for the tripping mechanism in case the tripping energy is derived from the operating mechanism.

6.1.7 Auxiliary Switches

Each breaker shall have auxiliary switches with adequate number of NO and NC contacts all wired to terminals located in the local control cabinet of the circuit breaker bay. 20 % spare contacts should be provided.

6.1.8 Indicating Devices

- i. Position indicators shall be provided to clearly indicate whether a circuit-breaker is open or closed.

Status Color

Open position Open Green

Closed position Closed Red

- ii. Each circuit-breaker shall be provided with an operation counter to record the number of tripping operations performed. The counter may be located at the local control cabinet.

6.1.9 Gas Connections

Necessary valves and connections shall be provided to assure ease in handling the SF6 gas.

6.1.10 TESTING FACILITIES:

Timing test facility shall be provided with switchgear such that it is not necessary to open up any gas section to make test connections to the circuit breaker terminals. All details of test facilities to be provided shall be submitted with technical bid.



6.2 Disconnecter Switches/Isolator and Maintenance Grounding switches

6.2.1 General

- I. The GIS disconnecter switches and grounding switches shall comply with the following general requirements of disconnect switches and the latest version of the relevant specifications IEC 62271-102.
- II. Disconnect switches shall be three phase encapsulated or Single Phase encapsulated, group operated, no break, with one common motor operated mechanism for all the three poles. These shall also have facilities for emergency manual operation and necessary handles shall be provided.
- III. High speed make proof earthing switches shall be E1 class operated. Safety earthing switches shall be E0 class operated. The disconnecter shall be M2 class operated.
- IV. Maintenance earthing switches shall be three phase encapsulated or Single Phase encapsulated, group operated, no break, with one common motor operated mechanism for all the three poles. These shall also have facilities for emergency manual operation and necessary handles shall be provided.
- V. Disconnect switches and grounding switches shall have Mechanical or electrical interlocks to prevent grounding switch from closing on an energized section. Interlocks with other bays for bus transfer switching shall be done through bay control cabinets. Actuation of the emergency manual operating device shall also disable the electrical control. Disconnectors in open condition shall be secured against reclosure.

Interlocking devices must provide absolute and positive protection against potentially harmful mal-operations of the switchgear. The following functions shall be assured:

- a) Forcing the operator into the only safe and logic sequence to actuate breakers, switches, isolators and grounding switches.
 - b) Checking the actual fully closed or fully open position of all switching elements before and after each move.
 - c) Providing the logical checks and issuing the resulting PERMISSIVE or BLOCKED signals for the switchgear.
 - d) Indicating positively the absolute condition/position of the supervised equipment.
 - e) Local manual and remote electrical operation of all essential functions.
 - f) Local emergency unlocking facilities via safety-key switches under the full responsibility of the operator. Intrabay and interbay interlocking shall be provided.
- VI. All main contacts, male and female, shall be silver plated.
 - VII. Each disconnect switch and grounding switch shall open or close only due to motor driven or manual operation independently. There should also be a pre-set timer in motor circuit for protection against time over –run in case of inadvertent failure of drive mechanism in any intermediate position of the disconnecter travel path.
 - VIII. The disconnect switches shall be capable of interrupting the charging current of the connected GIS bus & associated components.

6.2.2 Duty requirements:

The disconnecting switches shall have breaking capabilities as per IEC requirements. Contact shielding shall be designed to prevent restrikes and high local stresses caused by the transient recovery voltages when currents are interrupted.

The bus disconnecting switches shall reliably handle capacitive currents due to the making and breaking of switchgear components as well as commutation currents due to bus bar reconfiguration.

The fast acting ground switches, used for overhead double circuit lines and underground cable feeders shall be capable of switching induced current as per IEC requirement.

Short Circuit Requirements

The rated peak short-circuit current or the rated short time current carried by an isolator or earthing switch for the rated maximum duration of short circuit shall not cause:

- a) Mechanical damage to any part of the isolator or earthing switch.
- b) Separation of the contacts or contact welding.
- c) A temperature rise likely to damage insulation.

6.2.3 Operation Mechanism.

- I. Mechanism shall be arranged mechanically, electrically, so that all three phases of any particular disconnect switch or grounding switch operate simultaneously.
- II. All mechanisms shall be suitable for electrical motor operation to achieve a fully automatic operation. For emergency situations manual operation shall be possible. Handles or hand cranks shall be provided, together with all necessary operation rods and rod guides. Manual operation shall be prevented if the interlocking system does not allow the operation of the switch.
- III. The auxiliary supply shall be electrically decoupled from the motor when the switch is operated manually.
- IV. The mechanisms shall be arranged for locking in the open and in the closed position. Facility shall be available to allow the switch to be padlocked in any position.
- V. Disconnecting operating mechanism of all disconnectors/ isolator & earth switches shall be at easy operable height.
- VI. The isolator shall be provided with positive continuous control throughout the entire cycle of operation. The operating pipes and rods shall be sufficiently rigid to maintain positive control under most adverse conditions and when operated in tension or compression for isolator closing.

The operating mechanism design shall be such that during the operation of the isolator (especially manual operation), once the moving blades reach the sparking distance, springs shall take over to give a quick, snap action closing so that the isolator closing is independent of manual efforts. Similarly, the springs must assist during the opening operation to give quick breaking feature.

- VII. Similarly, the springs must assist during the opening operation to give quick breaking feature.
- VIII. Additional Requirements for Safety Earthing Switches
 - a) Earthing switch, whenever possible can form an integral part of each pole of the disconnector. Two independent earthing pads each with flexible copper braids and suitable connectors for earth conductor lead shall be provided at the hinge end of the earthing switch.
 - b) Interlocks shall be provided so that manual operation of the earthing switches or insertion of the manual operating device will disable the electrical control circuits.

6.2.4 Auxiliary Switches:

Each disconnect switch and grounding switch shall provided with sufficient Nos. of NO – NC as per entire scheme requirement plus two (2) NO-NC electrically independent contacts terminated up to terminal board, at user's disposal. The auxiliary switches shall indicate the position of the switch contacts, and shall be independent of the motor operation.

6.2.5 Position Indicators

- I. Mechanically connected position indicators shall be provided externally to permit observation of close/open position of the disconnect switch and grounding switch.
- II. Visual verification shall be provided for each pole of each disconnect switch and grounding switch to permit visual inspection of each switchblade position.

6.3 Current Transformers:

6.3.1 General

- I. The current transformers provided for each phase shall be supplied in accordance with the following general requirements and the latest revisions of the relevant IEC 61869 specifications.
- II. All transformers must be suitable for continuous operation of min. 20 % overload and for service under all rated and fault conditions.
- III. The current transformers must be of core in SF6 gas type only so as to meet insulation requirements of high voltage suitable for continuous operation when installed on the conditions.
- IV. The current transformer shall be ring / toroidal type, multi ratio with fully distributed secondary windings with relay accuracy as per latest relevant IEC Standards incl. multi core as per requirement and shall be mounted inside the high voltage enclosure.
- V. The secondary terminals of current transformers shall be placed outside the high voltage enclosures, mounted in suitable, accessible terminal boxes and the secondary leads of all the current transformers shall be wired to shorting type terminals.
- VI. It shall be possible to test each current transformer without the removal of gas through the insulated grounding switches.
- VII. Unless otherwise specified, cores for measuring instruments shall have accuracy classes of not more than 0.5 % and saturation factors less than 5.
- VIII. Current transformers for protection purposes shall be of accuracy class 5P and a saturation factor that will ensure the proper working of the protective devices for all short-circuit currents up to the rated value of the switchgear. Maximum possible DC component of short circuit current shall be considered for CT dimensioning.
- IX. The polarity of the primary and secondary windings of each current transformer shall clearly be indicated
- X. The number and position of the current transformers shall be relative to the circuit-breakers, disconnecting switches and ground switches as detailed in the attached single line diagram.
- XI. The rating, No of cores, ratios, accuracy class, characteristics etc. for the individual current transformer secondary cores shall be as indicated in data sheet. The various ratios of current transformers shall be obtained by changing the effective number of turns on the secondary winding.



- XII. Each current transformer shall be provided such that the enclosure current does not affect the accuracy or the ratio of the device or the conductor current being measured. Provision shall be made to prevent arcing across the enclosure insulation.

6.4 **VOLTAGE TRANSFORMER:**

6.4.1 SF6 insulated:

Each voltage transformer shall be metal enclosed, SF6 insulated in accordance with relevant IEC 61869. The location, polarity, ratios, and accuracy shall be as specified.

6.4.2 Construction:

VTs should be in segregated compartment and not forming a part of bus bar. Transformers should be of either plug-in construction or the disconnect-link type and be attached to the gas-insulated system.

A voltage transformer designed so that it does not have to be disconnected during dielectric testing. The metal housing of the transformer should be connected to the metal enclosure of the GIS with a flanged, bolted, and gasketed joint so that the transformer housing is grounded to the GIS enclosure. Adequate measures shall be provided to prevent any unacceptable impact on the secondary control and protection circuits, which might result from fast transients (VFT) or Ferro-resonance.

6.4.3 Covers and shields:

Special covers and any necessary corona shields should be supplied so that the system can be pressurized and dielectrically tested after removal of the transformer.

6.4.4 Primary and secondary terminals:

Primary and secondary terminals should have permanent markings for identification of polarity, in accordance with IEC.

6.4.5 Provision shall be made for grounding of the secondary windings inside the local control cabinet.

6.5 **Local & Remote Control and Operation**

6.5.1 General

One local control cabinet (LCC) for GIS shall be supplied for the local control and operation of each bay. Each LCC shall contain the local control, interlocking, operation and indication devices for the associated GIS bay.

The LCC shall be mounted for each GIS bay. The LCC's shall be located with sufficient space for access and the possibility to work at the equipment even when the LCC doors are open, or directly at the switch-gear in front of the related circuit breaker.

The LCC's shall be installed indoor type IP-54 protected. Hinged doors giving access to the components shall be provided.. The control and operation circuits shall be well shielded and with safety measures to protect operator from touching energized parts.

The LCC should have required arrangement for control and operations of GIS from Remote. In order to have ease in maintenance / isolation & better reliability supplier shall ensure that all Cable connection from GIS to LCC shall be plug in socket type only, any connection through glands or other arrangements shall be avoided.

The LCC shall include all required functions for control and supervision of a complete GIS as well as the marshalling of all connections to and from the GIS bays. Necessary provision for interfacing for remote operation shall be provided.

6.5.2 Required features for conventional local control cabinets

The LCC's shall be provided with the following features:

- a) A mimic diagram showing the single line diagram. Position indicators, on/off switches for the HV devices and local / off / remote switches shall be installed on or adjacent to the various symbols of the mimic diagram.

The following devices shall be supplied as a minimum:

Circuit breaker control switch with ON – OFF indicating lamps. – Circuit breaker “local-remote” selector switch. Disconnect switch, control switch with ON – OFF indicating lamps.

Grounding switch, control switch with ON – OFF indicating lamps.

Mimic bus including symbols according to the single line diagram.

Monitoring control of all high voltage switching devices in a bay.

Digital display of current, voltage, active and reactive power, power factor etc.

- b) Any interposing relays and control switches associated with the circuit breakers disconnect switches, grounding switches etc.
- c) The alarm and indication for devices specified e.g. gas, DC & AC supervision.
- d) Fuses and links. These shall be installed in the interior of the LCC's
- e) Terminal blocks for the terminating and marshalling of auxiliary supply circuits, control, interlocking, and indication & alarm circuits from the GIS and for cable connections to the remote control room or the owner's control system.
- f) Each LCC shall be provided with space heater to prevent the internal equipment from humidity deposit. The heater shall be rated 230 V AC and fed through MCB.
- g) A fluorescent lamp and a duplex convenience outlet rated 230 V AC, 15 amps with ground fault interrupter shall be installed in each LCC.
- h) The Local control cubicle shall be fitted with pre wired interface terminal blocks for connection to user's control & protection panels. The interface includes CT & PT inputs for protection & Measuring system, Protection trip 1 & 2 signals, Aux switch contacts etc.

6.5.3 Wiring Requirements

- I. Control panel shall be complete in all respects to ensure proper functioning of the control, protection, and monitoring and interlocking schemes.
- II. Wiring shall be done with flexible 1100V grade, FRLS, PVC insulated, switchboard wires with 2.5 mm² stranded copper conductor. Wiring between equipment and control cubicle shall be routed through G.I. rigid conduits and shall be done by PVC & screened cable only, with safety measures to protect operator from touching energized parts.
- III. Each wire shall identify at both ends with permanent markers bearing wire numbers as per Contractor's wiring diagram.
- IV. Wire termination shall be done with crimping type connectors with insulating sleeves. Wires shall not be spliced between terminals.
- V. All spare contacts of relays, push buttons, auxiliary switches etc. shall be wired up to terminal blocks in the control cubicle.
- VI. Terminal blocks shall be 1100V grade, stud type with engraved numbers suitable for termination of at least two numbers of 2.5 mm² stranded copper conductor. Terminal blocks for CT, PT, auxiliary AC & DC supply shall be disconnecting link type.

- VII. Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20% active terminals shall be furnished.
- VIII. Co-axial type cable glands suitable for use with shielded cables shall be used at each termination.
- IX. All control cables shall be installed and terminated in such a manner as to limit the effects of transient electromagnetic voltages on the control conductors to an acceptable level.
- X. Any cabling within GIS shall be supported on cable tray. No cable shall be in hanging position.
- XI. Insulator cones shall be embedded in full return current carrying metal fixing rings in order to avoid mechanical stresses to the cast resin part and to impart full conductivity across the flange connection. Earthing of different gas compartments/enclosures is not allowed with cross bonding with any metal strips.

6.5.4 Connections within the GIS and their LCC's

All cable connections between the various GIS modules and the LCC's shall be made by multi-core cables with multipoint plug in connections on both the ends. PTs & CTs circuit shall be wired with crimped type copper lugs.

The electrical connections between the various gas sections shall preferably be made by means of multiple contact connectors so that electrical connection is automatically achieved when bolting on section to another. The surface of the connector fingers and conductor tubes on such connections shall be silver plated.

6.6 Control Relay Panels

- 6.6.1 Separate Control Relay Panel (CRP) for each bay shall be supplied to facilitate control of circuit breakers, disconnecter, earth switches and metering, protection etc.
- 6.6.2 CRPs shall be free-standing floor mounted type panel to be located in separate room adjacent to GIS hall. CRP shall be in dust and vermin proof hot dipped galvanised sheet steel construction.
- 6.6.3 A mimic diagram shall be provided on the front of the panel with control switches and position indicators for CB, disconnecter and earth switches. The panel shall be dead front type with front door having clear glass cut-out of adequate size so that mimic diagram, annunciator windows, indicating lamps are clearly visible from outside.
- 6.6.4 CRP shall house bay control units (BCUs) and protection relays. These panels shall also house the various selector switches, auxiliary relays, timers, local indications, alarms and facia annunciation window etc. to realise various interlocks as per requirement among circuit breakers, disconnectors and earth switches and for breaker pole discrepancy, anti-pumping etc. It shall include the following as minimum:
 - a) Local / off / remote selection switch
 - b) CNT control switch for breaker
 - c) Breaker ON, OFF, Trip-1, Trip-2, Trip circuit healthy indications
 - d) Disconnecter & earth switches ON, OFF control switches & indications
 - e) DC supply healthy indication
 - f) Spring charging devices status
 - g) Aux. relays / other devices as required by the design.

6.6.5 All protection relays, bay control units, DMMs, PQMs and associated auxiliary equipment shall be of standard construction from experienced and reliable manufacturers. Important functions and features, in addition to the fault measuring capabilities, shall include:

- Programmable scheme logic,
- Remote communication interface for setting / interrogation from SCMS,
- 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.

6.6.6 Completely separate and isolated circuits shall be used for each operating mechanism control, trip- 1, trip-2, close, alarms and auxiliary devices. Close and trip circuits shall be kept isolated to their final mechanical or electrical actuators from the CRP terminals.

6.6.7 Trip circuit-1 & trip circuit-2 shall be individually monitored for continuity under open and closed condition of breaker. Close circuit shall be monitored under open condition of breaker.

6.6.8 The contacts and signals originating from/going to the GIS, associated auxiliary and monitoring equipment shall be wired up to the CRP, for external use.

6.7 Protection Relay :

6.7.1 All protection relays shall be provided with test plugs and all CT, VT wiring shall be wired through the test plugs.

6.7.2 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.

6.7.3 All protection relays shall be equipped with dual redundant communication port using IEC 61850 with site selectable Edition 1 & 2 , Dual communication (FO or RJ 45) with Parallel redundancy protocol (PRP), KEMA Level "A" certification communication 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.

6.7.4 Relay shall support complete ladder logic with various logic gate

6.7.5 All relays shall have connections for both CT and PT Inputs.

6.7.6 Line Differential Protection relay

- Shall have high-speed fault detection capability with typical relay operation time of less than 35-40 ms
- Shall have separate backup Over current & earth fault protection relay with fault locator functionality

- **Note:** Two separate relay to be provided for the Primary Protection for the as cable differential (87L) & overcurrent protection is provided as a backup to the primary protection.
- Graphical display for single line diagram (any one of the relays either main or backup)

6.7.7 **Transformer Differential Protection relay:**

- Differential protection with operating time less than 30ms for both low & high stage
- Shall have separate REF protection relay with site selectable high & Low impedance restricted earth fault functionality. Also, shall support Over current & earth fault functionality
- Relay shall support Graphical HMI for Single line diagram

6.7.8 **Busbar Protection relay**

- A numerical low impedance bus-bar protection scheme with phase segregated measurement shall be offered (ANSI 87BB). It shall be capable of detecting all types of faults, i.e. multi-phase and single phase-to-ground faults with an overall operating time of less than 1.5 cycles. The architecture of the bus-bar protection shall be derived from using individual bay units along with a central fault-measuring unit.
- In the architecture of the bus-bar protection, the central unit shall receive data from all bay units, carry out computation and comparison of the restraint and differential currents, locate the fault position, and send the trip decision to the respective bay units operating on the faulted bus-bars.
- The bus-bar protection shall support automatic transfer of data to ECMS at the substation, whenever system fault-related information or data is produced. The design shall support being scanned by ECMS and FMS for both SCADA like data (protection status, protection start / trip, fault values, fault location and fault records, etc.), and historical data (waveform records). Facilities shall include user interface (both front and rear ports), serial communication and diagnostic / self-supervision, etc. Communication software for local and remote access of data from, and parameter download into, the bay units and / or central unit shall also be provided.
- The protection shall use GPS time reference; however, the bus-bar protection shall be able to operate correctly independent of this time reference.
- The bus-bar protection, on operation, shall trigger the breaker fail relay scheme. The breaker failure relay (BFR, ANSI 50BF) scheme shall be provided to monitor the post-trip currents on all bays following fault detection by any of the generic protection relays. The BFR shall be integrated into the bus-bar protection scheme with the supply of additional software package to perform breaker fail relaying function. It shall be sensitive enough to operate between 20 % and 200 % of nominal current, adjustable in steps of less than or equal to 10 %.
- Minimum 2-line Human Machine Interface (HMI) facilities shall be provided on both bay and central units.

- The DC supplies to the bay units and central unit shall be fed from the independent station batteries in a redundant configuration (from DCDB – DC Distribution Board).
- The bus-bar protection shall be capable of being blocked by a lockable manual switch. Under this condition, the tripping functions shall also be blocked on all feeders (to be provided as hardwired facility). However, the measuring function of the bus-bar protection should remain in service to facilitate signal measurement checks in the restraint and operating circuits of the protection.
- Extension of the bus-bar protection system shall easily be made possible. The protection cubicles shall be completely wired for the total number of feeders specified in the scope of works. However, protection cubicles shall be designed to provide at least 2 spare wired points for each bus-bar section. In wired points, terminal blocks, wiring and space are provided but hardware equipment and other slot-in modules will not be supplied.
- The busbar differential protection bay units shall also provide the possibility to be used as additional back-up overcurrent protection with protection functions ANSI 50/50N and 51/51N.

6.8 **Power Quality Meter:**

- 6.8.1 Power Quality meter shall acquire following parameters: AC voltage, AC current, frequency, harmonics, flicker, power, energy, power factor, THD as per Class A IEC 61000-4-30 Ed.3 standard
- 6.8.2 Accuracy class active power 0.2S according to IEC 62053-22.
- 6.8.3 The PQM shall support standard protocols (HTTP, SNMP, IEC 61850, Modbus RTU, Modbus TCP, IEC103, OPC UA PubSub (MQTT) (IoT)) and standard data formats (COMTRADE, PQDIF, CSV)
- 6.8.4 Long term data evaluation directly in the device with the possibility of displaying a report in accordance with power quality standard such as EN 50160/user defined and ITIC curve
- 6.8.5 Recording of events: voltage dips, over voltages, interruptions: with 1/2 cycle continuous monitoring and recording with and time stamp (duration)
- 6.8.6 The device must incorporate at least 2GB internal memory for historical data.
- 6.8.7 Waveform capture of triggered events of voltage and current. Up to 3 seconds records must be possible
- 6.8.8 The PQM shall be capable of transient detection (100 microseconds) with sampling of 10,24 kHz

6.9 **BUSHINGS:**

Outdoor bushings shall be provided for connection of conventional external conductors to SF6 GIS. Suitable clamp & connectors shall be supplied with bushing. The dimensional and clearance requirements for the metal clad enclosure shall be maintained as per requirement of relevant standards.

All the bushings shall have an impulse & power frequency withstand level that is higher or equal to the level specified under item 2.1. Only SF6 insulated composite silicon

bushings will be accepted. The terminals on the outdoor bushings shall be a solid stem with dimensions specified.

6.10 **Metal-Enclosed Surge Arresters:**

- I. The surge arrestors shall conform in general to IEC 60099-4.
- II. The surge arrester shall be of heavy duty station class hermetically sealed, Gapless, ZnO, Surge arrester, suitable for use with GIS, for each phase, at the 220 kV line underground cable entry terminals of GIS shall be provided for Line Bays.
- III. Each Surge Arrester shall be provided with self leakage current monitoring device at convenient elevation.
- IV. These shall have adequate thermal discharge capacity for severe switching surges, long duration surges and multiple strokes.
- V. The surge arresters when provided with pressure relief devices shall be capable of withstanding the internal pressures developed during the above discharges without operation of the pressure relief devices. The surge arresters shall be provided with a discharge counter located at an accessible position.
- VI. Surge Arresters shall be of either the “plug-in” construction or the disconnect-link type and be attached to the gas-insulated system in such a manner that these can be readily disconnected from the system while the system is being dielectrically tested. The metal housing of the arrester shall be connected to the metal enclosure of the GIS with a flanged, bolted joint.
- VII. The ground connection shall be sized for the fault level of the GIS. It shall be insulated from the GIS-enclosure and grounded externally to permit periodic maintenance and monitoring of the leakage current.
- VIII. If the arresters are not equipped with removable links, special covers and any necessary corona shields should be supplied so that the system can be pressurized and dielectrically tested after removal of the arrester.
- IX. The size of the connecting conductor shall be such that all the energy is dissipated to the earth without getting overheated.

6.11 **Insulating Gas and gas leakage rate**

The GIS shall be furnished with sufficient sulfur-hexa-fluoride (SF₆) gas to pressurize the complete system in a sequential approach, one zone or compartment at a time to the rated nominal density. The guaranteed leakage rate of each individual gas compartment and between compartments p.a. shall be as per IEC60772-203, for the service life of equipment.

The quality of new filled-in SF₆ gas shall meet the following requirements in line with IEC 60376:

Reuse or recycling of removed gas:

Clear instructions shall be provided by bidder about handling, recycling & treatment of new and used SF₆ gas.

During commissioning dew point of SF₆ gas shall be measured and documented.

Components may be filled with N₂ for transportation and refilled with SF₆ at site.

6.12 **Gas sections**

The GIS enclosures shall be divided into several gas sections separated by gas-tight barriers. Each section shall be provided with necessary valves to allow evacuation and refill of gas without evacuation of any other section. Location of gas barrier insulators is

to be clearly discriminated outside the enclosure by a band of distinct colour normally used for safety purposes.

It should include the necessary valves, connections, density monitors, gas monitor system and controls, indication, orifices, and isolation to prevent current circulation. For the purpose of gas monitoring and maintenance, the GIS shall be divided into various individual zones in each bay. The CB gas zone shall be independent from all other gas compartments and shall meet the requirement of relevant IEC.

Each gas zone shall be furnished with a gas monitoring system consisting of a gas density continuous monitoring device provided with two electrically independent contacts which operate in two stages as follows:

- a) First alarm : At a gas density normally 5 to 10% below the nominal fill density.
- b) Second alarm : Minimum gas density to achieve equipment ratings.

In special cases determined by the supplier, a third stage with a set of contacts may be necessary in certain areas. Provisions shall be made for connecting pressure gauges, service cart, and moisture test instrumentation to any one of the gas sections.

Permanent Gas Treatment Devices:

Means shall be provided inside each enclosure for treating the SF₆ gas by the use of Desiccants, driers, filter, etc. to remove impurities in the gas. All gas compartments shall be fitted with static filter material containers that will absorb residual and entering moisture inside the high voltage enclosures. Filters inside the breaker compartment shall also be capable of absorbing gas decomposition products resulting from the switching arc.

6.13 **GIS Connection:**

6.13.1 GIS to TRANSFORMER:

Transformers shall be connected to the GIS by termination of 220 kV XLPE power cable to OIP condenser bushing. The connection between GIS and high voltage cable at GIS end shall be done through cable termination / cable sealing end. The plug in cable sealing ends for XLPE cables shall consist of gas tight plug in sockets and prefabricated plugs with grading elements of silicone rubber.

6.13.2 GIS to LINE:

The 220 kV line will be terminated to GIS by XLPE Single Core power cable to line termination gantry by conductor.

6.13.3 220 kV Power Cable connection:

The SF₆ GIS to XLPE cable termination shall conform to IEC-859 (latest edition). The provision shall be made for a removable link. The gap created when the link is removed should have sufficient electric strength to withstand the switchgear high voltage site tests. The corona rings/stress shields for the control of electrical field in the vicinity of the isolation gap shall be provided by the GIS manufacturer. All supporting structures for the SF₆ bus-duct connections between the XLPE cable sealing ends and the GIS shall be supplied by the supplier. The opening for access shall be provided in each phase terminal enclosures as necessary to permit removal of connectors to isolate the XLPE cables to allow carrying out the insulation tests. connection between GIS and high voltage cable at GIS end is done through cable termination / cable sealing end. Plug in cable sealing ends for XLPE cables shall consist of gas tight plug in sockets, and prefabricated plugs with grading elements of silicone rubber. A separate cable basement is provided for cable entry, its distribution and installation.

The design of the cable end box shall fully comply with the IEC standard. All end cable modules shall be suitable for connecting single core, XLPE specified cable. Single compression nickel plated brass cable glands & tinned copper lugs shall be provided by vendor for all cables to GIS assembly, LCC & CRP.

6.14 Special tools, tackles and equipments

Special tools, tackles and equipment that are required to perform installation, commissioning, operation & maintenance of the gas insulated switch gear shall be included in scope of supply. Minimum following tools shall be supplied.

- 1 A suitable designed mobile SF6 gas-handling unit shall be included to enable complete vacuuming and re-filling of SF6 gas. It shall contain and comprise a wheeled trolley housing, compressor, standard pressure gauges, piping and control. It may be noted that the gas handling unit shall be provided with all items and filters required to safely remove and dispose the de-composed / contaminated gasses in the GIS after any failure or flashover.
- 2 Dew point measurement meter (Suitable for 33 kV GIS also)
- 3 Partial Discharge monitoring System (Offline)
- 4 SF6 gas leakage detector (Suitable for 33 kV GIS also)
- 5 Gas purity detector for SO2, H2O, CF4, AIR etc., (Suitable for 33 kV GIS also)
- 6 Precision pressure gauge
- 7 Set of equipment for pressure measurement and gas density meter.
- 8 Gas-service carts (Suitable for 33 kV GIS also)
- 9 Any other special tool/tackle required.
- 10 The ladders and walkways shall be provided wherever necessary for access to the equipment. A portable ladder with adjustable height shall also be supplied for access to the equipment.
- 11 All interlocks that prevent potentially dangerous mal-operations shall be constructed such that these can be operated only by use of special tools.

The tools shall be shipped in separate containers, clearly marked with the name of the equipment for which these are intended. The requirement of HV testing during commissioning or repairing or replacement shall be arranged by successful bidder at no extra cost. No delay shall be permitted on account of the non availability of the HV test equipments.

7.0 Name plates

- 7.1 All equipment shall be provided Engraved nameplates shall preferably be of 3-ply (Black-White-Black) lamicoid sheets or anodised aluminium. Nameplates shall be fastened by screws and not by adhesives.
- 7.2 GIS rating and name plate
- 7.3 Each bay shall have a name plate showing listing of basic equipment and their relative location.
- 7.4 Each bay auxiliary control cubicle must be identified with its designation to which it is assigned.
- 7.5 Each of the equipment devices including CB, Disconnecter switch, Earthing switch, CT, VT and busbars etc. mounted inside the switchgear shall be provided with proper nameplate and rating plate. as per the latest edition of relevant IEC standards.

- 7.6 Special warning labels shall be provided wherever considered necessary.
- a) Gas Single Line Diagram showing all devices in a single line diagram with the gas sectionalizing of the GIS indicated

8.0 Test and inspection

8.1 Type Tests:

Following type test reports from NABL laboratory/ CPRI , ERDA , India./reputed international test laboratory , as specified in IEC standard 62271– 203 & 62271-100 (amended up to date) shall be submitted for the offered type, rating of GIS invariably with the technical bid. Bid without type test reports will not be considered for evaluation. The type test reports shall not be older than FIVE years and shall be valid up to expiry of validity of offer. However, if there is no change carried out by the manufacturer in the design since it was validated having carried our type tests, the Type Test Report should be not be older than 10 years and shall be valid up to expiry of validity of offer. In event of any changes in the offered design from the type tested design the bidder shall-confirm to carry out the required type test/s, special tests, before commencement of supply, without affecting delivery schedule, free of cost-

- I. Tests to verify the insulation level (Lightning impulse, Switching impulse and ac withstand test with PD) test on each GIS device (CB, Disconnecter, bus, etc).
- II. Dielectric tests.
- III. Tests to prove the radio interference voltage (RIV) level.
- IV. Tests to prove the temperature rise of any part of the equipment and measurement of the resistance of the main circuit.
- V. Tests to prove the ability of the main and earthing circuits to carry the rated peak and the rated short time withstand current.
- VI. Tests to verify the making and breaking capacity of the included switching devices.
- VII. Tests to prove the satisfactory operation of the included switching devices / Mechanical endurance tests
- VIII. Tests to prove the strength of enclosures.
- IX. Verification of the degree of protection of the enclosure.
- X. Gas tightness tests
- XI. Pressure test on partitions.
- XII. Electromagnetic compatibility tests (EMC).
- XIII. Additional tests on auxiliary and control circuits.
- XIV. Tests to prove performance under thermal cycling and gas tightness tests on insulators.
- XV. Type tests on Circuit breakers, disconnectors, earth switches, surge arrestors, CT, PT etc as per the relevant standards.
- XVI. Seismic test
- XVII. Gas leakage test
- XVIII. Timing tests are to be carried out after the switch gear has been completely charged with SF6 gas.

8.2 Routine Testing:

All equipment shall be subjected to the Routine tests as laid down in IEC Standard IEC 62271-203 in presence of Owners representative. Routine test shall include But not limited to the following:

1. Dielectric test on the main circuit.
2. Dielectric tests on auxiliary circuits.
3. PD test
4. Tests on auxiliary and control circuits.
5. Measurement of the resistance of the main circuit.
6. Gas leakage test
7. Design and visual checks.
8. Pressure tests of enclosures.
9. Functional tests
10. Tests on auxiliary circuits, equipment and interlocks in the control mechanism.
11. Complete mechanical operation tests.
12. Complete test of inter locking devices.
13. LCC- & Control Relay panel complete functional & interlock test as per approved drawing with LCC duly connected to respective bay GIS module in all respect.
 - IR test
 - HV test
14. Timing tests for circuit breaker
15. Primary injection test for all current and voltage transformers
16. Secondary injection tests for all protection relays.

8.3 Tests after installation of complete GIS at Site:

After installation and before being put into service, the GIS shall be tested in order to check the correct operation and dielectric integrity of the equipment as laid down in IEC 62271-203. The successful bidder shall furnish a commissioning test plan and a statement method for the tests on site. Tests shall include the following:

1. Dielectric tests on the main circuits.
2. Measurement of the resistance of the main circuit.
3. Gas tightness tests. (Gas leakage test)
4. Checks and verifications.
5. Gas quality verifications.
6. On site power frequency voltage withstand test with PD test.
7. Tests as per IEEE C37.122.1 clause 4.10.5
8. Functional & interlock tests for all items
9. Demonstration of operational compatibility with SCADA
10. Visual inspection, checks & verifications.



11. Mechanical operation tests of circuit breakers, Disconnectors and earthing switches and high-speed earthing switches
12. Insulation resistance measurement

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 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 DRAWING 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 MAINTENANCE:

The bidder shall provide the services of experienced persons, supervisors, Engineers, experts, etc. for AMC services for satisfactory operation.

The bidder shall have dedicated localized after sales & service team which should be capable any activity to operate complete GIS satisfactorily.

12.0 Training:

Training shall include the following any other specific area may be brought to notice and shall be included.

1. General Explanation for GIS
2. Layout and Architecture of GIS
3. Gas Sectionalisation of GIS
4. Construction of CB
5. Operating Mechanism of CB
6. Maintenance of CB
7. Overhaul of CB (Interrupting chamber)
8. Overhaul of CB (Operating Unit)
9. Construction of DS/ES
10. Maintenance of DS/ES
11. Overhaul of DS/ ES
12. Construction of Bus/ Cable head/ SF6 – air bushing
13. Maintenance of Bus/ Cable head/ SF6 – air bushing

14. Overhaul of Bus/ Cable head
15. Cable connections
16. Overhaul of various transformer connections
17. Operation of GIS with SCADA
18. Construction & Maintenance of Lightning Arrester
19. Construction & Maintenance of VT/CT
20. Construction & Maintenance of Local control panel
21. Erection of GIS at site.
22. Installation & Testing of GIS at site
23. Type tests of GIS
24. Routine tests of GIS.
25. Faults simulation of GIS
26. Localization of GIS fault.

13.0 PACKING AND DESPATCH

- 13.1 All equipments shall be suitably packed and protected during shipment/transportation by sea, rail and road in such a manner that it is protected against the climatic conditions and for any damage during transportation, transit and storage.
- 13.2 Each shipping unit shall be sealed in a clean dry condition with leak-tight shipping covers securely mounted for shipment. All covers to be removed during installation shall be clearly marked. Each shipping section shall be carefully sealed and filled with dry gas to a slightly positive pressure to prevent the entrance of moisture and contamination.
- 13.3 Gas insulated switchgear (GIS) shall be properly packed to protect during ocean shipment, inland transport, carriage at site and outdoor storage during transit and at the site. Completely assembled bays (subject to transport limitations) of the GIS shall be transported as one shipment unit. Packing materials shall be dust and waterproof. All packages shall be clearly, legibly and durably marked with uniform block letters on at least three sides. Fragile items like bushings, CTs, VTs, LAs and fully assembled bays shall be securely packaged and shipped in containers. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment wherever necessary.
- 13.4 Impact recorders (Accelerometers) shall be provided on the packages to confirm that GIS has not suffered any shocks during shipment, transport, handling, etc
- 13.5 All blanking plates, caps, seals, etc., necessary for sealing the gas sections during shipment to site shall be provided. Vendor to provide quantity of components accordingly considering permanent installation.

14.0 DEVIATIONS

Deviations, if any, from this standard shall be clearly indicated in the offer with reasoning.

ANNEXURE – I



DOCUMENTATION FOR 220 kV GAS INSULATED SWITCHGEAR

Sl.No.	Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1	Specification Sheet, duly completed	Y	Y	Y
2	Technical Particulars, duly filled-in	Y	Y	Y
3	General arrangement and foundation drg. for all the equipment.	N	Y	Y
4	Typical general arrangement drawings of the equipments indicating space requirement, room dimensions, crane capacity, Vertical load/ Live load data	N	Y	Y
5	Earthing layout	N	Y	Y
6	Sectional view of GIS	N	Y	Y
7	Gas Schematic diagram	N	Y	Y
8.	Control schematic and wiring diagrams	N	Y	Y
9	Catalogue for bought out accessories.	N	N	Y
10	Installation operation & maintenance manual	N	N	Y
11	Manufacturing Quality assurance plan with effective quality assurance system	N	Y	Y
12	Field Quality plan indicating instruction	N	Y	Y
13	Gas system installation procedures, gas handling procedures.	N	Y	Y
14	Type test certificates for GIS	N	N	Y
15	Spare parts list with identification	N	N	Y
16	Design Calculations for Bus-bar sizing, Short circuit forces and vibration on Bus-bar & each equipment, thermal stability and losses.	N	N	Y

Note:

- 4 hard copies & 1 soft copy shall be supplied with bid.
- 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
- 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.
- All final drawings and documents shall be submitted in CD in AutoCAD and MS office format as applicable for Owner's future reference.

Y - Yes, N - No

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SPECIFICATION SHEET
SF6 CIRCUIT BREAKER of 220 kV GIS

PROJECT: Coal Based Fertilizer Plant		PLANT: Electrical Distribution System	
ISSUED FOR : PROPOSAL <input type="checkbox"/> ENQUIRY <input checked="" type="checkbox"/> ORDER <input type="checkbox"/> FINAL <input type="checkbox"/>			
GENERAL			
Item No. :		Ref. Stds. :	
Quantity :		Encl. Docs. <input checked="" type="checkbox"/>	
Description :		Make :	
Code No. :		Maker's Type. :	
TESTS : Routine <input checked="" type="checkbox"/> Type <input checked="" type="checkbox"/> Others : <input checked="" type="checkbox"/>			
SERVICE CONDITIONS			
TECHNICAL DETAILS		AMBIENT CONDITIONS	
Type :	SF6	Temp.- Max./Min./Design Ref. : 46 / 1/ 50°C	
Rated Voltage :	220 kV	Rel. Humidity : 100%	Alt. above Sea < 1000M
Max System Voltage :	245 kV	Atmospheric Pollution	Dusts : Coal Dust & Urea Dust
Rated current at design site ambient temp :	1600 A		Vapour : Ammonia & Highly Corrosive
Breaking capacity :	50 kA (3 Sec)	Location	Indoor : <input checked="" type="checkbox"/> Outdoor : <input type="checkbox"/>
Making Capacity :	128 kA	AUX. POWER SUPPLY	
Short circuit current withstand :	50 kA for 3 sec	System Data	A.C. : 415/ 240 V \pm 10 %, 50Hz \pm 5%
Voltage withstand			D.C. : 110 V \pm 10 %, 2wire
1 Min power freq :	460kV	Instrument Contact Rating	A.C. :
1.2/50 micro sec impulse :	1050kVp		D.C. :
Characteristic for short line fault related to rated short circuit breaking current			
Operating cycle :	0 - 0.3 s - CO - 3 Min- CO		
Auto reclosing :	Required		
Enclosure material	Aluminium alloy		
Rated break-time (ms)	65	Not more than 100	
Rated closing time(ms):	65	Not more than 200	
Mechanical Endurance class	M2		
Electrical Endurance class	E1		
Restriking probability class	C2		
Inductive current breaking capability	Switch No Load current of transformer		
First pole to clear factor	As per IEC 62271-100		



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Opening time in ms	Not more than 40
Closing time in ms	Not more than 100
No of tripping coils per breaker	2
No of closing coils per breaker	1
TRV characteristics	As per IEC 62271-100

Note: Specification Sheet shall be filled by the bidder and submitted with the bid.



SPECIFICATION SHEET
CURRENT TRANSFORMER & VOLTAGE TRANSFORMER, 220 KV GIS

PROJECT: Coal Based Fertilizer Plant		PLANT: Electrical Distribution System	
ISSUED FOR : PROPOSAL <input type="checkbox"/>		ENQUIRY <input checked="" type="checkbox"/>	
ORDER <input type="checkbox"/>		FINAL <input type="checkbox"/>	
GENERAL			
Item No. :		Ref. Stds. :	
Quantity :		Encl. Docs. :	<input checked="" type="checkbox"/>
Description :		Make :	
Code No. :		Maker's Type. :	
TESTS :	Routine <input checked="" type="checkbox"/>	Type <input checked="" type="checkbox"/>	Others : <input checked="" type="checkbox"/>
SERVICE CONDITIONS			
TECHNICAL DETAILS		AMBIENT CONDITIONS	
Nominal system voltage	220 kV+10%	Temp.- Max./Min./Design Ref. : 46 / 1 / 50°C	
Maximum system voltage	245 kV	Rel. Humidity : 100%	Alt. above Sea < 1000M
Ltg Impulse withstand voltage	1050 kV	Atmospheric Pollution	Dusts : Coal Dust & Urea Dust
1 Min. P.F. withstand voltage	460 kV		Vapour : Ammonia & Highly Corrosive
Frequency	50 Hz +5%	Location	Indoor : <input checked="" type="checkbox"/> Outdoor : <input type="checkbox"/>
No. of Phases	Three	AUX. POWER SUPPLY	
Earthing Mode	Effectively /Solidly Earthed	System Data	A.C. : 415/ 240 V \pm 10 %, 50Hz \pm 5%
System BIL			D.C. : 110 V \pm 10 %, 2 Wire
Rated BIL		Instrument Contact Rating	A.C. :
Rated Normal Current	- A		D.C. :
Rated short time w.s. current	50kA (3 sec.)		
Rated making current	128 kA		
System fault level	50 kA (3 sec.)		
Rated Voltage	220kV		
Type of Mounting	Vertical Upright		
Creepage Distance (Min)			
Total	As per CBIP		
Protected	As per CBIP		
Type of Connection	Tubular/ ACSR		
Applicable standard	-----		



Current transformer					
Type					
No. of cores					
Core details	1	2	3	4	5
Rated primary current					
Rated secondary current					
Application	Metering	Protection	Protection	Protection	Protection
Rated burden					
Knee point voltage					
Magnetising current					
Secondary resistance					
Insulation class of winding					
Voltage transformer					
Type	Electromagnetic / Capacitive type				
Number of cores	3				
Rated primary voltage					
Method of pri. connection	Delta				
Core details	1	2	3		
Rated secondary voltage					
Application	Metering	Protection	Protection		
Method of sec. connection	Delta	Delta	Delta		
Accuracy class					
Rated burden					
Insulation class of winding					
Rated voltage factor					
Acceptable limit of variation of total capacitance over carrier freq. range					
Std reference range of freq. for which accuracy is valid					
Rated total Capacitance (pF)					

Note: Specification Sheet shall be filled by the bidder and submitted with the bid.



SPECIFICATION SHEET
DISCONNECTOR SWITCH OF 220kV GIS

PROJECT: Coal Based Fertilizer Plant		PLANT: Electrical Distribution System	
ISSUED FOR : PROPOSAL <input type="checkbox"/> ENQUIRY <input checked="" type="checkbox"/> ORDER <input type="checkbox"/> FINAL <input type="checkbox"/>			
GENERAL			
Item No. :		Ref. Stds. :	
Quantity :		Encl. Docs. :	<input checked="" type="checkbox"/>
Description :		Make :	
Code No. :		Maker's Type. :	
TESTS : Routine <input checked="" type="checkbox"/>		Type <input type="checkbox"/>	
Others : <input type="checkbox"/>			
SERVICE CONDITIONS			
TECHNICAL DETAILS		AMBIENT CONDITIONS	
Nom. Voltage with	220kV	Temp.- Max./Min./Design Ref. : 46 / 1 / 50°C	
Rated current	1600A	Rel. Humidity : 100%	Alt. above Sea < 1000M
Rated voltage(rms)Un	245kV		
Number of phases	3 Phase, 3 Wire	Atmosph eric Pollution	Dusts : Coal Dust & Urea Dust
Rated Frequency with + %	50 Hz +5%		Vapour : Ammonia & Highly Corrosive
Combined (V & F) Variation	+12.5%	Location	Indoor : <input checked="" type="checkbox"/> Outdoor : <input type="checkbox"/>
Rated short-time current	50KA 3 sec.	AUX. POWER SUPPLY	
Rated peak withstand current kA	128KA 3 sec.	System Data	A.C. : 415/ 240 V \pm 10 %, 50Hz \pm 5%
Voltage withstand			D.C. : 110 V \pm 10 %, 2 Wire
1 Min power freq :	460kV	Instrument	A.C. :
1.2/50 micro sec impulse :	1050kVp	Contact Rating	D.C. :
No.of spare auxiliary contacts on each isolator		6NOand 6NC	
No. of spare auxiliary contacts on each earthing switch		6NOand 6NC	
Enclosure material		Aluminium alloy	
Type of operating mechanism		Motor Operated	
Mechanical Endurance :			
Disconnecter		Class M2	
Earthing switch M1			



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Type Mechanical operation	Mechanically & Electrically Ganged
Bus transfer switching capability (% of rated current)	80
Rated bus charging current	0.2A
Rated induced current switching capability 102 Class B	As per IEC 62271–

Note: Specification Sheet shall be filled by the bidder and submitted with the bid.



**TECHNICAL PARTICULARS
220 KV GAS INSULATED SWITCHGEAR**

PROJECT: Coal Based Fertilizer Plant		PLANT: Electrical Distribution System	
ISSUED FOR : PROPOSAL <input type="checkbox"/> ENQUIRY <input checked="" type="checkbox"/> ORDER <input type="checkbox"/> FINAL <input type="checkbox"/>			
General		Service conditions	
Name of manufacturer (OEM)		Ambient Air Temp. in Deg. C Min./Max.	
Type tested at Name of Laboratory		Altitude above MSL, in mtr	
System Parameters		Pollution Class	
Highest System voltage in kV		Creepage distance, in mm/kV	
Rated voltage of System in kV		Relative humidity	
Rated voltage of Equipment in kV		Vibration level	
Rated Insulation level Phase to Earth and between Phases		Noise level	
One Min Power Frequency withstand voltage kVrms		Induced Electromagnetic Disturbance, in kV	
Switching impulse withstand voltage, kVp		Seismic conditions	
Phase to Earth		Auxiliary supply (AC & DC Voltage, Frequency)	
Between Phases		Operation-	
Lightning Impulse withstand voltage, kVp		Control	
Rated Frequency		Illumination & heater	
Rated current in Amp		Support Structure	
Rated current at 50 °C (equipment) in Amp		i Material	
Rated current at 50 °C (bus bar) in Amp		ii Minimum thickness of galvanizing	
Rated short circuit withstand current kArms		iii Foundation channels /Anchor bolts	
Duration in sec			
Peak, kAp			
Enclosure withstand time for an internal fault in sec.			
Estimated total energy loss at			
100 % of rated capacity			
75 % of rated capacity			
50 % of rated capacity			
25 % of rated capacity			
Enclosure			
Code of pressure vessel			
Design temperature in Deg.C			
Material			
Material grade & applicable standard			
Outside diameter in mm			
Minimum Wall Thickness, in mm			
Painting Shade & Thickness	External		
	Internal		
Degree of Protection			
Inductance in H/mt			
Capacitance in pF/mt			



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PROJECT: Coal Based Fertilizer Plant		PLANT: Electrical Distribution System	
ISSUED FOR : PROPOSAL <input type="checkbox"/> ENQUIRY <input checked="" type="checkbox"/> ORDER <input type="checkbox"/> FINAL <input type="checkbox"/>			
Resistance in Ohm/mt			
Expansion Bellow	Material		
	Min allowable adjustable displacement		
	Longitudinal :		
Transverse :			
Sealing system			
Estimated life in years			
Barrier	Material		
	Dielectric strength		
Grounding			
Grounding Material			
Grounding of complete GIS			
Grounding of individual compartment			
Grounding at flange joints			

SF6 Gas	
Quantity of SF6 Gas of complete GIS at filling pressure, in kg	
Quantity of SF6 Gas of largest compartment GIS at filling pressure, in kg	
Nos of Gas compartments	
Quantity of SF6 Gas of individual compartment GIS at filling pressure, in kg	
Maximum permissible dew point, in Deg.C	
Circuit Breaker	
Type	
Operating Mechanism type	
Nos. of phases	
Rated current in Amp	
Mechanical Endurance class	
Electrical Endurance class	
Restrike probability class	
Rated SC breaking current	
Rated SC breaking current - single phase test	
Rated Line charging breaking current	
Rated Cable charging breaking current	
Capacitor bank switching capability,	
Out of phase making & breaking current	
Rated short line fault current	
TRV characteristic	
First Pole to Clear factor	
Nos. of interrupters per phase	
Type of arc control device provided, if any	
Type of arcing contacts	
Material of main contact	
Material of Arcing contacts	
Filter material	
Timings of operations	



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a	- Opening at nominal control voltage	
b	Closing time at nominal control voltage	
	Tripping	
	Closing	
	Rated operating duty cycle	
	Tripping Coils	
	- No of coils	
	- Rated Watts	
	Closing Coil	
	- Rated Watts	
	Spring Charging Motor	
	- Rated Voltage	
	- Rated Watts	
	Spring charging time at rated Aux supply	
	Maintenance required after nos. of operation at	
i	No load	
ii	Rated current	
iii	25% of rated SC current	
iv	50% rated SC current	
	Rated SC current	
	Provision of anti pumping	
	No of operations after switching off of motor Aux. supply	
	Provision of Manual trip	
	Electrical interlocking	
	Padlocking	
	Type of Operation counter provided	
	DISCONNECTORS	
	Type	
	Rated current in Amp for	
	- Bus disconnecter	
	- Line disconnecter	
	- Transformer disconnecter	
	- PT disconnecter	
	Maximum Current that can be safely interrupted by the Isolator (Amp).	
	- Inductive	
	- Capacitive	
	Rate Short time withstand Current in kA, for 3 sec	
	Rated peak short time Current, kAp	
	Rated bus charging current, in Amp	
	Type of contacts	
	Material of contacts	
	Current Density at minimum cross section (A/mm ²)	
	Mechanical Endurance class	
	Type of Operating Mechanism	
	Operating Motor details	
	- Rated Voltage	
	- Rated Watts	
	Operating Time	
	- Closing	
	- Opening	
	Mechanical indication on drive shaft	



Maintenance Grounding Switch	
Type	
Rate Short time withstand Current in kA, for 3sec	
Rated peak short time Current, kAp	
Rated lightning impulse withstand voltage across the open gap, kVp	
Rated Power Freq withstand voltage across the open gap, kVrms	
Type of Operating Mechanism	
Operating Motor details	
- Rated Voltage	
- Rated Current	
- Rated Watts	
Operating Time	
- Closing	
- Opening	
Mechanical indication on drive shaft	
Current transformers	
i Type	
ii Material	
iii Position of Current Transformer	
iv Reference Standard	
v Rated Continuous thermal current	
vi Rated Short Time current	
vii Duration	
a Feeder Bay CT	
i Metering Core	
- Ratio	
- Output Burden	
- Accuracy Class	
ii Protection Core -1	
- Ratio	
- Output Burden	
- Accuracy Class	
iii Protection Core -2	
- Ratio	
- Output Burden	
- Accuracy Class	
b Transformer Bay CT	
i Metering Core	
- Ratio	
- Output Burden	
- Accuracy Class	
ii Protection Core -1	
- Ratio	
- Output Burden	
- Accuracy Class	
iii Protection Core -2	
- Ratio	
- Accuracy Class	
- Minimum Knee Point Voltage at highest ratio	
- Maximum Excitation Current at Vk	



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- Maximum Resistance at highest ratio	
iv Protection Core -3	
- Ratio	
- Accuracy Class	
- Minimum Knee Point Voltage at highest ratio	
- Maximum Excitation Current at Vk	
- Maximum Resistance at highest ratio	
c Bus Coupler Bay CT	
i Metering Core	
- Ratio	
- Output Burden	
- Accuracy Class	
ii Protection Core -1	
- Ratio	
- Burden	
- Accuracy Class	
iii Protection Core -2	
- Ratio	
- Burden	
- Accuracy Class	
Voltage Transformer	
Type	
Position of Voltage Transformer	
Reference Standard	
Rated Over Voltage Factor - Continuous	
Short Time Over Voltage Factor	
Duration	
Partial Discharge Level	
Thermal Rating of Primary Winding	
26 Line & Bus VT	
i Metering Core	
- Ratio	
- Output Burden	
- Accuracy Class	
ii Protection Core -1	
- Ratio	
- Output Burden	
- Accuracy Class	
iii Protection Core -2	
- Ratio	
- Output Burden	
- Accuracy Class	
Enclosed Surge Arrester	
Name of Manufacturer	
Arrester Class & Type (with mfr type design.)	
Rated system voltage (kV)	
Rated Arrester Voltage (kV)	
Max continuous operating voltage (MCOV) – (kV)	
Nominal Discharge Current (KA) with 8/20 Micro-second wave	
Max resistive component of cont current at MCOV-mA crest	
Max capacitive component of cont current at	



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MCOV -mA crest	
Long Duration Discharge Class	
Min. Energy Discharge Capability (KJ/KV rating)	
Max. switching current impulse residual voltage KVp	
1000 Amps	
250 Amps	
Pressure Relief Class KA (rms)	
High Current short duration impulse withstand level with 4/10 micro-second wave (KA) peak	
Over –voltage withstand capability – KV	
a) 100 Seconds	
b) 10 Second	
c) 1.0 Second	
d) 0.1 Second	
e) Reference Voltage (KV)	
f) Reference Current (KA)	
Surge counter	
Leakage monitor	
Local Control Cubical	
i Name of Manufacturer (OEM of GIS)	
ii Location in GIS	
iii Material	
iv Sheet Thickness	
v Degree of Protection	
vi Padlocking arrangement	
vii Major components of LCC	
- Bay control mimic diagram	
- Control Switches	
- Indicating lamps	
- Position indicators	
- Annunciation scheme	
- Auxiliary relays	
- Contact multiplication relays	
- System parameters display	
- Heater with thermostat	
- Interface terminal blocks for relaying & protection	
GIS to Line connection	
Nos of XLPE cable can be terminated	
Type of cable termination required	
GIS to Transformer connection	
Nos of XLPE cable can be terminated	
Type of cable termination required	

Note: Technical Particulars shall be filled by the bidder and submitted with the bid.



	ELECTRICAL DISTRIBUTION SYSTEM TALCHER FERTILIZERS LIMITED TECHNICAL SPECIFICATION – 33 kV GIS (PC183-TS-0832B)	PC183/E/4006/SecVI-3.1	0	
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TECHNICAL SPECIFICATIONS 33KV GAS INSULATED SWITCHGEAR



CONTENT

SECTION NUMBER	DESCRIPTION
1.	SCOPE
2.	CODES AND STANDARDS
3.	SERVICE CONDITIONS
4.	OPERATIONAL REQUIREMENT
5.	GENERAL REQUIREMENT OF DESIGN , CONSTRUCTION AND PERFORMANCE
6.	GAS INSULATED SWITCHGEAR COMPONENTS
7.	NAME PLATES
8.	TEST AND INSPECTION
9.	SPARES
10.	DRAWINGS AND DOCUMENTS
11.	MAINTENANCE
12.	TRAINING
13.	PACKING AND DESPATCH
14.	DEVIATION

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1.0 SCOPE

- 1.1 The specification covers scope of design, engineering, fabrication, manufacturing, inspection and testing before supply, transportation, delivery at destination, unloading & storage at site, site erection, site testing, commissioning and putting in to successful operation of Gas Insulated Switchgear (GIS) complete with all materials and accessories.
- 1.2 This specification shall be read in conjunction with attached specification sheet /data sheet.

2.0 CODES AND STANDARDS



- 2.1 The GIS equipments / components used shall comply with the requirements of latest revision of the following standards and also the other Indian and International Standards as applicable, unless otherwise specified:

IEC 60071 Insulation coordination
IEC 60255 Electrical Relays
IEC 60099 – 4 Metal-oxide surge arresters without gaps for a.c. systems
IEC 60137 Bushings for alternating voltages above 1000 V
IEC 60255 Electrical Relays
IEC 60270 High-voltage test techniques - Partial discharge measurements
IEC 60376 Specification of technical grade sulphur hexafluoride (SF₆) for use in electrical equipment
IEC 60480 Guidelines for the checking and treatment of sulphur hexafluoride (SF₆) taken from electrical equipment and specification for its re-use
IEC 60529 Degrees of protection provided by enclosures (IP Code)
IEC 60694 Common specifications for high-voltage switchgear and controlgear standards
IEC 62271-4 Use and handling of SF₆ Gas
IEC 61869-1 Instrument transformers — General requirements
IEC 61869-2 Additional requirements for current transformers
IEC 61869-3 Additional requirements for inductive voltage transformers
IEC 62271-4 Handling procedures for sulphur hexafluoride (SF₆) and its mixtures
IEC 62271-100 Alternating current circuit-breakers
IEC 62271-102 Alternating current disconnectors (isolators) and earthing switches
IEC 62271-200 Gas Insulated metal-enclosed switchgear for rated Voltages upto 52kV
IEC 62271-201 AC insulation-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV
IEEE 80 Standard for station grounding
IEEE std. C37.122.1-1993 IEEE guide for Gas Insulated substations
IEEE STD 693 Guidelines to ensure functional adequacy under Seismic disturbance

- 2.2 The equipment shall also conform to the provisions of CEA regulations and other statutory regulations currently in force.
- 2.3 In case of any contradiction between various referred standard/ specification/ data sheet and statutory regulation, most stringent requirements shall prevail. However, Owner's decision in this regard will be final and binding.
- 2.4 Item not covered and required shall confirm to the latest issue of IS/IEC.

3.0 SERVICE CONDITIONS

- 3.1 **Ambient Condition**

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3.1.1 The 33 kV GIS and the accessories to be supplied against this technical specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

Max/design ambient temperature	: 50 deg C
Min. ambient temperature	: 1 deg C
Max daily average ambient temperature	: 46 deg C
Max relative Humidity (%)	: 100%
Max altitude above M.S.L (meters)	: < 1000
Condensation	: Occasional
Induced electromagnetic disturbance	: 1.6 kV
Pollution class	: IV
Creepage distance	: 31 mm/kV
Seismic Zone	: Zone IV

3.1.2 The 33 kV GIS shall be suitable for installation and satisfactory operation in a pressurised substation or in a substation with restricted natural air ventilation in a tropical, humid and corrosive atmosphere.

3.2 System Details

3.2.1 The required overall parameters of GIS shall be as follows:



Parameter	Unit	Value
Rated System Voltage	KV	33± 10%
Highest System/Equipment Voltage	KV	36
One min. Power frequency withstand Voltage	KVrms	70
Rated Lightning Impulse withstand voltage	KVp	170
Rated Frequency Hz 50	Hz	50 ± 5%
Rated Continuous busbar current at 50 deg C Design temperature	Amp	3150
Incomer/ bus coupler current rating at 50 deg C	Amp	3150
Outgoing bay (Feeder and Transformer Bay)- current rating at 50 deg C	Amp	2000
Rated Short circuit Withstand current for 3 sec	KA	40
Rated dynamic withstand current	KA	100
System Neutral earthing	-	Solidly Earthed
Maximum SF6 Gas leakage rate per year	% per year	As per IEC

3.2.2 Auxiliary supply voltage.

For Operation, control and signalling	110 Volts DC (+10% & -20%)
For other loads	415 / 230 Volts (+/-10 %), AC 50 Hz (+/-5 %),

4.0 Operational Requirement

4.1 All equipments shall be suitable for continuous duty operation at the specified rating under the specified ambient conditions and system detail and operating condition including sudden change of load and voltage without exceeding permissible limit of temperature as per relevant standard.

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4.2 The assembled equipment shall be capable of withstanding the electrical, mechanical and thermal ratings of the specified system. All joints and connections shall be required to withstand the forces of expansion, vibration, contraction, and specified seismic requirements without deformation or malfunction and leakage. The apparatus shall be capable of withstanding the specified environment.

5.0 General Requirement of Design, Construction and Performance

5.1 GIS shall consist of 33kV SF6 Gas-Insulated Switchgear with vacuum circuit breakers, Double bus-bars with two sections, 3-phases with all other associated equipment, complete with control and power wiring, as indicated in the Conceptual single line diagram attached. Provision shall also be made for additional bays one on each side (without equipments) over and above bays shown in SLD.

The 33kV switchgear shall be capable of withstanding the electrical and mechanical stresses as specified in the Technical Data Sheets.

A leakage rate of less than 0.1% per annum is required. The gas tanks should therefore preferably be state of the art manufactured of stainless steel and cut / welded by laser or manufactured from 6mm thick aluminum alloy.

All Circuit Breakers & Disconnectors operating mechanism to be of pure Spring-spring type (any hydraulic or pneumatic is not acceptable).

A mechanical mimic diagram of suitable size showing incoming/outgoing 33kV feeders shall be provided on the front side of cubicles. In case of bay control units equivalent displays on the unit are acceptable.

5.2 Enclosures

5.2.1 The switchgear shall be of the free-standing, self-supporting, dead-front, double bus design with all high-voltage equipment installed inside gas-insulated metallic grounded enclosures and suitably sub-divided into individual arc and gas-proof compartments.

5.2.2 The SF6 GIS shall be of INDOOR type. The degree of protection shall be at least IP65 for gas compartments and IP4X for low voltage and other compartments as specified in IEC-60529.

5.2.3 The metal enclosures for the SF6 gas insulated equipment modules shall be made of non magnetic & arc-proof material i.e. Aluminium alloy, offering mechanical and thermal properties suitable for this application. The enclosure shall be suitable for three phases, i.e. Single enclosure. The external fixtures should be made of corrosion resistant material and should be capped where required. Suitable Bellow Compensators shall be made of Stainless steel to preserve the mechanical strength of the equipment at the connection portions under all condition.



5.2.4 Enclosures shall withstand the full rated fault current as specified in the Technical Data Sheets during arcing faults without puncturing.

5.2.5 The exterior surface finish of switchgear paint shade shall be RAL 7035. Sufficient quantities of all paints and preservatives required for touching up at sites shall be furnished

5.2.6 Gas section barriers including seals to the conductor and enclosure wall shall be gas-tight and shall be capable of withstanding the maximum pressure differential that could occur across the barrier,. These shall also not contain any substances which could contaminate the enclosed gas or affect its insulating properties over a period of time.

5.2.7 The enclosure shall be designed to practically eliminate the external electromagnetic field and thereby electro-dynamic stresses even under short circuit conditions.

5.2.8 The switchgear shall have earth bus for connection to the plant earth grid.

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- 5.2.9 The SF6 gas insulated metal enclosed switchgear shall be totally safe against inadvertent touch of any of its live constituent part.
- 5.2.10 Whenever possible, the complete feeders or major assembly of components should be shipped as transport units.
- 5.2.11 Bus-bar compartments and breaker compartments must have their own independent gas supervision and alarm systems with contact density gauges for alarm and indication.
- 5.2.12 The fully enclosed bus-bars shall be made from electrolytic drawn copper.
- 5.2.13 Bus-bars and their enclosures shall take thermal expansion of the entire switchboard into account.
- 5.2.14 Suitable mounts and compensators shall be provided where necessary.
- 5.2.15 Suitable clearance between phases and between live parts and enclosure shall be verified to keep it safe for the operator to approach and even to touch the enclosure in the worst case of gas leak, i.e., when the pressure inside the enclosure becomes equal to the air pressure outside the Switchgear.
- 5.2.16 Enclosures shall be free standing and self supporting. Unless indicated otherwise in the requisition these shall be supplied with a base frame. The floor shall not be considered as being part of the enclosure.
- 5.2.17 All components requiring periodic maintenance shall be easily accessible.
- 5.2.18 Cable installation work on functional units (replacements or new installations) and equipping of spare panels shall be safely possible without adjacent units having to be de-energized.
- 5.2.19 The Loss of Service Continuity category (LSC) of the switchgear shall be LSC2 according to IEC 62271-200.
- 5.2.20 For operator safety the switchgear must have protection system against internal faults in each partitioned compartment.
- 5.2.21 Unlikely in the event of internal arc the hot gases are guided via pressure relief disks from each compartment concerned. The hot gases should be guided away from the operator either by the venting direction of pressure release disc or by the pressure relief duct ends guided into open air or fitted with absorbers to cool and de-energize the hot gases. The release of gases shall be directed by the pressure relief disc so to minimize the hazards to persons or risk of fire to be reliably prevented. Evidence is to be provided for fully type tested GIS Switchgear in accordance with IEC 62271-200, IAC class AFLR at 40 kA for 1 Second.
- 5.2.22 The temperature-compensated manometer for pressure measurement must also permanently monitor the relevant gas compartment. Manometer shall have positive indication without use of any proximity switch or any auxiliary AC/DC supply. Provision must be made for action to be taken when the upper or lower threshold is exceeded, leading to a drastic reduction in damage by internal arc faults.
- 5.3 Modular Design**
- 5.3.1 The GIS design shall be modular and to be easily installed and commissioned with ability to extend on both ends in future with simplified civil engineering works and suitable for use in locations where severe environmental conditions exists.
- 5.3.2 The GIS switch gear shall be of modular design offering high degree of flexibility. Each module shall be complete with SF6 gas circuit breaker, Bus Side & Line Side Disconnectors with maintenance Grounding switches, bus & elbow sections, Voltage transformers, Current transformers, L.A., local control cubicle, and cable end enclosures and all necessary components required for safe & reliable operation and maintenance.



- 5.3.3 The bus bars shall be sub-divided into compartments including the associated bus bar disconnecter. The busbars must be of flat copper of rectangular cross-section to DIN standards and continuous in the section concerned without any transverse barrier or Bus bars are partitioned at each bay with an objective to isolate Busbar compartment for the purpose of extension and at the same time avoid damage to adjacent bays in the event of fault. Individual bus bar pieces may be bolted together panel by panel. This is must be to ensure all live part of busbars including interpanel connections are also inside SF6 gas insulation. Plug-in type interpanel busbar connections in air shall not be permitted. Bus bar extensions shall be possible with the offered arrangement without a shutdown of the substation, for maintenance on a bus bar module minimum outage of bays shall be ensured.
- 5.3.4 Arc faults caused by external reasons shall be positively confined to the originating compartment and shall not spread to other parts of the switchgear. In case of any internal arc fault in a busbar, busbar disconnecter or circuit breaker, of double bus system, repair works shall be possible without shutting down complete substation and at least one busbar and the undisturbed bays must remain in operation.
- 5.3.5 Each bay module should be equipped with suitable arrangement for easy dismantling and refitting during maintenance without disturbing other units.
- 5.3.6 There shall not be any kind of interference to the connected & nearby equipment and system, when the equipment is operated at maximum service voltage.
- 5.3.7 All the operating mechanisms of CB, Bus Side disconnecter with ES & Line side disconnecter with ES, shall be present on panel front and operated standing in front of panel on the individual equipment for better reliability.

5.4 **Maintenance and repair of a circuit breaker:**

The positioning of the circuit breaker in the GIS shall be such that it shall be possible to access the circuit breaker of any feeder from the front/ rear bottom side for routine inspection, maintenance and repair at site without interfering with the operation of the adjacent feeders. The GIS shall be so designed that any component of the GIS can be removed easily.

Internal components shall be maintenance free for at least 10 years. Routine replacement of insulating gas shall not be required in less than ten years.

5.5 **Interchangeability**



As much as possible, all the parts shall be of standard manufacture with similar parts and assemblies of same rating being interchangeable.

5.6 **Future Extension**

The modular design of GIS switch gear shall be capable of extension in the future on either end by the addition of extra feeders, bus couplers, busbars, circuit breakers, Disconnectors, and other switch gear components without drilling cutting, welding or minimum dismantling any major part of the equipment.. The arrangement shall be such that expansion of the original installation can be accomplished with minimum GIS down time. In case of extension, the interface shall incorporate facilities for installation and testing of extension to limit the part of the existing GIS to be re-tested and to allow for connection to the existing GIS without further dielectric testing.

5.7 **Physical arrangement**

- 5.7.1 The layout shall be properly designed by the bidder to completely accommodate the present & future requirements of the sub-station as per the furnished single line diagram. These may be adjusted as necessary to suit the manufacturer's standard design.

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5.7.2 The arrangement of the switchgear offered must provide adequate access for checking and maintenance.

5.7.3 Optimized arrangements are required so as to reduce installation time, minimize maintenance & repair cost, provide ease of operation and facilitate future expansions.

5.7.4 The number of transport/shipping splits shall be minimized to keep installation time of GIS to a minimum. The arrangement shall afford maximum flexibility for routine maintenance. Equipment removal and SF6 handling should be accomplished with ease. The ease of operation shall be ensured.

5.8 Gas Sectionalisation

5.8.1 The switch-gear gas enclosures must be sectionalized, with gas tight barriers between sections or compartments.

5.8.2 The sections shall be so designed as to minimize the extent of plant rendered inoperative when gas pressure is reduced either by excessive leakage or for maintenance purposes and to minimize the quantity of gas that has to be evacuated and then recharged before and after maintaining any item of equipment.

5.8.3 The arrangement of gas sections or compartments shall be such that it is possible to extend existing bus-bars without having to take out of service another section of the bus-bar at a time.

5.8.4 For limitation of any internal arc to the concerned bay or bus section, the necessary gas work should be limited only to the affected gas compartment / bus section present on either side of bus sectionalizer or bus-bar sectionalized bay by bay, without disturbing adjacent bay or other live bus section.

5.8.5 Sectionalisation shall ensure that circuit breaker enclosure will not include any other equipment in its gas compartment.

5.9 Expansion Joints and Flexible Connections

5.9.1 The layout shall sufficiently take care to the thermal expansion / contraction of the assembly by the provision of expansion joints. Expansion joints shall be placed in between any bay section of the busbar.

5.9.2 The number and position of expansion joints or flexible connections shall be determined by the manufacturer to ensure that the complete installation will not be subject to any expansion stresses which could lead to distortion or premature failure of any piece of the SF6 equipment, support structures or foundations. Bracing shall be provided for all mechanical components against the effects of short circuit currents specified under system parameter. The design calculations for all the supports shall be submitted.



5.9.3 The continuity of service during thermal expansion / contraction and vibrations shall be ensured. Expansion joints, flexible connections and adjustable mountings shall be provided to compensate for reasonable manufacturing and construction tolerances in the associated equipment to which the GIS may be connected. Required sliding plug-in contacts for conductors shall be provided.

5.9.4 Metallic bellows (preferably of stainless steel) shall be provided over expansion joints.

5.10 Barrier and Non-Barrier Insulators

5.10.1 Support insulators shall be used to maintain the conductors and enclosure in proper relation. These support insulators may be of two types. Barrier insulators which are employed to isolate gas compartments and non-barrier insulators which allow the gas pressure to equalize.

5.10.2 The gas barrier insulators sealing to the conductors and the enclosure wall shall be provided as per requirement.

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5.11 Gas seals, Gas Density & pressure and other requirements.

- 5.11.1 Double sealing of O-ring type shall be used for sealing the connections between the switch-gear modules. The leakage rates shall be kept to an absolute minimum under all normal pressure, temperature, electrical load and fault conditions.
- 5.11.2 Piping and fittings for gas monitoring and gas supply shall be made of copper or brass.
- 5.11.3 All gas compartments shall be fitted with filter material which absorbs the residual moisture and moisture entering inside the High-voltage enclosure.
- 5.11.4 The guaranteed leakage rate of each individual gas compartment must be less than 0.1 % p.a. over the lifetime of the Switchgear.
- 5.11.5 Initial Filling of the equipment must guarantee gas service periods of not less than 10 years.
- 5.11.6 Assembled enclosures must withstand at least twice their rated internal operating pressure. This fact must be proven on each individual section of the Switchgear.

5.12 Gas Treatment Requirements

Under normal operating conditions it shall not be necessary to treat the insulating SF6 gas between major overhauls.

5.13 Gas Monitoring Devices

Gas density or pressure monitoring devices (manometer) shall be provided for each gas compartment. The devices shall provide continuous and automatic monitoring of the state of the gas. The SF6 gas monitoring device shall have two supervision and alarm settings. The gas monitoring device shall monitor at least the following, locally and on remote.



- i. "Gas Refill" Level- This will be used to annunciate the need for gas refilling.
- ii. "Breaker Block" Level- This is the minimum gas density at which the manufacturer will guarantee the rated fault interrupting capability of the breaker. At this level the device contact shall trip the breaker and block the closing circuits.
- iii. Over pressure alarm level- This alarm level shall be provided to indicate abnormal pressure rise in the gas compartment.

5.14 Conductors

The conductors shall be made of electrolytic grade copper suitable for specified voltage and current ratings. The electrical connections between the various gas sections shall be made by means of multiple contact connectors (plug-in type / bolted) so that electrical connection is automatically achieved when bolting one section to another. Field welding of conductor is not acceptable. The surface of the connector fingers and conductor on such connections

5.15 Gas filling and Evacuating Plant/Gas reclaimer for 33 kV GIS unit.

- 5.15.1 All apparatus necessary for filling, evacuating, and recycling the SF6 gas into and from the switch-gear equipment shall be supplied to enable any maintenance work to be carried out.
- 5.15.2 The apparatus for filling, evacuating and recycling all gases to be used shall be provided with all necessary pipes, couplings flexible hoses, tubes and valves for coupling to the switch-gear equipment.
- 5.15.3 The gas compartments shall preferably be fitted with permanent vacuum couplings through which the gas is pumped into or evacuated from the compartments.

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5.15.4 The initial gas filling of the entire switch-gear including the usual losses during commissioning shall be supplied over and above the 20% quantity of spare gas.

5.16 **Support Structures**

All supporting structures necessary for the support of the GIS equipment including associated parts such as anchor bolts, beams etc. shall be supplied. Any scaffolding or a movable platform required for maintenance shall also be supplied.

All steel structure members shall be powder coated. Thickness of coating shall be 100 micron. All field assembly joints shall be bolted. Field welding shall not be acceptable.

5.17 **Safety Precautions**

5.17.1 The switchgear must provide a maximum degree of safety for the operators and others in the vicinity of the switch gear under all normal and fault conditions. The safety clearances of all live parts of the equipment shall be as per relevant standards.

5.17.2 It must be made impossible to touch any live part of the switchgear unwillingly, i.e. without use of tools or brute force.

5.17.3 An operator standing in the normal operating position should not be endangered by any moving external part of the switchgear.

5.17.4 INTERLOCKS:

Mechanical & electrical interlocks shall be provided to ensure absolute and reliable protection against potentially harmful Mal-operation of the switchgear. All interlocks that prevent potentially dangerous mal operations shall be so constructed such that These cannot be defeated easily.

1) Specifically the following conditions shall be impossible to reach:

- a) Electrically and manually closing or opening of the disconnecter / earthing switch while the breaker is closed.
 - b) Electrical closing of disconnecter switch, while the earthing switch at the remote end is closed.
 - c) Electrical closing of earthing switch while the remote end disconnecter/circuit breaker is in closed position.
 - d) Electrical / manual closing of busbar disconnectors of any circuit while the busbar earthing switch is closed.
- 2) 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.
- 3) Bus-bar disconnectors of any circuit shall not close electrically or manually while a Bus-bar Earthing Switch is closed.



5.17.5 If in spite of all possible safety measures if any arc occurs, the following is required.

5.17.5.1 The effects of an internal arcing fault must be limited to the related gas compartment.

5.17.5.2 Each gas compartment must have its own automated external pressure relief device to provide instant and safe discharge of accidental overpressure.

5.17.5.3 The set points for the pressure relief device shall be lower than pressure withstanding capability of the enclosure with sufficient margin.

5.17.5.4 To limit the effects of an internal arc the switch gear shall be suitably subdivided into individual arc and gas-proof compartments, at least for

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Bus-bar

3-position disconnecter for each busbar

Circuit breaker

Line isolators and earthing switch, (Line, transformer)

5.17.6 The following requirements are to be followed.

5.17.6.1 The bracing/welding of all components subject to mechanical forces caused by short circuit currents shall be capable so as to withstand the effects of at least 2.5 times the rated symmetrical short time withstand current.

5.17.6.2 The thermal rating for all current carrying parts and insulating materials shall be a minimum of three seconds for the rated short time withstand current.

5.17.6.3 All components of the switch gear which are on ground potential shall be electrically interconnected and effectively earthed.

5.18 **Grounding of GIS:**

5.18.1 All grounding connections must remain operational during and after an arc fault. Proper grounding for mitigating over voltages during disconnecter operation shall be included. Viewing windows shall be provided at the Disconnectors and earthing switches to ensure that each contact position can be inspected easily from the floor level.

5.18.2 GIS will be housed on GIS floor. The bidder shall provide under-ground mat below the substation. The bidder shall also provide adequate number of Galvanized steel risers to be connected to grounding mat, as per relevant standards.

5.18.3 The bidder shall supply entire material for ground bus of GIS such as conductor, clamps, joints, operating and safety platforms etc. to be laid / embedded in GIS floors. All required grounding connectors and associated hardware material shall be in bidder scope.



5.18.4 The grounding arrangement of GIS shall ensure that touch and step voltages are limited to safe values as per IEEE std. 80-2000. Calculation for sizing of grounding conductors including ground mat for step & touch potential shall be furnished.

6.0 **GAS INSULATED SWITCHGEAR COMPONENTS**

6.1 **Circuit Breaker:**

6.1.1 **General:**

- i. The GIS circuit breakers shall comply with the following general requirements for circuit breakers and the latest revisions of the relevant IEC-62271-100 specifications
- ii. Circuit – breakers shall be of with vacuum as arc quenching medium & SF6 as insulation medium and with a minimum- maintenance contact system. These shall be of single / three phase encapsulated type.
- iii. These should be shipped as a completed three-phase unit within a complete bay module.
- iv. Each circuit-breaker shall have Spring – Spring drive mechanism ensuring proper closing and opening and shall permit checking of adjustments and opening/closing characteristic. The ON/OFF latches shall be mechanically interlocked with each other. The circuit breaker shall be completely factory assembled, adjusted and tested.
- v. The total break time from energizing the trip coil at rated control voltage to final arc extinction shall be as short as possible, but in any event not greater than 3.5 cycles i.e. 70 ms.
- vi. The breakers shall be restrike-free.

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- vii. The circuit-breakers shall be capable of tripping and re-closing (Auto reclose) according to the specified duty cycle without derating: O –0.3 s – CO – 3 min. – CO. • Short line faults.

The circuit breakers shall be complied to mechanical endurance class M2 & shall be capable of being operated locally or from remote. Local operation shall be by means of an open/close control switch located in the bay control cabinet. The minimum guaranteed nos. of maintenance free operations of complete GIS shall be 30000 Nos



- viii. The Drive shall have sufficient stored energy for completing 1CO with auxiliary power switched off.
- ix. Each SF6 gas compartment shall be designed for automatic pressure relief in case of pressure built-up due to arcing, at the same time, ensuring that escaping gases are clear-of the operating personal in the front of the Switchgear. Any devices for pressure relief shall be absolutely vermin, dust and damp proof under normal service conditions.
- x. The protection relays and Bay Control Units or Bay Control and Protection Units shall be installed in separate metal-enclosed LV compartments associated with each individual feeder panel.
- xi. A gas service cart with pressure-vessel, vacuum pump, and all required gauges and Fittings for servicing the Switchgear shall be included in the scope of supply.
- xii. Routine maintenance to any of its external components, including the protective relays and instrument transformers, shall not be required in less than five year intervals; internal components shall be maintenance-free for at least ten years, including the refilling of gas.
- xiii. The Switchgear shall be of the free-standing, single-front, single-tier, self-supporting, dead-front design with all high voltage equipment installed inside, SF6 gas-insulated, metallic and earthed enclosures, suitably divided into individual arc and SF6 gas-proof compartments, at least for:
- a. Bus-bars,
 - b. Bus Side Disconnectors & earthing switches,
 - c. Circuit breakers,
 - d. Cable connections.
 - e. Line side disconnectors & earthing switches
- xiv. Each SF6 gas-filled compartment is to be equipped with suitable static filters to absorb any humidity that penetrates through the enclosure materials over long periods of time. In addition filters for removal of SF6 decomposition products shall be provided in those compartments in which arcing or corona discharges can take place.
- xv. Each compartment shall have pressure relief devices and pressure indication gauge. Gauge will have clearly visible pointer and low and high pressure alarms.
- xvi. All incomers and outgoing feeders shall be provided with surge arresters.
- xvii. LV Compartment shall be located at an accessible height.

6.1.2 Closing Devices

The closing coils shall be suitable for operation at any voltage between 110% and 80% of the nominal control voltage measured at the device terminals

6.1.3 Tripping Devices

- i. All electrical tripping coils shall be suitable for operation at any voltage between 110% and 70% of the nominal control voltage measured at the device terminals.

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- ii. Each circuit-breaker shall be equipped with two shunt trip system. The one shunt trip system shall be electrically separated from the other system.
- iii. An emergency hand tripping (mechanical) device shall be provided in the operating mechanism.

6.1.4 Anti-Pumping

The circuit-breaker mechanism shall be provided with anti pumping device.

6.1.5 Operating Mechanism

The operating mechanism shall be in a dust proof (minimum IP 4X) box for this INDOOR installation of Gas Insulated Switchgear. One vermin-proof, sheet steel cabinet of adequate size shall be provided for housing the operating mechanism, aux relays, control and auxiliary equipment and for terminating all control, alarm and auxiliary circuits in suitable terminal boxes. The control cabinet shall be provided with hinged doors with provision for locking and removable cable gland plates for bottom cable entry. Viewing windows shall be provided for observation of the instruments without opening the cabinet. Suitably engraved nameplates shall be provided to identify all equipment in the control cabinet.

The breakers shall have at least 4 normally open (NO) and 4 normally closed (NC) spare auxiliary contacts for Owner's use. If these are not available, auxiliary relays shall be used to multiply the auxiliary contacts of the breakers.

6.1.6 Spring operated Mechanism

- i. Closing action of circuit breaker shall compress the opening spring ready for tripping.
- ii. When closing springs are discharged after closing a breaker, closing springs shall automatically be charged for the next operation and an indication of this shall be provided in the LCC.
- iii. Provisions shall be made to prevent a closing operation of the breaker when the springs in the partial charged condition.
- iv. A mechanical indicator shall be provided to indicate the status of the spring.
- v. Mechanical interlocks shall be provided in the operating mechanism to prevent discharging of closing springs when the breaker is in closed position.
- vi. The spring operating mechanism shall have adequate energy stored in the operating spring to close and latch the circuit breaker against the rated making current and also to provide the required energy for the tripping mechanism in case the tripping energy is derived from the operating mechanism.



6.1.7 Auxiliary Switches

Each breaker shall have auxiliary switches with adequate number of NO and NC contacts all wired to terminals located in the local control cabinet of the circuit breaker bay. 20 % spare contacts should be provided.

6.1.8 Indicating Devices

- i. Position indicators shall be provided to clearly indicate whether a circuit-breaker is open or closed.

	Status	Color
Open position	Open	Green
Closed position	Closed	Red

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- ii. Each circuit-breaker shall be provided with an operation counter to record the number of tripping operations performed. The counter may be located at the local control cabinet.

6.1.9 Gas Connections

Necessary valves and connections shall be provided to assure ease in handling the SF6 gas.



6.1.10 TESTING FACILITIES:

Timing test facility shall be provided with switchgear such that it is not necessary to open up any gas section to make test connections to the circuit breaker terminals. All details of test facilities to be provided shall be submitted with technical bid.

6.2 Disconnecter Switches/Isolator and Maintenance Grounding switches

6.2.1 General

- I. Means to safely isolate and ground any feeder breaker of the Switchgear shall be provided with disconnecter / grounding switches.
- II. The GIS disconnecter switches and grounding switches shall comply with the following general requirements of disconnect switches and the latest version of the relevant specifications IEC 62271-102.
- III. Motor-operated combined isolation / grounding switches, Disconnecter / grounding switches shall be designed to withstand the rated and fault current of the Switchgear. Designs where the actual grounding of the feeder / bus-bar is done via the circuit breaker, i.e., where the disconnecter is used only to preselect the grounding position, are preferred.
- IV. Such three-way switches must have definitive stops at their "ON", "ISOLATED" and "GROUNDED" positions, with no direct movement from the "ON" through the "ISOLATED" into the "GROUNDED" position.
- V. View-ports or mechanical indicators / mimic connected directly and permanently to the operating shaft are required to positively display the actual switch position. Indirect position indicators are not acceptable.
- VI. Power operated drives shall be provided which shall be suitable for local, remote (Substation Control and Monitoring System - SCMS) and also should be fitted with an emergency manual operation facility.
- VII. Disconnect switches shall be three / single phase encapsulated, group operated, no break, with one common motor operated mechanism for all the three poles. These shall also have facilities for emergency manual operation and necessary handles shall be provided.
- VIII. Line side disconnecter with Earthing Switch shall be E1 class operated. Safety earthing switches shall be E0 class operated. The disconnecter shall be M1 class operated.
- IX. Maintenance earthing switches shall be single phase encapsulated, group operated, no break, with one common motor operated mechanism for all the three poles. These shall also have facilities for emergency manual operation and necessary handles shall be provided.
- X. Disconnect switches and grounding switches shall have electrical and Mechanical interlocks to prevent grounding switch from closing on an energized section. Interlocks with other bays for bus transfer switching shall be done through bay control cabinets. Actuation of the emergency manual operating device shall also disable the electrical control. Disconnectors in open condition shall be secured against reclosure.
- XI. All main contacts, male and female, shall be silver plated.



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- XII. Each disconnect switch and grounding switch shall open or close only due to motor driven or manual operation independently. There should also be a pre-set timer in motor circuit for protection against time over –run in case of inadvertent failure of drive mechanism in any intermediate position of the disconnecter travel path.
- XIII. The disconnect switches shall be capable of interrupting the charging current of the connected GIS bus & associated components.

6.2.2 Interlock System

- I. The interlock System must positively prevent an Operator from reaching or creating unintentionally a dangerous or potentially dangerous condition.
- II. Specifically the following conditions must be impossible to reach:
 - Forcing the operator into the only safe and logic sequence to actuate breakers, switches, isolators and grounding switches.
 - Checking the actual fully closed or fully open position of all switching elements before and after each move.
 - Providing the logical checks and issuing the resulting PERMISSIVE or BLOCKED signals for the switchgear.
 - Indicating positively the absolute condition/position of the supervised equipment.
 - Electrically and manually operating the breaker with the disconnecter / grounding switch not fully engaged in any of its three positions.
 - Electrically and manually closing or opening of the disconnecter / grounding switch while the breaker is closed.
 - Electrically and manually closing of the disconnecter switch while the earthing switch at the remote end is closed.
 - Electrically and manually closing of the disconnecter / grounding switch while the remote end isolator/circuit breaker is in closed position.
 - Local emergency unlocking facilities via safety-key switches under the full responsibility of the operator. Intrabay and interbay electrical interlocking shall be provided.
- III. When the manual emergency cranks are used, it shall be impossible to control the devices electrically.
- IV. Electrical 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.
- V. 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.
- VI. Moreover the Bus-bar Isolator of any circuit shall not close electrically or manually while a Bus-bar Earthing Switch is closed.
- VII. Castel key interlocks shall be provided in all incoming and outgoing feeders to provide mechanical interlocking with the upstream / downstream Feeders.
- VIII. Castel Key Interlock shall be provided between the Capacitor Bank main door to the HV VCB in the GIS.

6.2.3 Duty requirements:

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The disconnecting switches shall have breaking capabilities as per IEC requirements. Contact shielding shall be designed to prevent restrikes and high local stresses caused by the transient recovery voltages when currents are interrupted.

The bus disconnecting switches shall reliably handle capacitive currents due to the making and breaking of switchgear components as well as commutation currents due to bus bar reconfiguration.

The disconnecter shall be used for the safe isolation and earthing of the line side feeder/ cable. In the event of maintenance activities on CB compartment, the breaker is isolated physically from bus side as well as line side.

Cable feeders shall be capable of switching induced current as per IEC requirement.

Short Circuit Requirements

The rated peak short-circuit current or the rated short time current carried by an isolator or earthing switch for the rated maximum duration of short circuit shall not cause:



- a) Mechanical damage to any part of the isolator or earthing switch.
- b) Separation of the contacts or contact welding.
- c) A temperature rise likely to damage insulation.

6.2.4 Operation Mechanism.

- I. Mechanism shall be arranged mechanically, electrically, so that all three phases of any particular disconnect switch or grounding switch operate simultaneously.
- II. All mechanisms shall be suitable for electrical motor operation to achieve a fully automatic operation. For emergency situations manual operation shall be possible. Handles or hand cranks shall be provided, together with all necessary operation rods and rod guides. Manual operation shall be prevented if the interlocking system does not allow the operation of the switch.
- III. The auxiliary supply shall be electrically decoupled from the motor when the switch is operated manually.
- IV. The mechanisms shall be arranged for locking in the open and in the closed position. Facility shall be available to allow the switch to be padlocked in any position.
- V. Disconnecting operating mechanism of all disconnecter/ isolator & earth switches shall be at easy operable height.
- VI. The isolator shall be provided with positive continuous control throughout the entire cycle of operation. The operating pipes and rods shall be sufficiently rigid to maintain positive control under most adverse conditions and when operated in tension or compression for isolator closing.

The operating mechanism design shall be such that during the operation of the isolator (especially manual operation), once the moving blades reach the sparking distance, springs shall take over to give a quick, snap action closing so that the isolator closing is independent of manual efforts. Similarly, the springs must assist during the opening operation to give quick breaking feature.

- VII. Similarly, the springs must assist during the opening operation to give quick breaking feature.
- VIII. Additional Requirements for Safety Earthing Switches
 - a) Earthing switch, whenever possible can form an integral part of each pole of the disconnecter. Two independent earthing pads each with flexible copper braids and

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suitable connectors for earth conductor lead shall be provided at the hinge end of the earthing switch.

- b) Interlocks shall be provided so that manual operation of the earthing switches or insertion of the manual operating device will disable the electrical control circuits.

6.2.5 Auxiliary Switches:

Each disconnect switch and grounding switch shall provided with sufficient Nos. of NO – NC as per entire scheme requirement plus two (2) NO-NC electrically independent contacts terminated up to terminal board, at user's disposal. The auxiliary switches shall indicate the position of the switch contacts, and shall be independent of the motor operation.



6.2.6 Position Indicators

- I. Mechanically connected position indicators shall be provided externally to permit observation of close/open position of the disconnect switch and grounding switch.

6.3 Current Transformers:

6.3.1 General

- I. The current transformers provided for each phase shall be supplied in accordance with the following general requirements and the latest revisions of the relevant IEC 61869 specifications.
- II. All transformers must be suitable for continuous operation of min. 20 % overload and for service under all rated and fault conditions.
- III. The current transformers must be outside SF6 gas compartment.
- IV. The current transformer shall be ring / toroidal type, multi ratio with fully distributed secondary windings with relay accuracy as per latest relevant IEC Standards incl. multi core as per requirement and shall be mounted inside the high voltage enclosure.
- V. The secondary terminals of current transformers shall be placed outside the high voltage enclosures, mounted in suitable, accessible terminal boxes and the secondary leads of all the current transformers shall be wired to shorting type terminals. At this terminal block one side of each transformer shall be connected to earth.
- VI. It shall be possible to test each current transformer without the removal of gas through the insulated grounding switches.
- VII. Unless otherwise specified, cores for measuring instruments shall have accuracy classes (0.2S) of not more than 0.5 % and saturation factors less than 5.
- VIII. Current transformers for protection purposes shall be of accuracy class 5P and a saturation factor that will ensure the proper working of the protective devices for all short-circuit currents up to the rated value of the switchgear. Maximum possible DC component of short circuit current shall be considered for CT dimensioning.
- IX. The polarity of the primary and secondary windings of each current transformer shall clearly be indicated.
- X. The number and position of the current transformers shall be relative to the circuit-breakers, disconnecting switches and ground switches as detailed in the attached single line diagram.
- XI. The rating, No of cores, ratios, accuracy class, characteristics etc. for the individual current transformer secondary cores shall be as indicated in data sheet. The various ratios of current transformers shall be obtained by changing the effective number of turns on the secondary winding.

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XII. Each current transformer shall be provided such that the enclosure current does not affect the accuracy or the ratio of the device or the conductor current being measured. Provision shall be made to prevent arcing across the enclosure insulation.

XIII. To guarantee the correct operation of the connected protection equipment, through faults stability calculations shall be submitted showing sufficiency of the chosen CT cores, i.e. rated output, rated accuracy, limit factor, rated primary current, knee-point e.m.f. and resistance of the secondary windings (corrected to the maximum service temperature). Maximum possible DC component of short circuit current shall be considered for CT dimensioning.

6.4 **VOLTAGE TRANSFORMER:**

6.4.1 General:

Each voltage transformer shall be metal enclosed, SF6 insulated in accordance with relevant IEC 61869. The location, polarity, ratios, and accuracy shall be as specified.

The rated output shall match the maximum load of the equipment connected plus min. 25 %, but with a minimum of 50VA unless specified otherwise. The ratios shall be as per the single line diagrams.

Unless otherwise specified Voltage transformers for measuring purposes shall be of accuracy class 0.2, and Voltage transformers for protection purposes shall be of accuracy class 1 (3P).

Voltage transformers must be able to withstand the full rated power frequency withstand and BIL voltages.

Voltage transformers shall be inductive direct plug-in type.

V.T. secondary MCB's shall be provided.

It shall not be possible to connect the secondary circuits of VTs in parallel. In case only one Voltmeter has been installed a selector switch shall be provided.

It shall be possible to isolate the voltage transformer without de-pressuring any gas filled compartment.

6.4.2 Construction:

VTs should be mounted either in same GIS panel or in segregated compartment and not forming a part of bus bar. Transformers should be of either plug-in construction or the disconnect-link type and be attached to the gas-insulated system.

A voltage transformer designed so that it does not have to be disconnected during dielectric testing. The metal housing of the transformer should be connected to the metal enclosure of the GIS with a flanged, bolted, and gasketed joint so that the transformer housing is grounded to the GIS enclosure. Adequate measures shall be provided to prevent any unacceptable impact on the secondary control and protection circuits, which might result from fast transients (VFT) or Ferro-resonance.

6.4.3 Covers and shields:



Enclosures of voltage transformers shall be grounded and completely safe to touch during operation.

6.4.4 Primary and secondary terminals:

Primary and secondary terminals should have permanent markings for identification of polarity, in accordance with IEC.

6.4.5 Provision shall be made for grounding of the secondary windings inside the local control cabinet.

6.5 **Local & Remote Control and Operation**

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6.5.1 General

One local control cabinet (LCC) for GIS shall be supplied for the local control and operation of each bay. Each LCC shall contain the local control, interlocking, operation and indication devices for the associated GIS bay.

The LCC shall be mounted integrally within each GIS bay. The LCC's shall be located with sufficient space for access and the possibility to work at the equipment directly at the switch-gear in front of the related circuit breaker.

The LCC's shall be installed indoor type Minimum IP 4X protected. Access to the components shall be provided.. The control and operation circuits shall be well shielded and with safety measures to protect operator from touching energized parts.

The LCC should have required arrangement for control and operations of GIS from Remote.

The LCC shall include all required functions for control and supervision of a complete GIS. Necessary provision for interfacing for remote operation shall be provided.

6.5.2 Required features for conventional local control cabinets

The LCC's shall be provided with the following features:

A mimic diagram showing the single line diagram. Position indicators, on/off switches for the HV devices and local / off / remote switches shall be installed on or adjacent to the various symbols of the mimic diagram.

- 6.5.2.1 Each LCC shall be provided with space heater to prevent the internal equipment from humidity deposit. The heater shall be rated 230 V AC and fed through MCB.

Low Voltage Compartment:

The following devices shall be supplied as a minimum:



Circuit breaker control switch with ON – OFF indicating lamps. – Circuit breaker “local-remote” selector switch. Disconnect switch, control switch with ON – OFF indicating lamps.

Grounding switch, control switch with ON – OFF indicating lamps.

Monitoring control of all high voltage switching devices in a bay.

Digital display of current, voltage, active and reactive power, power factor etc.



- 6.5.2.2 Any interposing relays and control switches associated with the circuit breakers disconnect switches, grounding switches etc.
- 6.5.2.3 The alarm and indication for devices specified e.g. gas, DC & AC supervision.
- 6.5.2.4 Fuses and links. These shall be installed in the interior of the LCC's
- 6.5.2.5 Terminal blocks for the terminating and marshalling of auxiliary supply circuits, control, interlocking, and indication & alarm circuits from the GIS and for cable connections to the remote control room or the owner's control system.
- 6.5.2.6 A fluorescent lamp and a duplex convenience outlet rated 230 V AC, 15 amps with ground fault interrupter shall be installed in each LCC.
- 6.5.2.7 The Low voltage compartment shall be fitted with pre wired interface terminal blocks for connection to user's control & protection panels. The interface includes CT & PT inputs for protection & Measuring system, Protection trip 1 & 2 signals, Aux switch contacts etc.
- 6.5.2.8 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.

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- 6.5.2.9 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, disconnect switch motor control, alarm, space heater, trip, etc., shall be wired in series to a group / common alarm terminal.
- 6.5.2.10 Each switchgear shall be provided with 2 (two) independent feeders from the DC distribution board of the DC system. Each feeder shall normally feed one section of the switchboard. Switching facility with autochangeover shall be provided at the switchboard such that any one feeder can feed the entire switchboard secondary load.
- 6.5.2.11 Voltages for control, trip and alarm shall be monitored by built-in normally energized auxiliary relays, separate for each bus or feeder section. These relays shall be time delayed on drop-off and their contacts shall be wired to group / common alarm terminals.
- 6.5.2.12 All breakers shall have key-operated selector switches installed in their low voltage compartment (separate from the bay control unit). The key shall be removable in the remote positions only.
- 6.5.2.13 The switch shall have following functions:
- Local position (the breaker isolator and earthing switches can only be operated locally by its push buttons).
 - Remote position (the breaker and Isolator can only be operated from ECMS).
- 6.5.2.14 Breaker / isolator / earthing switch ON / OFF control switches (separate from Bay Control Unit) shall be provided.
- 6.5.2.15 To prevent condensation, space heaters shall be installed in each LV equipment compartment. Each LV equipment compartment shall have a space heater feeder, fed from a separate external power source (from SPDB - Small Power Distribution Board) and protected by a two-pole MCB with auxiliary N/C contact wired to a group / common alarm terminal. The heater elements shall be controlled by humidity and temperature.

6.5.3 Wiring Requirements

- I. Control panel shall be complete in all respects to ensure proper functioning of the control, protection, and monitoring and interlocking schemes.
- II. Wiring shall be done with flexible 1100V grade, FRLS, PVC insulated, switchboard wires with 2.5 mm² stranded copper conductor. Wiring between equipment and control cubicle shall be routed through G.I. rigid conduits and shall be done by PVC & screened cable only, with safety measures to protect operator from touching energized parts.
- III. Each wire shall identify at both ends with permanent markers bearing wire numbers as per Contractor's wiring diagram.
- IV. Wire termination shall be done with crimping type connectors with insulating sleeves. Wires shall not be spliced between terminals.
- V. All spare contacts of relays, push buttons, auxiliary switches etc. shall be wired up to terminal blocks in the control cubicle.
- VI. Terminal blocks shall be 1100V grade, stud type with engraved numbers suitable for termination of at least two numbers of 2.5.0 mm² stranded copper conductor. Terminal blocks for CT, PT, auxiliary AC & DC supply shall be disconnecting link type.
- VII. Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20% active terminals shall be furnished.

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- VIII. Co-axial type cable glands suitable for use with shielded cables shall be used at each termination.
- IX. All control cables shall be installed and terminated in such a manner as to limit the effects of transient electromagnetic voltages on the control conductors to an acceptable level.
- X. Any cabling within GIS shall be supported on cable tray. No cable shall be in hanging position.
- XI. Insulator cones shall be embedded in full return current carrying metal fixing rings in order to avoid mechanical stresses to the cast resin part and to impart full conductivity across the flange connection. Earthing of different gas compartments/enclosures is not allowed with cross bonding with any metal strips.



6.5.4 Connections within the GIS and their LCC's

All cable connections between the various GIS modules and the LCC's shall be made by multi-core cables with multipoint plug in connections on both the ends. PTs & CTs circuit shall be wired with crimped type copper lugs.



The electrical connections between the various gas sections shall preferably be made by means of multiple contact connectors so that electrical connection is automatically achieved when bolting on section to another. The surface of the connector fingers and conductor tubes on such connections shall be silver plated.

6.6 Control Relay Panels

- 6.6.1 Separate Control Relay Panel (CRP) for each bay shall be supplied to facilitate control of circuit breakers, disconnecter, earth switches and metering, protection etc.
- 6.6.2 CRPs shall be free-standing floor mounted type panel to be located in separate room adjacent to GIS hall. CRP shall be in dust and vermin proof hot dipped galvanised sheet steel construction.
- 6.6.3 A mimic diagram shall be provided on the front of the panel with control switches and position indicators for CB, disconnecter and earth switches. The panel shall be dead front type with front door having clear glass cut-out of adequate size so that mimic diagram, annunciator windows, indicating lamps are clearly visible from outside.
- 6.6.4 All protection relays, bay control units, DMMs and associated auxiliary equipment shall be of standard construction from experienced and reliable manufacturers. Important functions and features, in addition to the fault measuring capabilities, shall include:
- Programmable scheme logic,
 - Remote communication interface for setting / interrogation from SCMS,
 - 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.
- 6.6.4 CRP shall house bay control units (BCUs) and protection relays. These panels shall also house the various selector switches, auxiliary relays, timers, local indications, alarms and facia annunciation window etc. to realise various interlocks as per requirement among circuit breakers, disconnectors and earth switches and for breaker pole discrepancy, anti-pumping etc. It shall include the following as minimum:

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- a) Local / off / remote selection switch
 - b) CNT control switch for breaker
 - c) Breaker ON, OFF, Trip-1, Trip-2, Trip circuit healthy indications
 - d) Disconnecter & earth switches ON, OFF control switches & indications
 - e) DC supply healthy indication
 - f) Spring charging devices status
 - g) Aux. relays / other devices as required by the design.
- 6.6.5 Completely separate and isolated circuits shall be used for each operating mechanism control, trip- 1, trip-2, close, alarms and auxiliary devices. Close and trip circuits shall be kept isolated to their final mechanical or electrical actuators from the CRP terminals.
- 6.6.6 Trip circuit-1 & trip circuit-2 shall be individually monitored for continuity under open and closed condition of breaker. Close circuit shall be monitored under open condition of breaker.
- 6.6.7 The contacts and signals originating from/going to the GIS, associated auxiliary and monitoring equipment shall be wired up to the CRP, for external use.
- 6.7 Protection Relay :**
- 6.7.1 All protection relays shall be provided with test plugs and all CT, VT wiring shall be wired through the test plugs.
 - 6.7.2 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.
 - 6.7.3 All protection relays shall be equipped with dual redundant communication port using IEC 61850 with site selectable Edition 1 & 2 , Dual communication (FO or RJ 45) with Parallel redundancy protocol (PRP), KEMA Level "A" certification communication 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.
 - 6.7.4 Protection relays and BCUs shall be supplied from 110 V DC. The relay's maximum DC auxiliary power consumption shall be less than 15 W (all inputs activated and over the full supply range) except busbar protection relay.
 - 6.7.5 Relay shall have 15 or more user programmable function LEDs and 1 fixed LED for relay healthiness.
 - 6.7.6 All Numerical relays shall have features for electrical measurements including voltage, current, power, frequency, power factor etc.
 - 6.7.7 All numerical relays shall have provision of both current (CT) and voltage (VT) inputs as required for protection & measurement purposes using protection cores.
 - 6.7.8 The relay shall be capable of measuring and storing values of a wide range of event, faults and disturbance. The relay shall have facility to record at least 1000 Events.
 - 6.7.9 The numerical relay shall provide supervisory functions such as trip circuit supervision, I2t counter for maintenance & CB wear estimation, CT supervision
 - 6.7.10 All protective relays shall be fully drawn out type with automatic CT shorting.
 - 6.7.11 Relay shall support complete ladder logic with various logic gate

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6.7.12 All relays shall have connections for both CT and PT Inputs.

6.7.13 **Incomer & Bus Sectionalizer Feeder Protection** shall have following functions:

- Instantaneous Over current protection
- IDMT Over current protection
- Instantaneous Earth fault protection
- Reverse power protection
- Directional over current protection
- Under power
- Low & high impedance REF
- Voltage vector shift
- df/dt protection
- Under/Over frequency protection.
- Under/Over voltage protection.
- Circuit breaker failure with two time.
- Cable Fault locator
- Graphical display for single line diagram

6.7.14 **Outgoing feeder with cable differential relay** shall have following protection functions:

Note: Two separate relay to be provided for the Primary Protection for the as cable differential (87L) & overcurrent protection is provided as a backup to the primary protection. All protection singles in a single relay will not acceptable.

Graphical display for single line diagram (any one of the relays either main or backup)

6.7.14.1 **Primary Line Differential protection relay:**



- Differential protection for two-ending-operation & operating time must be less than 35ms
- Protection Interfaces for optical fiber cables support distance up to 2km with multimode or 30km with single mode FO as per the requirement

6.7.14.2 **Backup overcurrent relay :**

- Instantaneous Over current protection
- IDMT Over current protection
- Instantaneous Earth fault protection
- Low & high impedance REF
- Circuit breaker failure with two time
- Cable Fault locator

6.7.14.3 **Transformer Differential protection relay:**

- Differential protection with operating time less than 30ms for both low & high stage



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- Shall have separate REF protection relay with site selectable high & Low impedance restricted earth fault functionality. Also, shall support Over current & earth fault functionality
- Relay shall support Graphical HMI for Single line diagram

6.8 Busbar Differential Protection

- 6.8.1 A numerical low or high impedance bus-bar protection scheme with phase segregated measurement shall be offered (ANSI 87BB). It shall be capable of detecting all types of faults, i.e. multi-phase and single phase-to-ground faults with an overall operating time of less than 1.5 cycles. The architecture of the bus-bar protection shall be derived from using individual bay units along with a central fault-measuring unit.
- 6.8.2 In the architecture of the bus-bar protection, the central unit shall receive data from all bay units, carry out computation and comparison of the restraint and differential currents, locate the fault position, and send the trip decision to the respective bay units operating on the faulted bus-bars.
- 6.8.3 The bus-bar protection shall support automatic transfer of data to ECMS at the substation, whenever system fault-related information or data is produced. The design shall support being scanned by ECMS and FMS for both SCADA like data (protection status, protection start / trip, fault values, fault location and fault records, etc.), and historical data (waveform records). Facilities shall include user interface (both front and rear ports), serial communication and diagnostic / self-supervision, etc. Communication software for local and remote access of data from, and parameter download into, the bay units and / or central unit shall also be provided.
- 6.8.4 The protection shall use GPS time reference; however, the bus-bar protection shall be able to operate correctly independent of this time reference.
- 6.8.5 The bus-bar protection, on operation, shall trigger the breaker fail relay scheme. The breaker failure relay (BFR, ANSI 50BF) scheme shall be provided to monitor the post-trip currents on all bays following fault detection by any of the generic protection relays. The BFR shall be integrated into the bus-bar protection scheme with the supply of additional software package to perform breaker fail relaying function. It shall be sensitive enough to operate between 20 % and 200 % of nominal current, adjustable in steps of less than or equal to 10 %.
- 6.8.6 2-line Human Machine Interface (HMI) facilities shall be provided on both bay and central units.
- 6.8.7 The DC supplies to the bay units and central unit shall be fed from the independent station batteries in a redundant configuration (from DCDB – DC Distribution Board).
- 6.8.8 The bus-bar protection shall be capable of being blocked by a lockable manual switch. Under this condition, the tripping functions shall also be blocked on all feeders (to be provided as hardwired facility). However, the measuring function of the bus-bar protection should remain in service to facilitate signal measurement checks in the restraint and operating circuits of the protection.
- 6.8.9 Extension of the bus-bar protection system shall easily be made possible. The protection cubicles shall be completely wired for the total number of feeders specified in the scope of works. However, protection cubicles shall be designed to provide at least 2 spare wired points for each bus-bar section. In wired points, terminal blocks, wiring and space are provided but hardware equipment and other slot-in modules will not be supplied.
- 6.8.10 The busbar differential protection bay units shall also provide the possibility to be used as additional back-up overcurrent protection with protection functions ANSI 50/50N and 51/51N.

6.9 BUSHINGS:

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All the bushings shall have an impulse & power frequency withstand level that is higher or equal to the level specified under item 2.1. Only SF6 insulated Epoxy Cast Resin will be accepted.

6.10 **Metal-Enclosed Surge Arresters:**

- I. The surge arrestors shall conform in general to IEC 60099-4.
- II. The surge arrester shall be of heavy duty Distribution Class hermetically sealed, Gapless, ZnO, Surge arrester, suitable for use with GIS, for each phase, at the 33 kV line underground cable entry terminals of GIS shall be provided for Line Bays.
- III. These shall have adequate thermal discharge capacity for severe switching surges, long duration surges and multiple strokes.
- IV. Surge Arresters shall be of either the “plug-in” construction or the disconnect-link type and be attached to the gas-insulated system in such a manner that these can be readily disconnected from the system while the system is being dielectrically tested. The metal housing of the arrester shall be connected to the metal enclosure of the GIS with a flanged, bolted joint.
- V. The ground connection shall be sized for the fault level of the GIS. It shall be insulated from the GIS-enclosure and grounded externally to permit periodic maintenance and monitoring of the leakage current.
- VI. The size of the connecting conductor shall be such that all the energy is dissipated to the earth without getting overheated.

6.11 **Insulating Gas and gas leakage rate**

The GIS shall be furnished with sufficient sulfur-hexa-fluoride (SF6) gas to pressurize the complete system in a sequential approach, one zone or compartment at a time to the rated nominal density. The guaranteed leakage rate of each individual gas compartment and between compartments shall be 0.1 % p.a. over the lifetime of the Switchgear. for the service life of equipment.

The quality of new filled-in SF6 gas shall meet the following requirements in line with IEC 60376:

Reuse or recycling of removed gas:

Clear instructions shall be provided by bidder about handling, recycling & treatment of new and used SF6 gas.



During commissioning dew point of SF6 gas shall be measured and documented.

Components may be empty or filled with N2 for transportation and refilled with SF6 at site.

6.12 **Gas sections**

The GIS enclosures (one enclosure for all the three phases or Single phase encapsulation) shall be divided into several gas sections separated by gas-tight barriers. Each section shall be provided with necessary valves to allow evacuation and refill of gas without evacuation of any other section. Location of gas barrier insulators is to be clearly discriminated outside the enclosure by a band of distinct colour normally used for safety purposes.

It should include the necessary valves, connections, density monitors, gas monitor system and controls, indication, orifices, and isolation to prevent current circulation. For the purpose of gas monitoring and maintenance, the GIS shall be divided into various individual zones in each bay. The CB gas zone shall be independent from all other gas compartments and shall meet the requirement of relevant IEC.

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Each gas zone shall be furnished with a gas monitoring system i.e. manometer consisting of a gas density continuous monitoring device provided with two electrically independent contacts which operate in two stages as follows:

- a) First alarm : At a gas density normally 5 to 10% below the nominal fill density.
- b) Second alarm : Minimum gas density to achieve equipment ratings.

In special cases determined by the supplier, a third stage with a set of contacts may be necessary in certain areas. Provisions shall be made for connecting pressure gauges, service cart, and moisture test instrumentation to any one of the gas sections.

Permanent Gas Treatment Devices:

Means shall be provided inside each enclosure for treating the SF6 gas by the use of Desiccants, driers, filter, etc. to remove impurities in the gas. All gas compartments shall be fitted with static filter material containers that will absorb residual and entering moisture inside the high voltage enclosures. Filters inside the breaker compartment shall also be capable of absorbing gas decomposition products resulting from the switching arc.



6.13 GIS Connection /Termination:

6.13.1 GIS to TRANSFORMER:

- a. Transformers shall be connected to the GIS by termination of 33 kV XLPE power cable to OIP condenser bushing. The connection between GIS and high voltage cable at GIS end shall be done through cable termination / cable sealing end. The plug in cable sealing ends for XLPE cables shall consist of gas tight plug in sockets and prefabricated plugs with grading elements of silicone rubber. All high voltage cables will be connected from below through cut-outs in the floor. To maintain the totally insulated design concept of the Switchgear, only fully insulated plug-in type terminations with direct solid dielectric-to-gas insulation shall be used.
- b. Terminations (including plugs) and all accessories shall be provided for all feeders including spares.
- c. Provision for cable termination of XLPE cables, as indicated in 33kV GIS SLD, shall be considered for outgoing cable feeders and incomers, as a minimum. **The plug in cable sealing ends for XLPE cables shall consist of gas tight plug in sockets and prefabricated plugs with grading elements of silicone rubber.**
- d. Sufficient space must be provided in the Switchgear to terminate and connect required cables per phase. Suitable cable support, trays / cleats and grounding facilities must be provided in the cable basement area including all outgoing feeders.
- e. Suitable arrangements of test plug / socket shall be provided which will permit full dielectric testing for outgoing cable of all cable feeders including primary current injection test for current transformers. It shall be possible to carry out the tests without dismantling other equipment.
- f. Totally insulated panel connections, cable plug connectors featuring the inner cone bushing system are required. They must be completely safe to touch. There must be sufficient provision & space available for connection of up to four no. of cables of upto 630 sqmm sizes or as per system SLD requirement

6.14 Locks and Padlocks

- a. Provisions for padlocks and padlocks shall be provided on the switchgear for locking the marshalling compartments or other live parts of the Switchgear to be opened during maintenance.

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- b. Padlocks shall be provided as listed below (three ordinary keys for each lock shall be supplied):
- Locking the Disconnecter/Earthing Switch in the isolated and earthed position,
 - Locking the C.B. control switch,
 - Locking the local/off/remote switch,
 - Locking the 3 (three) selector switches required for manual / automatic transfer operation.
- c. Six (6 Nos.) master keys to fit all types of control and lock switches shall be provided.
- d. Suitable wall mounted metal cased key cabinet shall be provided. In each key box provisions shall also be foreseen to keep permit books and danger boards.

6.15 Earthing of Metallic Parts

- a. All metal parts of the Switchgear and all integral earthing features shall be connected directly to a copper earth bar, which shall run along the full length of the switchgear.
- b. The cross-sectional area of the earth bars shall be as specified and capable to carry the max. rated short time withstand current of the Switchgear for the specified time.



6.16 Voltage Detectors

Each 33 kV 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.

The indicators shall be located on front of the panel. It may be noted that this unit shall also be suitable to be used for interlocking of earthing switches (voltage free condition), whenever feeders are not equipped with voltage transformers.

6.17 Corrosion Protection

- a. The Switchgear shall be treated and protected to withstand at least five years of operation after energizing under the site conditions without sustaining significant corrosion or attacks from fungus or rodents, provided the surfaces remain mechanically undamaged.
- b. The manufacturer's standard corrosion protection may be acceptable subject to the approval by COMPANY.
- c. As minimum painting standard for all steel surfaces, the following is applicable:
- Cleaning to bare metal by mechanical and / or chemical means,
 - Phosphatising or priming with at least one coat of zinc-rich primer. Paints of toxic nature such as lead or chromate are not allowed,
 - Finish painting shall be preferably consisting of powder coating method with DFT 100 micron or electro-statically applied and oven-dried epoxy powder to a thickness of at least 60 microns. Alternatively, at least two coats of epoxy-based compound lacquer may be spray-applied.
- d. All hardware used in the assembly of the Switchgear must be either of corrosion proof material, or be hot dip galvanized.
- e. Gas monitoring and service piping shall be made of copper or stainless steel.

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6.18 Switchgear space heater

- a. 33 kV Switchgear motor-drive compartments shall have a space heater, fed from a separate power source (regardless of the position of the 33 kV CB (ON or OFF) position, protected by a two-pole MCB in combination with an earth leakage protecting device of 30 mA, with auxiliary N/C contact wired to a group/common alarm terminal and shall be equipped with sensors for temperature and humidity control.
- b. The heater shall be located at a suitable position and its capacity shall be as required to maintain the interval temperatures above the dew point taking into consideration the specified environmental conditions.
- c. A switch for each heater shall be provided so that the heater circuit can be switched "ON" or "OFF" as required independently.
- d. When the heating system is live, this shall be indicated by means of a prominently situated red LED.



6.19 Internal Fault

- a. The switchgear shall be qualified as classification IAC according to IEC 62271-200 with regard to its mechanical strength in the event of an internal arc. The test performance shall be in conformity with accessibility type AFLR.
- b. The test shall be executed for all separate compartments within the functional unit containing HV equipment, i.e. bus-bar compartment, circuit breaker / contactor compartment and cable compartment.
- c. Type test reports regarding internal arc withstand performance shall be available in the quotation stage.
- d. All assemblies shall be type-tested at the rated short circuit current with an arc duration of 3 seconds.

6.20 Special tools, tackles and equipments

Special tools, tackles and equipment that are required to perform installation, commissioning, operation & maintenance of the gas insulated switch gear shall be included in scope of supply. Minimum following tools shall be supplied.

- 1 A suitable designed mobile SF6 gas-handling unit shall be included to enable complete vacuuming and re-filling of SF6 gas. It shall contain and comprise a wheeled trolley housing, compressor, standard pressure gauges, piping and control. It may be noted that the gas handling unit shall be provided with all items and filters required to safely remove and dispose the de-composed / contaminated gasses in the GIS after any failure or flashover.
- 2 A suitable calibrated manometer shall be provided to enable calibration of gas manometers and gas pressure switches.
- 3 Precision pressure gauge
- 4 Set of equipment for pressure measurement and gas density meter.
- 5 Any other special tool/tackle required.
- 6 The ladders and walkways shall be provided wherever necessary for access to the equipment. A portable ladder with adjustable height shall also be supplied for access to the equipment.
- 7 All interlocks that prevent potentially dangerous mal-operations shall be constructed such that these can be operated only **by use of special tools**.

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The tools shall be shipped in separate containers, clearly marked with the name of the equipment for which these are intended. The requirement of HV testing during commissioning or repairing or replacement shall be arranged by successful bidder at no extra cost. No delay shall be permitted on account of the non availability of the HV test equipments.

7.0 Name plates



- 7.1 All equipment shall be provided engraved nameplates shall preferably be of 3-ply (Black-White-Black) lamicoic sheets or anodised aluminium. Nameplates shall be fastened by screws and not by adhesives.
- 7.2 GIS rating and name plate
- 7.3 Each bay shall have a name plate showing listing of basic equipment and their relative location.
- 7.4 Each bay auxiliary control cubicle must be identified with its designation to which it is assigned.
- 7.5 Each of the equipment devices including CB, Disconnecter switch, Earthing switch, CT, VT and busbars etc. mounted inside the switchgear shall be provided with proper nameplate and rating plate. as per the latest edition of relevant IEC standards.
- 7.6 Special warning labels shall be provided wherever considered necessary.
- a) Gas Single Line Diagram showing all devices in a single line diagram with the gas sectionalizing of the GIS indicated

8.0 Test and inspection

8.1 Type Tests:

Following type test reports from NABL laboratory/ CPRI , ERDA , India /reputed international test laboratory, as specified in IEC standard 62271-200, 62271-100 (amended up to date) shall be submitted for the offered type, rating of GIS invariably with the technical bid. Bid without type test reports will not be considered for evaluation. The type test reports shall not be older than FIVE years and shall be valid up to expiry of validity of offer. However, if there is no change carried out by the manufacturer in the design since it was validated having carried our type tests, the Type Test Report should be not be older than 10 years and shall be valid up to expiry of validity of offer In event of any changes in the offered design from the type tested design the bidder shall confirm to carry out the required type test/s, special tests, before commencement of supply, without affecting delivery schedule, free of cost.

- I. Tests to verify the insulation level (Lightning impulse, Switching impulse and ac withstand test with PD) test on each GIS device (CB, Disconnecter, bus, etc).
- II. Dielectric tests
- III. Partial Discharge tests
- IV. Tests to prove the temperature rise of any part of the equipment and measurement of the resistance of the main circuit.
- V. Tests to prove the ability of the main and earthing circuits to carry the rated peak and the rated short time withstand current.
- VI. Tests to verify the making and breaking capacity of the included switching devices.
- VII. Tests to prove the satisfactory operation of the included switching devices / Mechanical endurance tests
- VIII. Internal Arc Classification

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- IX. Pressure test on partitions.
- X. Verification of the degree of protection of the enclosure.
- XI. Gas tightness tests
- XII. Electromagnetic compatibility tests (EMC).
- XIII. Additional tests on auxiliary and control circuits.
- XIV. Type tests on Circuit breakers, disconnectors, earth switches, surge arrestors, CT, PT etc as per the relevant standards.
- XV. Seismic test
- XVI. Gas leakage test

8.2 Routine Testing:



All equipment shall be subjected to the Routine tests as laid down in IEC 62271-200 in presence of Owners representative. Routine test shall include But not limited to the following:

- I. Dielectric test on the main circuit.
- II. Dielectric tests on auxiliary circuits
- III. Partial discharge measurements
- IV. Tests on auxiliary and control circuits.
- V. Measurement of the resistance of the main circuit.
- VI. Gas leakage test
- VII. Design and visual checks.
- VIII. Functional tests
- IX. Tests on auxiliary circuits, equipment and interlocks in the control mechanism.
- X. Complete mechanical operation tests
- XI. Complete test of interlocking devices.
- XII. LCC- & Control Relay panel complete functional & interlock test as per approved drawing with LCC duly connected to respective bay GIS module in all respect.
 - IR test
 - Hv test
- XIII. Timing tests for circuit breaker
 - 15.Primary injection test for all current and voltage transformers
 - 16.Secondary injection tests for all protection relays.

8.3 Tests after installation of complete GIS at Site:

After installation and before being put into service, the GIS shall be tested in order to check the correct operation and dielectric integrity of the equipment as laid down in IEC 62271-200. The successful bidder shall furnish a commissioning test plan and a statement method for the tests on site. Tests shall include the following:

- 1. Dielectric tests on the main circuits.
- 2. Measurement of the resistance of the main circuit.
- 3. Gas tightness tests. (Gas leakage test)
- 4. Checks and verifications.

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5. Gas quality verifications.
6. On site power frequency voltage withstand test
7. Tests as per IEEE C37.122.1 clause 4.10.5
8. Functional & interlock tests for all items
9. Demonstration of operational compatibility with SCADA
10. Visual inspection, checks & verifications.
11. Mechanical operation tests of circuit breakers, Bus Side Disconnecter switches with earthing switches and Line side disconnecter switches with Earthing Switches.
12. Insulation resistance measurement

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 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 Any other spare parts not specified, but required, shall also be quoted along with the offer. All spare parts shall be identical to the parts used in the equipment

10.0 DRAWING 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 MAINTENANCE:



The bidder shall provide the services of experienced persons, supervisors, Engineers, experts, etc. for AMC services for satisfactory operation.

The bidder shall have dedicated localized after sales & service team which should be capable any activity to operate complete GIS satisfactorily.

12.0 Training:

Training shall include the following any other specific area may be brought to notice and shall be included.



1. General Explanation for GIS
2. Layout and Architecture of GIS
3. Gas Sectionalisation of GIS
4. Construction of CB
5. Operating Mechanism of CB
6. Maintenance of CB

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7. Overhaul of CB (Interrupting chamber)
8. Overhaul of CB (Operating Unit)
9. Construction of DS/ES
10. Maintenance of DS/ES
11. Overhaul of DS/ ES
12. Construction of Bus/ Cable head/ SF6 – air bushing
13. Maintenance of Bus/ Cable head/ SF6 – air bushing
14. Overhaul of Bus/ Cable head
- 15.-Cable connections
16. Operation of GIS with SCADA
17. Construction & Maintenance of Lightning Arrester
18. Construction & Maintenance of VT/CT
19. Construction & Maintenance of Local control panel
20. Erection of GIS at site.
21. Installation & Testing of GIS at site
22. Type tests of GIS
23. Routine tests of GIS.
24. Faults simulation of GIS
25. Localization of GIS fault.



13.0 PACKING AND DESPATCH

- 13.1 All equipments shall be suitably packed and protected during shipment/transportation by sea, rail and road in such a manner that it is protected against the climatic conditions and for any damage during transportation, transit and storage.
- 13.2 Each shipping unit shall be sealed in a clean dry condition with leak-tight shipping covers securely mounted for shipment. All covers to be removed during installation shall be clearly marked. Each shipping section shall be carefully sealed and filled with dry gas to a slightly positive pressure to prevent the entrance of moisture and contamination.
- 13.3 Gas insulated switchgear (GIS) shall be properly packed to protect during ocean shipment, inland transport, carriage at site and outdoor storage during transit and at the site. Completely assembled bays (subject to transport limitations) of the GIS shall be transported as one shipment unit. Packing materials shall be dust and waterproof. All packages shall be clearly, legibly and durably marked with uniform block letters on at least three sides. Fragile items like bushings, CTs, VTs, LAs and fully assembled bays shall be securely packaged and shipped in containers. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment wherever necessary.
- 13.4 Impact recorders (Accelerometers) shall be provided on the packages to confirm that GIS has not suffered any shocks during shipment, transport, handling, etc
- 13.5 All blanking plates, caps, seals, etc., necessary for sealing the gas sections during shipment to site shall be provided. Vendor to provide quantity of components accordingly considering permanent installation.

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14.0 DEVIATIONS

Deviations, if any, from this standard shall be clearly indicated in the offer with reasoning.

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ANNEXURE – I



DOCUMENTATION FOR 33kV GAS INSULATED SWITCHGEAR

Sl.No.	Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1	Specification Sheet, duly completed	Y	Y	Y
2	Technical Particulars, duly filled-in	Y	Y	Y
3	General arrangement and foundation drg. for all the equipment.	N	Y	Y
4	Typical general arrangement drawings of the equipments indicating space requirement, room dimensions, crane capacity Vertical load/ Live load data	N	Y	Y
5	Earthing layout	N	Y	Y
6	Sectional view of GIS	N	Y	Y
7	Gas Schematic diagram	N	Y	Y
8.	Control schematic and wiring diagrams	N	Y	Y
9	Catalogue for bought out accessories.	N	N	Y
10	Installation operation & maintenance manual	N	N	Y
11	Manufacturing Quality assurance plan with effective quality assurance system	N	Y	Y
12	Field Quality plan indicating instruction	N	Y	Y
13	Gas system installation procedures, gas handling procedures.	N	Y	Y
14	Type test certificates for GIS	N	N	Y
15	Spare parts list with identification	N	N	Y
16	Design Calculations for Bus-bar sizing, Short circuit forces and vibration on Bus-bar & each equipment, thermal stability and losses.	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied with bid.
2. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
3. 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.
4. All final drawings and documents shall be submitted in CD in AutoCAD and MS office format as applicable for Owner's future reference.



Y - Yes, N - No

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SPECIFICATION SHEET
VACUUM CIRCUIT BREAKER of 33 kV GIS

PROJECT: Coal Based Fertilizer Plant		PLANT: Electrical Distribution System	
ISSUED FOR : PROPOSAL <input type="checkbox"/> ENQUIRY <input checked="" type="checkbox"/> ORDER <input type="checkbox"/> FINAL <input type="checkbox"/>			
GENERAL			
Item No. :		Ref. Stds. :	
Quantity :		Encl. Docs. :	<input checked="" type="checkbox"/>
Description :		Make :	
Code No. :		Maker's Type. :	
TESTS :	Routine <input checked="" type="checkbox"/>	Type <input checked="" type="checkbox"/>	Others : <input checked="" type="checkbox"/>
SERVICE CONDITIONS			
TECHNICAL DETAILS		AMBIENT CONDITIONS	
Type :	VCB	Temp.- Max./Min./Design Ref. : 46 / 1/ 50°C	
Rated Voltage :	33 kV	Rel. Humidity : 100%	Alt. above Sea < 1000M
Max System Voltage :	36 kV	Atmospheric Pollution	Dusts : Coal Dust & Urea Dust
Rated current at design site ambient temp. :	3150 A		Vapour : Ammonia & Highly Corrosive
Breaking capacity :	40 kA (3 Sec)	Location	Indoor : <input checked="" type="checkbox"/> Outdoor : <input type="checkbox"/>
Making Capacity :	100kA kA	AUX. POWER SUPPLY	
Short circuit current withstand :	40 kA for 3 sec	System Data	A.C. : 415/ 240 V ± 10 %, 50Hz + 5%
Voltage withstand			D.C. : 110 V ± 10 %, 2wire
1 Min power freq. :	70 kV	Instrument Contact Rating	A.C. :
1.2/50 micro sec impulse :	170 kVp		D.C. :
Characteristic for short line fault related to rated short circuit breaking current			
Operating cycle :	0 - 0.3 s - CO - 3 Min- CO		
Auto reclosing :	Required		
Enclosure material	Aluminium alloy		
Rated break-time (ms)	65	Not more than 100	
Rated closing time(ms):	65	Not more than 200	
Mechanical Endurance class	M2		
Electrical Endurance class	E2		
Restriking probability class	C2		
Inductive current breaking capability	Switch No Load current of transformer		
First pole to clear factor	As per IEC 62271-100		
Opening time in ms	Not more than 55ms		
Closing time in ms	Not more than 100		
No of tripping coils per breaker	2		
No of closing coils per breaker	1		
TRV characteristics	As per IEC 62271-100		



Note: Specification Sheet shall be filled by the bidder and submitted with the bid.

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SPECIFICATION SHEET
CURRENT TRANSFORMER & VOLTAGE TRANSFORMER, 33 KV GIS

PROJECT: Coal Based Fertilizer Plant		PLANT: Electrical Distribution System			
ISSUED FOR : PROPOSAL <input type="checkbox"/> ENQUIRY <input checked="" type="checkbox"/> ORDER <input type="checkbox"/> FINAL <input type="checkbox"/>					
GENERAL					
Item No. :		Ref. Stds. :			
Quantity :		Encl. Docs. :	<input checked="" type="checkbox"/>		
Description :		Make :			
Code No. :		Maker's Type. :			
TESTS : Routine <input checked="" type="checkbox"/> Type <input checked="" type="checkbox"/> Others : <input checked="" type="checkbox"/>					
SERVICE CONDITIONS					
TECHNICAL DETAILS			AMBIENT CONDITIONS		
Nominal system voltage	33 kV+10%	Temp.- Max./Min./Design Ref. :	46 / 1/ 50°C		
Maximum system voltage	36 kV	Rel. Humidity :	100%	Alt. above Sea < 1000M	
Ltg Impulse withstand voltage	170kV	Atmospheric Pollution	Dusts : Coal Dust & Urea Dust		
1 Min. P.F. withstand voltage	70kV	Location	Indoor : <input checked="" type="checkbox"/>	Outdoor : <input type="checkbox"/>	
Frequency	50 Hz +5%	AUX. POWER SUPPLY			
No. of Phases	Three	System Data	A.C. : 415/ 240 V ± 10 %, 50Hz ± 5%		
Earthing Mode	Effectively /Solidly Earthed		D.C. : 110 V ± 10 %, 2 Wire		
System BIL		Instrument Contact Rating	A.C. :		
Rated BIL			D.C. :		
Rated Normal Current					
Rated short time w.s. current	40kA (3 sec.)				
Rated making current	100kA				
System fault level	40 kA (3 sec.)				
Rated Voltage	33kV				
Type of Mounting					
Protected					
Type of Connection	Plug-in				
Applicable standard	-----				
Current transformer					
Type					
No. of cores					
Core details	1	2	3	4	5
Rated primary current					
Rated secondary current					
Application	Metering	Protection	Protection	Protection	Protection
Rated burden					
Knee point voltage					
Magnetising current					
Secondary resistance					
Insulation class of winding					
Voltage transformer					
Type	Electromagnetic/ Capacitive type				
Number of cores	3				
Rated primary voltage					
Method of pri. connection	Delta				
Core details	1	2	3		
Rated secondary voltage					
Application	Metering	Protection	Protection		
Method of sec. connection	Delta	Delta	Delta		
Accuracy class					
Rated burden					
Insulation class of winding					
Rated voltage factor					
Acceptable limit of variation of total capacitance over carrier freq. range					
Std reference range of freq. for which accuracy is valid					
Rated total Capacitance (pF)					



Note: Specification Sheet shall be filled by the bidder and submitted with the bid.

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SPECIFICATION SHEET
DISCONNECTOR SWITCH OF 33KV GIS

PROJECT: Coal Based Fertilizer Plant		PLANT: Electrical Distribution System	
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GENERAL			
Item No. :	Ref. Stds. :		
Quantity :	Encl. Docs. :	<input checked="" type="checkbox"/>	
Description :	Make :		
Code No. :	Maker's Type. :		
TESTS : Routine <input checked="" type="checkbox"/>		Type <input type="checkbox"/>	Others : <input type="checkbox"/>
SERVICE CONDITIONS			
TECHNICAL DETAILS		AMBIENT CONDITIONS	
Nom. Voltage with	33kV	Temp.- Max./Min./Design Ref. : 46 / 1/ 50°C	
Rated current	3150	Rel. Humidity : 100%	Alt. above Sea < 1000M
Rated voltage(rms)Un	36kV		
Number of phases Wire		Atmospheric Pollution	Dusts : Coal Dust & Urea Dust
Rated Frequency with + %	50 Hz +5%		Vapour : Ammonia & Highly Corrosive
Combined (V & F) Variation	+12.5%	Location	Indoor : <input type="checkbox"/> Outdoor : <input checked="" type="checkbox"/>
Rated short-time current	40kA 3 sec	AUX. POWER SUPPLY	
Rated peak withstand current	100kA	System Data	A.C. : 415/ 240 V + 10 %, 50Hz + 5%
Voltage withstand			D.C. : 110 V + 10 %, 2 Wire
1 Min power freq :	70 kV	Instrument	A.C. :
1.2/50 micro sec impulse :	170 kVp	Contact Rating	D.C. :
No. of spare auxiliary contacts on each isolator	6NO and 6NC		
No. of spare auxiliary contacts on each earthing switch	6NO and 6NC		
Enclosure material	Aluminium alloy		
Type of operating mechanism	Motor Operated		
Mechanical Endurance :			
Disconnecter	Class M2		
Earthing switch	Class M1		
Type Mechanical operation	Mechanically & Electrically Spring Operated Ganged		
Bus transfer switching capability (% of rated current)	80		
Rated bus charging current	0.2A		
Rated induced current switching capability	As per IEC 62271-102 Class B		

Note: Specification Sheet shall be filled by the bidder and submitted with the bid.

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TECHNICAL PARTICULARS 33 KV GAS INSULATED SWITCHGEAR

PROJECT: Coal Based Fertilizer Plant		PLANT: Electrical Distribution System	
ISSUED FOR : PROPOSAL <input type="checkbox"/> ENQUIRY <input checked="" type="checkbox"/>		ORDER <input type="checkbox"/> FINAL <input type="checkbox"/>	
General		Service conditions	
Name of manufacturer (OEM)		Ambient Air Temp. in Deg. C Min./Max.	
Type tested at Name of Laboratory		Altitude above MSL, in mtr	
System Parameters		Pollution Class	
Highest System voltage in kV		Creepage distance, in mm/kV	
Rated voltage of System in kV		Relative humidity	
Rated voltage of Equipment in kV		Vibration level	
Rated Insulation level Phase to Earth and between Phases		Noise level	
One Min Power Frequency withstand voltage kVrms		Induced Electromagnetic Disturbance, in kV	
Switching impulse withstand voltage, kVp		Seismic conditions	
Phase to Earth		Auxiliary supply (AC & DC Voltage, Frequency)	
Between Phases		Operation-	
Lightning Impulse withstand voltage, kVp		Control	
Rated Frequency		Illumination & heater	
Rated current in Amp		Support Structure	
Rated current at 50 °C (equipment) in Amp		i Material	
Rated current at 50 °C (bus bar) in Amp		ii Minimum thickness of galvanizing	
Rated short circuit withstand current kArms		iii Foundation channels /Anchor bolts	
Duration in sec			
Peak, kAp			
Enclosure withstand time for an internal fault in sec.			
Estimated total energy loss at			
100 % of rated capacity			
75 % of rated capacity			
50 % of rated capacity			
25 % of rated capacity			
Enclosure			
Code of pressure vessel			
Design temperature in Deg.C			
Material			
Material grade & applicable standard			
Outside diameter in mm			
Minimum Wall Thickness, in mm			
Painting Shade & Thickness	External		
	Internal		
Degree of Protection			
Inductance in H/mt			
Capacitance in pF/mt			
Resistance in Ohm/mt			
Expansion Bellow	Material		
	Min allowable adjustable displacement		
	Longitudinal :		
	Transverse :		
Sealing system			
Estimated life in years			
Barrier	Material		
	Dielectric strength		
Grounding			
Grounding Material			
Grounding of complete GIS			



**ELECTRICAL DISTRIBUTION SYSTEM
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PROJECT: Coal Based Fertilizer Plant	PLANT: Electrical Distribution System
ISSUED FOR : PROPOSAL <input type="checkbox"/> ENQUIRY <input checked="" type="checkbox"/> ORDER <input type="checkbox"/> FINAL <input type="checkbox"/>	
Grounding of individual compartment	
Grounding at flange joints	

SF6 Gas	
Quantity of SF6 Gas of complete GIS at filling pressure, in kg	
Quantity of SF6 Gas of largest compartment GIS at filling pressure, in kg	
Nos of Gas compartments	
Quantity of SF6 Gas of individual compartment GIS at filling pressure, in kg	
Maximum permissible dew point, in Deg.C	
Circuit Breaker	
Type	
Operating Mechanism type	
Nos. of phases	
Rated current in Amp	
Mechanical Endurance class	
Electrical Endurance class	
Restrike probability class	
Rated SC breaking current	
Rated SC breaking current - single phase test	
Rated Line charging breaking current	
Rated Cable charging breaking current	
Capacitor bank switching capability,	
Out of phase making & breaking current	
Rated short line fault current	
TRV characteristic	
First Pole to Clear factor	
Nos. of interrupters per phase	
Type of arc control device provided, if any	
Type of arcing contacts	
Material of main contact	
Material of Arcing contacts	
Filter material	
Timings of operations	
a - Opening at nominal control voltage	
b Closing time at nominal control voltage	
Tripping	
Closing	
Rated operating duty cycle	
Tripping Coils	
- No of coils	
- Rated Watts	
Closing Coil	
- Rated Watts	
Spring Charging Motor	
- Rated Voltage	
- Rated Watts	
Spring charging time at rated Aux supply	
Maintenance required after nos. of operation at	
i No load	
ii Rated current	
iii 25% of rated SC current	
iv 50% rated SC current	
Rated SC current	
Provision of anti pumping	
No of operations after switching off of motor Aux. supply	
Provision of Manual trip	
Electrical interlocking	
Padlocking	
Type of Operation counter provided	



**ELECTRICAL DISTRIBUTION SYSTEM
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DISCONNECTORS	
Type	
Rated current in Amp for	
- Bus disconnecter	
- Line disconnecter	
- Transformer disconnecter	
- PT disconnecter	
IvMaximum Current that can be safely interrupted by the Isolator (Amp).	
- Inductive	
- Capacitive	
Rate Short time withstand Current in kA, for 3 sec	
Rated peak short time Current, kAp	
Rated bus charging current, in Amp	
Type of contacts	
Material of contacts	
Current Density at minimum cross section (A/mm ²)	
Mechanical Endurance class	
Type of Operating Mechanism	
Operating Motor details	
- Rated Voltage	
- Rated Watts	
Operating Time	
- Closing	
- Opening	
Mechanical indication on drive shaft	
Maintenance Grounding Switch	
Type	
Rate Short time withstand Current in kA, for 3sec	
Rated peak short time Current, kAp	
Rated lightning impulse withstand voltage across the open gap, kVp	
Rated Power Freq withstand voltage across the open gap, kVrms	
Type of Operating Mechanism	
Operating Motor details	
- Rated Voltage	
- Rated Current	
- Rated Watts	
Operating Time	
- Closing	
- Opening	
Mechanical indication on drive shaft	
Current transformers	
i Type	
ii Material	
iii Position of Current Transformer	
iv Reference Standard	
v Rated Continuous thermal current	
vi Rated Short Time current	
vii Duration	
a Feeder Bay CT	
i Metering Core	
- Ratio	
- Output Burden	
- Accuracy Class	
ii Protection Core -1	
- Ratio	
- Output Burden	
- Accuracy Class	
iii Protection Core -2	
- Ratio	
- Output Burden	
- Accuracy Class	



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b Transformer Bay CT	
i Metering Core	
- Ratio	
- Output Burden	
- Accuracy Class	
ii Protection Core -1	
- Ratio	
- Output Burden	
- Accuracy Class	
iii Protection Core -2	
- Ratio	
- Accuracy Class	
- Minimum Knee Point Voltage at highest ratio	
- Maximum Excitation Current at V_k	
- Maximum Resistance at highest ratio	
iv Protection Core -3	
- Ratio	
- Accuracy Class	
- Minimum Knee Point Voltage at highest ratio	
- Maximum Excitation Current at V_k	
- Maximum Resistance at highest ratio	
c Bus Coupler Bay CT	
i Metering Core	
- Ratio	
- Output Burden	
- Accuracy Class	
ii Protection Core -1	
- Ratio	
- Burden	
- Accuracy Class	
iii Protection Core -2	
- Ratio	
- Burden	
- Accuracy Class	
Voltage Transformer	
Type	
Position of Voltage Transformer	
Reference Standard	
Rated Over Voltage Factor - Continuous	
Short Time Over Voltage Factor	
Duration	
Partial Discharge Level	
Thermal Rating of Primary Winding	
26 Line & Bus VT	
i Metering Core	
- Ratio	
- Output Burden	
- Accuracy Class	
ii Protection Core -1	
- Ratio	
- Output Burden	
- Accuracy Class	
iii Protection Core -2	
- Ratio	
- Output Burden	
- Accuracy Class	
Enclosed Surge Arrester	
Name of Manufacturer	
Arrester Class & Type (with mfr type design.)	
Rated system voltage (kV)	
Rated Arrester Voltage (kV)	
Max continuous operating voltage (MCOV) – (kV)	
Nominal Discharge Current (KA) with 8/20 Micro-second wave	
Max resistive component of cont current at MCOV-mA crest	



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Max capacitive component of cont current at MCOV -mA crest	
Long Duration Discharge Class	
Min. Energy Discharge Capability (KJ/KV rating)	
Max. switching current impulse residual voltage KVp	
1000 Amps	
250 Amps	
Pressure Relief Class KA (rms)	
High Current short duration impulse withstand level with 4/10 micro-second wave (KA) peak	
Over –voltage withstand capability – KV	
a) 100 Seconds	
b) 10 Second	
c) 1.0 Second	
d) 0.1 Second	
e) Reference Voltage (KV)	
f) Reference Current (KA)	
Surge counter	
Leakage monitor	
Local Control Cubical	
i Name of Manufacturer (OEM of GIS)	
ii Location in GIS	
iii Material	
iv Sheet Thickness	
v Degree of Protection	
vi Padlocking arrangement	
vii Major components of LCC	
- Bay control mimic diagram	
- Control Switches	
- Indicating lamps	
- Position indicators	
- Annunciation scheme	
- Auxiliary relays	
- Contact multiplication relays	
- System parameters display	
- Heater with thermostat	
- Interface terminal blocks for relaying & protection	
GIS to Line connection	
Nos of XLPE cable can be terminated	
Type of cable termination required	
GIS to Transformer connection	
Nos of XLPE cable can be terminated	
Type of cable termination required	

Note: Technical Particulars shall be filled by the bidder and submitted with the bid.

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**TECHNICAL SPECIFICATION
SPECIFICATION FOR ELECTRICAL CONTROL AND
MONITORINGSYSTEMS (ECMS)**

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6.0	COMMUNICATION & MONITORING REQUIREMENTS
7.0	LOAD CONTROL AND TIE LINE CONTROL
8.0	TESTS
9.0	DRAWINGS & DOCUMENTS
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11.0	PACKING
12.0	DEVIATION
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1.0 SCOPE

1.1 This specification covers the general requirements for design, engineering, manufacture, testing at works and delivery in well packed condition at site, erection, programming (as required), testing and commissioning at site of PLC/ RTU based ELECTRICAL CONTROL AND MONITORING SYSTEMS (ECMS) of entire fertilizer complex

1.2 SCOPE OF SUPPLY :

The systems shall comprise (but not limited to):

- 1) Dual redundant Processors (Hot standby) & Racks
- 2) Dual redundant power supplies (240 V AC) for all equipment/ devices.
- 3) Dual redundant communication buses and associated devices
- 4) Dual redundant servers
- 5) Dual redundant data bus with Minimum 1GBPS FO uplink for communication with other ECMS substations and Single Ring data bus with minimum 100MBPS FO uplink for communication within each substation for interfacing individual switchboard end IEC61850 complaint ethernet switches used for switchboard IED interfacing
- 6) I/ O Panels with digital, analogue, pulse and all other types of I/Os, dual redundant power supply modules etc.
- 7) SOE(Sequence of Event) Module
- 8) Operator's Work stations with 32" LED monitors, keyboard, mouse and other input/ output devices as required.
- 9) Engineering work station with 32" LED monitors, keyboard, mouse and other input/ output devices as required.
- 10) One number industrial grade HMI (PC based with 32" LED monitor of latest configuration) , keyboard, mouse and other input/ output devices as required.
- 11) One supervisory work station with LED monitor, keyboard, mouse and other input/ output devices as required.
- 12) Giant screen LED.
- 13) 2 Nos. Industrial Laptop.
- 14) One 132 Column Dot matrix event Printer for printing in black & white colour (each MRSS and OUSS)
- 15) 2 Nos. A4 and 1 No. A4 & A3 color LaserJet printer-cum-copier (each MRSS and OUSS)
- 16) 1 Nos. A4 color LaserJet printer-cum-copier (each Substation other than MRSS and OUSS)
- 17) OFC data and all other cables as required with appropriate components & devices for connection & termination
- 18) UPS Power shall be tapped from UPS of respective Substation.
- 19) All required furniture, Industrial Grade PC console with chairs etc. of Godrej Make.
- 20) All Ethernet switches shall be IEC61850 Compliant KEMA certified with Dual Redundant Power Supplies (Universal AC/DC)

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- 21) All Panels, excluding Server racks, shall be free standing, IP42 with double front arrangement, ergoform lock arrangement and RAL7035 color shade
- 22) Earthing connections for all ECMS equipment and Panel earthing connections shall be segregated as Signal Earthing and Safety Earthing respectively
- 23) RTU / PLC Logic editor shall be IEC-61131-3 compliant
- 24) ECMS Server alongwith RTU / PLC shall be IEC61850 compliant and KEMA or equivalent certified
- 25) All optical fibers all cores shall be terminated on respective LIUs
- 26) All optical fiber cables shall be laid via HDPE pipes and the same shall be separate for redundant fiber optic cables
- 27) All communication cables within substations (Ethernet CAT6, RS485 etc.) shall be laid via GI conduits
- 28) All panel illumination shall be latest LED type.
- 29) Cable Tray & support structure.

1.3 The scope shall also cover the following requirements

- a) Interfacing with DCS through soft link to display the parameters of ECMS at DCS for monitoring.
- b) Current Transducers/ Voltage Transducers / Power Transducers / Energy Transducers / RTD Transducers / Aux. Relays etc. to generate input signals Wherever signal is to be duplicated, for providing to ECMS, Signal Multiplier etc..
- c) Aux. Relays / Opto-Coupler etc. to inter face between Low Voltage regime of ECMS & Electrical System of Plant.
- d) The load shedding signal shall be sent in less than 20 ms and maximum delay time between detection of the load shedding and action by the circuit breaker / contactor shall not be more than 150 ms (including detection, treatment and action).
- e) The proposed system will receive the signal from various field transducers or energy meters for measuring the load on feeders. At each switchgear location, the Mod-Bus RTU communication ports shall be considered for providing the integration with energy meters.
- f) At each switchgear location, the IEC61850 communication ports shall be considered for providing the integration with numerical relays, protection relays, generator relays.
- g) As built drawings, user manuals, programming unit, training of Owner Personnel etc..
- h) It shall be mandatory on part of the Contractor to associate Owner engineers in software installation & testing work.

1.4 The above devices and analogue / digital inputs (only as applicable) from main power equipments in various switchboards, transformer, DG set, transducers / RTD will be networked with ECMS system. The system shall be installed in the ECMS room located at different Substations in entire Fertiliser Complex. Moreover, Centralised ECMS shall be in Main Receiving Substation.

2.0 **SITE CONDITIONS**

2.1 The equipment located in the control rooms shall be in air-conditioned environment and shall operate satisfactorily under the following conditions:

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<u>FOR</u>	<u>TEMPERATURE</u>	<u>HUMIDITY</u>
Operation	10-35°C	20-80% RH
Storage & Transportation	-30 to +60°C	5-95% RH

- 2.2 All the other equipments e.g., RTUs, Interfacing Panels etc. shall be designed for operation, storage and transportation under the following environment with the limits given below. These shall be suitable for satisfactory operation when installed in a pressurized substation with restricted natural air ventilation, in tropical humid and corrosive atmosphere. These shall be designed suitable for the site conditions specified in the data sheets. If no specifically mentioned there in, a design ambient temperature of 40°C and an altitude not exceeding 1000M above the mean sea level shall be considered.

<u>FOR</u>	<u>TEMPERATURE</u>	<u>HUMIDITY</u>
Operation	0-40°C	10-95% RH
Storage & Transportation	-30 to +60°C	5-95% RH

- 2.3 The equipments shall withstand transportation and handling by air, sea and road under packed conditions. The equipments shall also be resistant to termite, fungus, rodents and salty environment.

3.0 Technical Requirements for ECMS

3.1 General

The primary purpose of the ECMS is to provide, by means of microprocessor based technology, control and monitoring functions for power system components. The ECMS shall be linked to protection and metering devices and control systems via dual redundant communication network. The protocols used shall be in accordance with IEC 61850 standards.

The ECMS architecture shall be built as an automated real-time process engine for data acquisition, faults recording, plant performance, energy management, processing, data storage, graphical presentation and display. All components shall be approved and reliable with the highest attainable attributes for uniformity, interoperability and inter-changeability. The design shall be modular to facilitate easy maintenance for fault diagnosis and repair. It shall be possible to alter, extend or upgrade any element of the ECMS by simple addition of hardware with the necessary software augmentation and configuration.

All control system equipment shall be powered by 240V AC UPS. AC driven components such as monitors, printers and other peripheral devices shall be fed by 240V AC UPS power.

A time/frequency facility to determine the system wide coordinated time, power system time, time deviation, power system frequency, and power system frequency deviation shall be provided. The reference time shall be obtained from LSTK Contractor-supplied receivers using Global Positioning System (GPS) satellite signals. The time receiver shall include propagation delay compensation to provide an overall accuracy of ± 1ms and shall also include an offset to permit correction to local time. The internal time base shall have a stability of 1ms per hour or better. The reference time, the power system time and the power system frequency shall be indicated by separate digital displays. Reference time shall be synchronized with reference system time of the existing ECMS systems. Supplier shall also liaise with DCS vendor to finalize the data exchange philosophy and take into account the expected DCS time delays when designing the ECMS system (as far as required). The GPS time reference shall be extended to the ECMS system, sub-system EIU, BCU and CCU.

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To provide remote diagnostics by the LSTK Contractor via the public telephone system, a modem shall be provided. All expenses in connection with remote diagnostics up to the end of the defect liability period shall be included in the total contract price.

The scope of supply and services shall include but not be limited to the following:

1. ECMS substation control system consisting of redundant CCU servers, CCUs, SCUs, redundant printers, redundant GPSs, redundant modems, redundant OWSs, EWSs and all required switches in all substations within the plant.
2. All required interface equipment and switches.
3. All required interconnection cables for equipment provided by Supplier and required for Tie-in.
4. All required DC/DC and DC/AC converters.
5. For ECMS communication between different locations, redundant SDH communication is required and details can be referred in fibre optic cable block diagram.
6. All required ECMS substation components for Tie-in with the existing substations.
7. The MMI SCADA can also be connected to plant LAN for viewing the trends & reports of electrical system through Web Browser from any no. of PCs.
8. Two sets of all special tools required for installation, construction, operation and maintenance of equipment including communication protocol tester (laptop with special software for protocol testing).
9. Furniture for all operator consoles (desks, chairs, etc.) in all substations where Operator & Engineering Console for ECMS.
10. All required software. It shall be the responsibility of the Supplier /vendor to obtain and provide all licenses required for the operation of the software.
11. On-site testing and commissioning including connections to all switchgear, transformers etc. and other equipment's.
12. 2 (Two) weeks trial operation after commissioning.
13. On Site training of the OWNER personnel (1 week).
14. A Substation comprises the following equipment:-
 - a. 220 kV Gantry / Isolator
 - b. 220 KV GIS Indoor Switchgear
 - c. 33 kV GIS Indoor Switchgear
 - d. 11 kV Switchgears
 - e. 3.3 kV Switchgears
 - f. 415 Volt Switchboards (Normal & Emergency)
 - g. Power & Distribution transformers
 - h. HT / LT Motors
 - i. DG Sets (in separate shed) & related equipments
 - j. UPS Systems & ACDBs
 - k. Battery sets & Battery chargers
 - l. Variable Frequency Drives (VFD) / Soft Starters

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- m. Capacitor banks & APFC
- n. Other electrical appliances as required.

3.2 The ECMS shall be designed to carry out following functions:-

- Data acquisition and display of power generation distribution parameters and energy balance in every network configuration.
- Sequence of Event(SOE) Recording
- Load shedding
- Load sharing (KW and KVAR)
- Auto synchronising
- NGR switching
- Capacitor control
- Larger motor start inhibits
- Maximum Demand Limit Control
- Tie Line Control
- Air Raid Control
- EDG Step Loading
- OLTC Control

3.3 The ECMS, by taking reference of the power generated by STGs/ State Grid Power shall send command to the switchboard feeders for tripping or starting the loads in preset sequence as decided later on in consultation with Owner/Consultant, as per process requirement. Switchboard here is 33 kV, 11KV, 3.3KV and LV Switchboard breaker outgoing feeders and contactor feeders which need reacceleration from process point of view.

3.4 PLC/ RTU Processor

The processor unit shall be selected such that processor loading is less than 50%, memory utilization not to exceed 50%, communication bus bandwidth utilization less than 50%(calculated at the time of handing over) and the processors are capable of executing following functions:

- a) Receiving binary, analog & pulse input signals from the field and operator initiated commands from HMI and/ or control panels.
- b) Implementing all logic functions for control, protection and annunciation of the status of equipment/systems, parameters.
- c) Providing supervisory information for alarm, various types of displays, status information, trending, historical storage of data etc.
- d) Providing all basic functions for binary gating operations, modulating controls, storage, counting, timing, logging, transfer operations and comparison functions. The Contractor shall submit full details regarding various functions considered by them with capability for expansion.
- e) Representatives of Owner/ Consultant shall be associated while developing the programs and logic.
- f) The PLC / RTU system shall be provided with necessary interface hardware and software for dual fiber optic connectivity & interconnection with station wide LAN for

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two – way transfer of signals for the purpose of information sharing. The plant information shall be made available through OPC compliant Ethernet link following TCP/IP standard. The exact data structure shall be as decided during detailed engineering.

- g) RTU shall support communication and data transfer communication and data exchange with Main ECMS server over IEC 61850 MMS
- h) RTU shall support communication and data transfer of mission critical data objects over IEC 61850 GOOSE for publishing and subscription of load shedding triggers with all peer RTUs
- i) It shall be incorporated with advanced control system with all required accessories with advanced network data transmission capability for remote I/O connectivity

3.5 The data transferred transfer (from/ to) shall be effected ensuring complete security. The exact number of points to be transferred through the above communication

3.6 **Control Points**

The ECMS shall be capable of providing control functions from the locations listed below. However, only one control point shall be capable of carrying out control functions at any given time but it shall be possible to view the plant status, metering indications, control targets, and other parameters from other locations.

- Equipment Interface Unit (EIU) /Bay Control Unit (BCU) at the switchgears or other equipment
- Substation Control Unit (SCU)
- ECMS

This EIU shall be fully instrumented and provided with all indications and grouped alarms necessary to operate the plant locally. It shall be fitted with a 3 position lockable selector switch enabling the control function to be carried out at either the EIU (“local” label on the selector switch), the SCU (labelled and indicated as “remote” on the selector switch) and OFF (to block all the digital control option altogether).

The BCU is a facility at the local control level to provide the means of controlling the medium voltage switchgear. This BCU point shall be provided with a 3 position lockable selector switch enabling the control function to be carried out at either the BCU (“local” on the selector switch), the SCU (indicated as “Remote” on the selector switch) and OFF (to block all the digital control option altogether).

The SCU is a facility at the substation level to provide means of controlling the entire substation via a redundant system of control interface (PC based with keyboard and VDU), if not indicated otherwise in the ECMS layout drawings. The SCU shall display site graphical representation of the plant configuration, alarms (audible & visual), indications, analogue measured values, relay historical records, fault records, fault values, protection start/trip, etc. The control from the SCU shall only be effective if the selector switch provided at EIU/BCU is set to the “remote” position.

At the ECMS, the control shall only be effective if the selector switch provided at EIU/BCU and SCU are set to “remote” position. The system at the ECMS shall display site graphical representation of plant configuration, position indication of the individual switching units, tap changers position, alarms (audible & visual), analogue measured values, relay historical records, fault records, fault values, protection start/trip, etc.

3.7 Functional Requirements :

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The ECMS shall have following functions :

Display of the station single line diagram and individual feeder mimic diagrams with status (including measuring values) indication for proper operation/ control, effective monitoring and load management shall be inclusive of but not limited to the following:

- a) 220 kV Gantry / Isolator
ON, OFF, Control supply ON
- b) 220 kV GIS
Voltage, current, frequency, kW, kVA, kVAR, kWh, PF,
ON, OFF, Trip on Fault, trip circuit healthy, control supply ON
- c) 33 kV GIS
Voltage, current, frequency, kW, kVA, kVAR, kWh, PF,
ON, OFF, Trip on Fault, trip circuit healthy, control supply ON
- d) STGs 1 & 2 (Future Provision)
Voltage, current, frequency, kW, kVA, kVAR, kWh, PF, field current, output voltage of AVR
Stator winding temperature, Rotor winding temperature, bearing temperature, cooling medium input/ output temperature
ON, OFF, Trip on Fault, trip circuit healthy, control supply ON of Generator Breaker,
ON/ OFF status of NGR breaker, if any.
- e) Diesel Generator Sets
Voltage, current, frequency, kW, kVA, kVAR, kWh, PF, field current, output voltage of AVR
Stator winding temperature, Rotor winding temperature, bearing temperature, cooling medium input/ output temperature, Diesel Tank Level
ON, OFF, Trip on Fault, trip circuit healthy, control supply ON of Generator Breaker,
ON/ OFF status of NGR breaker, if any
- f) Transformers
Winding temperature, oil temperature, MOG level, status of Buchholz Relay, PRV, Moisture ppm (in Power Transformer)
- g) Incomers/ Feeder Breakers (PCC/PMCC/MCC)
kW, kVA, kVAR, kWh, PF, Current, voltage
ON, OFF, Trip on Fault, trip circuit healthy, control supply ON
- h) Bus-couplers
ON, OFF, Trip on Fault, trip circuit healthy, control supply ON
- i) HT & LT Motor Feeders in EPMCC/PMCC/MCCs.
kW, kVA, kVAR, kWh, A, PF
ON/ OFF, Trip on Fault, trip Circuit healthy, Ready, condition of Emergency stop button & Local /Remote selector switch on LCS.
- j) MCC/ PCC/ ASPB Power Feeder

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kW, kVA, kVAR, kWh, A, PF
ON/ OFF, current, Trip on fault

k) UPS

Supply Input1 ON, Input2 ON, Input3 ON
Voltage Battery1, Battery2, Stabilizer
Charging current Battery1, Battery2
Voltage Output Inverter1, Inverter2
Load current UPS1, UPS2, Bypass line

l) Battery & Battery Charger

Input supply ON
Input voltage
Battery Voltage
Battery Charging current
Load voltage DC
Load Current DC

m) Power Supply for all I/O / RTU Rack shall be monitored at ECMS.

n) All panel Cooling Fan failure Alarm shall be monitored at ECMS

o) All ECMS equipment, including but not limited to, such as Incoming and Outgoing supply MCBs, redundant power supply of RTU, IO modules, Ethernet switches, Terminal Servers etc. shall be monitored at ECMS

p) All Server Incoming and Outgoing supply MCBs, redundant power supply of servers etc. shall be monitored at ECMS

3.8 Periodic measurement of Analog values and display of process values on the screen displays such as three-phase volts (phase to phase, phase to neutral), three - phase Amps, frequency, power factor, energy (KWh, KVArh), active and reactive power, tap changer position, Voltage, transformer winding/ oil temperature with graphical representation/trend curves and energy calculation, diesel engine temperatures/speed, motor winding temperature, diesel generator temperature, running hours, motor winding temperature.

3.9 Acquisition, printout and display of substation reports and events; printout and display of individual feeder and substation equipment alarms with date and time stamp. Event/alarm time resolution shall be one millisecond (1ms) or better.

3.10 Storage and archiving of process data for at least 3 years or at least 1 (one) TB for each server/operation station, whichever is greater.

3.11 On-line condition monitoring for Power transformers (dissolved gas analysis, etc.) of GIS, Main & Offsite substations of capacity 40 MVA and above .

3.12 Resetting of electrical trip lockout relays.

3.13 Alarm annunciation and management.

3.14 Self-supervision with display of system alarms and hardware status, including communication links.

3.15 Clock synchronization through GPS receiver.

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- 3.16 Performance of automatic sequential control functions such as automatic bus transfer / change.
- 3.17 System functioning shall not require multiple alarm acknowledgement or manual entries (at different workstation) for the same alarm event.
- 3.18 Classification of alarms with major, minor and low priority levels. Alarms shall provide audible and visual indications. They should also be printed on a logger, and be displayed at workstations.
- 3.19 Plant and station-wide switchgear bay interlocking, Transformer and Diesel generator parallel operation logic.
- 3.20 Communication between the different levels of the control system architecture.
- 3.21 Communication with the station Process Control System for ON/OFF control and status indication of the motors.
- 3.22 Three authorization levels including monitoring (view), control engineering and system manager levels with respective multiple password organization for access control.
- 3.23 Reporting of acquired data in user defined formats (intuitive numerical and graphical presentation).
- 3.24 Setting and parameters downloading/uploading to relays without interrupting the real-time online field communications through a reliable informative interface.
- 3.25 Automatic uploading and archiving of the protection relay disturbance recorder files, without interruption of the real time data communications through a reliable informative interface. Disturbance record analysis Software shall be provided by the Contractor and shall be installed on Operator and Engineering Workstation.
- 3.26 Maintenance records & program.
- 3.27 Record of number of operations of substation devices (breakers, tap changers etc.).
- 3.28 Operator manual entry facility (e.g. tags or flags etc.).
- 3.29 Recording of station outdoor ambient temperatures, humidity, pressure and indoor (GIS, ECMS Rooms) ambient temperatures.
- 3.30 Mobility : Email & alarm alert on mobile in case of any abnormal situation arise in PLC / RTU system or in plant.
- 3.31 A web based energy reporting system.
- 3.32 Redundancy Requirements:
- 3.32.1 Failure of a single module should not impact operation of ECMS. The dual redundant arrangement shall be a Master-Slave, hot standby system. In the event of a failure of one unit, the second unit shall take over control in a bumpless fashion. Also an alarm shall be indicated on the failure unit.
- 3.32.2 A loss of power may not cause the loss of configuration data. This data shall be stored in EPROMS, EEPROMS, or RAM with back-up battery having a design life of 10 years or more. After restoration of power the system shall restart automatically.
- 3.32.3 The redundancy shall furthermore be fully extended into design of the communication interfaces and media. This principle of redundancy should ensure at least the following features:
- Outage of one member of each pair of duplicated components shall not result in any reduction of functionality,

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- Outage of one communication link from individual feeder bay or common unit to the central components shall not affect any other communication link between the central components and all other feeder or common units.

3.32.4 The above requirements may be obtained by means of:

- Duplicated bus-systems with dual-port technique,
- Star configurations,
- Ring Topology,
- And/or any feasible combination of above.

The Vendor/Supplier shall clearly define how the architecture offered in the Bid to meet the redundancy requirements. Therefore, a system block diagram has to be submitted with the Bid.

3.33 Software Requirements

- 3.33.1 The ECMS shall be supplied with user-friendly application software suitable for operation on personal computer workstations (HMI). The workstations shall serve as central control stations by controlling and monitoring the devices in the system, recording events, indicating alarm conditions, and displaying and logging device data. All softwares (Windows 10, Anti Virus, Application Softwares, Energy Reporting Softwares etc.) provided by the Contractor shall be licensed softwares and shall provide the same in Original Licensed CDs for reloading the same as and when required. The Energy Management Software shall be user friendly and user programmable.
- 3.33.2 The system shall be based on standard firmware and software, which has already been implemented in other systems. Software configuration tools shall be available to adopt the system to a specific Switchgear layout, to do settings, to create displays, to define event and alarm text etc. Configuration software shall require no knowledge in programming languages or system source code.
- 3.33.3 Configuration software is provided to the user to configure, set up and modify the data acquisition, data processing and database system components to suit the requirements of specific application functions. The software application shall include programmable logic functions and automatic control functions such as voltage control, transformer tap change control and capacitor switching.
- 3.33.4 This software application shall also have the ability to execute automated sequences initiated either manually by a single command from the operator interface or automatically by a set of conditions at the station, as defined by the logic algorithms.
- 3.33.5 The system shall have an open architecture to ease data exchange between different applications and systems. This concept shall be made available for future extensions, which exceeds the functions defined in this specification.
- 3.33.6 The basic ECMS graphical presentation shall be in the form of power system single line diagrams utilizing standard symbols. The system shall have the capability to display multiple layers of semi-detailed and detailed single line diagrams that dynamically display the magnitude of specified system parameters. Displays shall be hierarchical with initial access at the highest level leading to screens giving data for specific aspects of the system, all displays shall be in English with SI units.
- 3.33.7 The system shall incorporate a monitoring and self-diagnostics software serving both hardware and software. Diagnostics shall provide an effective way of reducing system downtime. Especially on-line diagnostics should help to locate the malfunctioning device or diagnose the fault.

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3.33.8 Programming unit shall have access to the processor of the control system for programming. Programming shall not require special computer skills. On the programming console, it shall be possible to do the programming, self-diagnostics, testing of sequence, simulation and any sequence modification. Programming shall be possible in any of the following formats :

- Flow-chart or block logic representing the instructions graphically.
- Ladder diagrams.

3.33.9 A forcing facility shall be provided for changing the states of inputs and outputs, timers and flags to facilitate fault finding and other testing requirements. It shall be possible to display the signal flow during operation of the program. Programming shall be possible OFF line.

3.33.10 A NORMAL / TEST / PROGRAM / OFF lockable selector switch shall be provided in Operator Console. In case of test mode of operation, all outputs should be blocked.

3.33.11 Provision shall be made for erasing and duplicating the user program and long term storage facilities shall be provided with the help of magnetic tape, cartridge or EPROM.

3.33.12 Manual intervention shall be possible at any stage of operation. Protection commands shall have priority over manual commands and manual commands shall prevail over auto commands.

3.33.13 In PLC /RTU controller, memory should exist as to where the sequence was aborted due to power supply failure so that further operation from that point can restart after power supply restoration. This restart after recovery of the power supply shall be through operator intervention so as to enable verification of readiness of all other associated equipments.

3.33.14 All software's required for implementation of control logic, operator station displays/ logs, storage & retrieval and other functional requirement shall be provided. The programs shall include high level languages as far as possible. Contractor shall provide sufficient documentation and program listing so that it is possible for the Owner to carry out modification at a later date.

3.33.15 The software shall be capable of displaying waveform capture and harmonic analysis graphics from the metering and protective devices supporting these features.

3.33.16 The software shall accommodate user customization of the system and capable of exporting data in a format compatible with third party Power System Analysis software such as ETAP, and general software such as MS Excel, MS Word etc.

3.33.17 All events shall be dated and time stamped. The system shall be capable of constructing a sequence of events from the captured data. Time stamping rates must be capable of discriminating between the transient of high-speed events. Alarm and Event messages must be capable of being instantly sorted by sequence of events/alarms, source type, source name, date, micro second time stamp, device type or type of alarm.

3.33.18 The database archiving layer shall manage the input of data from the translation application into the database. Since the data is "buffered" in CSV files, the importing of data can be sequential, therefore, speeding up the importing process and improving reliability.

3.33.19 The database archiving function will be independent and detached from the translation layer. This will allow independent importing of data locally and on the central system server.

3.33.20 The ECMS application software shall be capable of displaying all the monitored data and configured set points for the metering and protective devices.

3.33.21 The monitored quantities and the set point parameters of the protective and metering devices shall be represented in a consistent, modular format.

3.33.22 Historical data logging, alarming, real time trending and historical trending shall be standard

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features within the package.

- 3.33.23 The ECMS system supplier shall develop the presentation of graphics and data on the ECMS system.
- 3.33.24 The graphic representation of metering and protective devices shall display all device data in tabular format. Graphic representations should be easily configurable by the end user, allowing for the addition, deletion and changing of devices after installation. A data base display of selectable metering and protective device set points, operating parameters and stored information shall be provided. All screens shall provide the complete electrical data for the part of the system being displayed on the screen. The software shall be capable of displaying waveform capture and harmonic analysis graphics from the metering and protective devices supporting these features.
- 3.33.25 A functional system log shall provide a history of all alarm and upset events.
- 3.33.26 The information shall be accessed by selecting different pages using the keyboard or touch screen. Password protection shall be used for selected information and control commands.
- 3.33.27 The screen formats to be displayed shall include as a minimum:
- Overall system representation
 - Generation one line diagrams (circuit breaker status, bus voltage, etc)
 - Switchgear one line diagrams (220kV / 33kV / 11kV / 3.3 kV/ 0.415kV)
 - Generator performance (all generator status outputs)
 - Generator set points and capability curves
 - Synchronizing function displays
 - Control displays
 - Report displays
 - ECMS system overviews showing healthiness of the system
 - Alarm displays – including any self diagnostic alarms
 - Help functions
- 3.33.28 The Operator machine interface shall have different levels of use being protected by password security, such as Operator, Supervisor and Engineer.
- 3.33.29 Engineering and development software required for logic modification and graphics development shall also be loaded on the engineering station PC.
- 3.33.30 Pendrive with License for the above software shall be supplied with the system.
- 3.33.31 The computer operating system shall be independent of the hardware configuration and application; it shall be a standard system and shall not be modified by the ECMS manufacturer.
- 3.33.32 The latest release of software shall be supplied and tested at factory acceptance test (FAT). Consideration to update the software package shall be given before expiration of warranty.
- 3.33.33 Each software delivered under this contract, whether new or update/extension shall be licensed to OWNER. Copies of each software shall be handed over to OWNER.
- 3.33.34 After satisfactory completion of ECMS equipment site testing and commissioning two sets of Back up copy of all software such as application software, database configuration files, etc. shall be handed over to OWNER.

3.34 Sequence of Event (SOE) Recording:

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The Sequence of Event Recording System shall be integral part for recording the change of state of various inputs, and operator actions in chronological order for analysing various upset conditions and other diagnostics in plant emergency conditions.

For sequence of event recording, following signals shall be considered as minimum:

- Protective relay trips of generators breaker, critical motor and power feeder breakers
- Transformer alarm and trip, Turbine alarms and trip
- “Circuit Breaker OFF” contact for all HT feeders and LT incomer and buscoupler.

The sequence of event recording shall be with a resolution of 1 msec or better.

3.35 Time Synchronization

The system shall employ Simple Network Time Protocol (SNTP) for time synchronization over the Ethernet with Accuracy of 1 ms or better which is as per IEC 61850.

The system shall provide global time synchronizing stamps to all hardware and software to periodically time synchronize all data collection devices with internal time clocks, time stamped to the millisecond.

3.36 Latest and proven industry standard operating system to ensure openness and connectivity with other system in industry standard protocols (TCP-IP/ OPC etc.) shall be provided. The system shall have user oriented programming language & graphic user interface.

3.37 All system related software including Real Time Operating System, File management software, screen editor, database management software. On line diagnostics/ debug software, peripheral drivers software and latest versions of standard PC-based software and latest WINDOWS based packages etc. and any other standard language offered shall be furnished as a minimum.

3.38 All application software for PLC / RTU system functioning like input scanning, acquisition, conditioning processing, control and communication and software for operator interface of monitors, displays, trends, curves, bar charts etc. Historical storage and retrieval utility and alarm functions shall be provided.

3.39 The Contractor shall provide software locks and passwords to Owner/ Consultant’s engineers at site for all operating & application software so that Owner/ Consultant’s engineers can take backup of these software and are able to do modifications at site.

3.40 Logs and Reports

- Alarms and Events
- Operator actions
- Power system status
- Generation of reports like MIS reports etc.
- All the Alarms and Events shall be stored in the hard disc. It shall be possible to filter the Alarms and Events and to print out the same as and when required.
- Historical Data Storage.

3.41 Self-Diagnostic:

The ECMS shall perform a continuously running built-in self-check to improve system reliability/availability. The self-diagnostic procedures shall provide sufficient information relating to the problem to facilitate remedial actions within the minimum possible time. The information supplied should indicate the type, magnitude and location of the fault, and action required to be taken following rectification in order to safely restore the control system to full operational service. Self-diagnostic messages shall be stored in the history and shall be shown on the EWS as well as the event printers on detection of any fault on the following as a minimum:

- The whole ECMS Data communication network

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- Any system card (I/O card, controllers, etc.)
- Power supply

3.42 Electrical Immunity

The ECMS shall be able to generally withstand the impact of the electrical tests imposed upon the Switchboard as defined in IEC 61439 and IEC 60947, without any damage to or malfunction of the ECMS.

3.43 Disturbance Immunity

The entire ECMS shall be suitably screened to optimize electromagnetic compatibility (EMC). The system shall comply with and be tested in accordance with the requirements of the IEC 61000 series of publication.

Any electromagnetic disturbance generated by the ECMS and individual components shall not exceed a level which would affect the correct operation of both radio and telecommunications equipment. In addition the ECMS shall have an adequate level of intrinsic immunity to external electromagnetic disturbance to enable it to operate as intended.

Standard UHF and VHF personal radio equipment will be operated in close proximity (less than 1 meter) of the system equipment. The system shall have total immunity from the UHF/ VHF radios used for plant communications.

The VENDOR shall provide type test certificates from a recognized testing authority to verify that the complete ECMS is effectively screened against EMC in line with the applicable IEC standards.

3.44 Communication Integrity

The communication interface bus between the CCU and the IPR/MCU/FCU Modules shall be tolerant to the electromagnetic disturbances shall be fully protected against any short circuit or similar faults without loss of communication.

Reliability of the communication bus shall be monitored in terms of overruns, quality (i.e. framing, parity and checksum errors) and response time-outs.

Failure of communication bus shall generate an alarm to the DCS via the CCU but the current state of devices shall be maintained unless configured otherwise.

3.45 ECMS Spare Capacity

The ECMS shall have the following spare capacity after completing the scope of work in accordance with this specification:

- 20 % installed, pre-wired, spare I/O cards, with a minimum of one of each type.
- 20% spare channels shall be available in each Input/ Output card.
- 20 % wiring, power capacity, spare space/slots in I/O racks etc for future expansion.
- 20% spare slots/ MTUs with dummy cards shall be available in each I/ O cabinet.
- 20 % terminal strips.
- 50 % spare memory, disk space, processing and data highway/network capacity.
- All cards (including spare and dummy cards) shall be wired up to terminal blocks

In addition, at least two serial link ports & two optical ports shall be provided for future connections.

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By adding the spare capacity as indicated above, the performance of the system shall not degrade by any means.

4.0 **Hardware Requirements**

4.1 **Introduction**

This section describes the hardware and software components required to satisfy the ECMS requirements as described in the previous sections. Special attention shall be paid to expandability of the system from existing stations to be connected in the future stages.

Suppliers/Vendors are encouraged to propose their standard hardware and software configurations as long as it meets or exceeds the requirements of this specification. The described allocation of functions to individual servers shall not limit the Vendor from offering their standard configuration, but deviations shall be clearly indicated in the Bid.

International standards shall be applied for hardware and software interfaces to allow system expansion and to reduce dependencies on a single manufacturer.

Software and hardware shall be identical and compatible to the operator consoles. Each of the identical consoles shall be capable of taking over the function of any other console.

The system shall be expandable for accommodating at least 4 (four) additional consoles in order to take care of possible future network extensions.

3 (three) operator consoles shall be supplied at the CCU located at the ECMS room of Main Substation. The third workstation shall be used for configuration, maintenance, disturbance record analysis and training purposes, without interrupting the main system supervision and control functions. Software and hardware shall basically be identical and compatible to the operator consoles. Each of the identical consoles shall be capable of taking over the function of any other console.

4.2 **Bay Control Units (BCUs) for Medium / High Voltage Switchgears**

BCUs shall be designed to perform a large number of functions for control, protection, metering, monitoring, etc. and forms the local control level. They acquire process data resulting from auxiliary contact closures of primary plant, protection, tap position indications, alarm output operations, metering impulses and analogue measured values derived from current/voltage transformers. Therefore, the BCU hardware shall be fitted with the process interface slot-in modules for digital inputs and outputs, analogue inputs, accumulator pulse inputs, etc.

In detail, the BCUs shall execute the following functions:

- Acquiring of process data,
- Process data and position indication,
- Control,
- Interlocking,
- Snychrocheck,
- Sequence of commands,
- Operation cycle counter,
- Interface with the primary equipment,
- Communication with the SCUs.

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BCUs shall be supplied with a touch screen or push buttons for mimic and local operator HMI, status indicating LEDs, and other control facilities.

415 V low voltage switchgear shall be equipped with similar Feeder / Motor Manager.

4.3 Equipment Interface Units (EIUs)

EIUs shall be designed to perform the interface with the primary equipment not equipped with BCUs for control and monitoring through ECMS. The local control will be performed by other features of the primary equipment. Therefore, the EIU hardware shall be fitted with the process interface slot-in modules for digital inputs and outputs, analogue inputs, accumulator pulse inputs, etc. Numerical relays of each feeder may act as EIU.

4.4 Substation Control Units (SCUs)

SCUs shall coordinate the BCUs/EIUs and shall process and transfer the data to the servers of CCU and neighbouring substation. It shall form together with the engineering workstation the substation control level. In addition to its tasks regarding internal and external communication, it carries out automatic inter-bay functions and data logic.

The processor unit shall be selected such that processor loading is less than 50%, memory utilization not to exceed 50%, communication bus bandwidth utilization less than 50% (calculated at the time of handing over).

- 4.5 Each PLC / RTU/ Controller unit shall be provided with two processing units and memories, one for normal operation and another as hot standby. In case of failure of working processor, the hot standby processor shall automatically take over the complete plant operation and appropriate alarm shall be caused simultaneously. The transfer from main processor to standby processor shall be totally bump less and shall not cause any disturbance in the electrical network. The system shall revert to fail safe mode in the event of both processors failing simultaneously. It shall be possible to keep any of the processors as master and other as standby. The standby processor shall be continuously and simultaneously updated in line with the changes in the working processor.

The memory shall be field expandable. The memory capacity shall be sufficient for the complete system operation and have a capability for at least 20% expansion in future. Programmed operating sequences and criteria shall be stored in non volatile semiconductor memories like EPROM. All dynamic memories shall be provided with buffer battery backup. The backup period shall not be less than 360 hours and the batteries shall be lithium or Ni-Cd type.

- 4.6 The server shall be equipped with sufficient hard disc capacity and memory to hold the complete real time data base and to perform basic data analysis, verification, filter and calculation functions like topology analysis, etc. The servers shall be provided with redundant hard disk drive (RAID-5) configuration. The main system shall also provide full server capabilities including fast backup and restore functions. The storage capacity of each server shall be sufficient to cover a period of at least 3 years or 1 (one) TB whichever is greater.

The servers shall have a 64 bit structure and shall be equipped with a real time operation system.

Minimum Configuration:

- Industrial Server grade Intel Xeon, Dual CPU (Resultant speed 8 GHz or more) .
- 4 MB (Min.) Cache memory.
- 16 GB RAM. (Min.)
- 2 X 72 Hot swap SCSI HDD (RAIR level-1 Disc mirroring) .

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- Combo drive
- 2 Serial ports, 1 parallel port, 5 USB port (for all client as well server).
- Graphic accelerator card with minimum 8 MB onboard RAM)
- Dual Network interface.
- 32" LED colour monitors
- Keyboard and Mouse.
- Operating system Windows 10
 - a) Make- HP/ DELL (for server and machines) and Samsung / DELL (for monitors)

Softwares:

- PLC / RTU System software (Windows Programming)
- Application Programme software
- HMI software
- Database Software
- Any and all other software's that may be required
- Operating System: Windows

The system shall be provided with 100% hot redundancy of

- a) Processors and memories
- b) Power supplies
- c) Communication buses
- d) Servers

In detail, the substation control shall execute the following functions:

- Acquisition of the substation related process data,
- Interface with the protection relays,
- Communication with the main system servers,
- Inter-bay switching sequences,
- Inter-bay tripping,
- Inter-bay interlocking,
- Handling of all reports, events, trends, failures, alarms and analogue values (both measured and processed),
- Distributing data to the communication interfaces and workstations,
- Providing data to the printer,
- Receiving an absolute time signal from GPS and distributing it to various ECMS components over the LAN,
- Communication with the PCS/DCS,
- SCUs must work as a redundant system on a main/standby configuration with automatic fail-over logic.

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4.7 Central Control Unit (CCU)

Redundant servers/computers shall be provided to show the station processes at all operating conditions.

The processor unit shall be selected such that processor loading is less than 50%, memory utilization not to exceed 50%, communication bus bandwidth utilization less than 50% (calculated at the time of handing over).

Each PLC / RTU/ Controller unit shall be provided with two processing units and memories, one for normal operation and another as hot standby. In case of failure of working processor, the hot standby processor shall automatically take over the complete plant operation and appropriate alarm shall be caused simultaneously. The transfer from main processor to standby processor shall be totally bump less and shall not cause any disturbance in the electrical network. The system shall revert to fail safe mode in the event of both processors failing simultaneously. It shall be possible to keep any of the processors as master and other as standby. The standby processor shall be continuously and simultaneously updated in line with the changes in the working processor.

The memory shall be field expandable. The memory capacity shall be sufficient for the complete system operation and have a capability for at least 20% expansion in future. Programmed operating sequences and criteria shall be stored in non volatile semiconductor memories like EPROM. All dynamic memories shall be provided with buffer battery backup. The backup period shall not be less than 360 hours and the batteries shall be lithium or Ni-Cd type.

The system shall be provided with 100% hot redundancy of

- a) Processors and memories
- b) Power supplies
- c) Communication buses
- d) Servers

These computers shall be in charge of all centralized data processing, supporting the following:

- Acquisition of the substation related process data.
- Interface with the protection relays for station wide interlocking, tripping, and switching,
- Communication with the main system servers and PCS,
- Station wide automatic control sequences,
- Handling of all report, events, trends, failures, alarms and analogue values(both measured and processed),
- Distributing data to the communication interfaces and workstations,
- Providing data to the printers,
- Featuring database central management and system self-supervision,
- Providing a facility for mass storage of data at substation level,
- Receiving an absolute time signal from GPS and distributing it to various ECMS components over the LAN.

The server shall be equipped with sufficient hard disc capacity and memory to hold the complete real time data base and to perform basic data analysis, verification, filter and

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calculation functions like topology analysis, etc. The servers shall be provided with redundant hard disk drive (RAID-5) configuration. The main system shall also provide full server capabilities including fast backup and restore functions. The storage capacity of each server shall be sufficient to cover a period of at least 3 years or 1 (one) TB whichever is greater.

The servers shall have a 64 bit structure and shall be equipped with a real time operation system.

Minimum Configuration:

- Industrial Server grade Intel Xeon, Dual CPU (Resultant speed 8 GHz or more) .
- 4 MB (Min.) Cache memory.
- 16 GB RAM. (Min.)
- 2 X 72 Hot swap SCSI HDD (RAIR level-1 Disc mirroring) .
- Combo drive
- 2 Serial ports, 1 parallel port, 5 USB port (for all client as well server).
- Graphic accelerator card with minimum 8 MB onboard RAM)
- Dual Network interface.
- 32” LED colour monitors
- Keyboard and Mouse.
- Operating system Windows 10
- Make- HP/ DELL (for server and machines) and Samsung / DELL (for monitors)

Softwares:

- PLC / RTU System software (Windows Programming)
- Application Programme software
- HMI software
- Database Software
- Any and all other software's that may be required
- Operating System: Windows

The CCU shall be connected to the fully redundant Process and Local Area Networks.

An intermediate interface panel shall be provided. The panel shall incorporate substation CCUs to receive data from other electrical equipment including the switchgears, AC UPS systems, DC UPS systems,

Emergency Diesel Generator control panels, Transformers, miscellaneous electrical control panels etc.

4.8 **Operator Work Station (OWS)**

Each OWS shall consist of a 64 bit workstation with full graphics, 2 (two) nos. 32 inch high resolution flat screen LED displays and shall be fully equipped with the required hard disc space, keyboard, mouse and shall be connected via the redundant networking facilities to the substation control units.

The Graphical User Interface (GUI) of the OWS shall comply with available standards like X-Windows, OSF/Motif etc. Each computer system shall be an intelligent full-graphics device,

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providing local, high-speed processing capability. Modern, intuitive and clearly structured windowing techniques shall be applied for displaying, analysis and operation purposes.

There shall be no limitations for assigning different groups of windows and activities to a certain screen. All activities to be performed by the operator shall be handled via interactive dialogues using the keyboard and/or mouse.

The OWS system shall be supplied with a VDU-based operator interface. This interface shall comprise a number of interlinked displays, which will not be limited to the following:

- Operator selection, control, report and help screens
- Substation Overview(s),
- Single line diagrams,
- Detailed view of individual bays or circuits including diesel generator sets,
- Alarm list(s),
- Event list(s),
- ECMS system diagram,
- Communication architecture,
- Protection relay interface,
- LV AC & DC system diagram,
- Daily/Monthly reports.
- Alarm monitoring/reporting, generation of logs, calculations, printing of logs & reports etc.
- Generators: set points and actual operating points, generator capability curves, synchronizing.
- Alarms and operator prompts including any self diagnostic alarms etc.
- Suitable Interface with stations wide LAN for two way transfer of data

The operator functions shall be inclusive of (as minimum) :

- local/ remote selection,
- Auto/ Manual selection,
- Open/ Close operation,
- start/ stop selection,
- ON/OFF/ TRIP,
- Sequence auto,
- By-passing criteria etc.

Supervisory functions like:

- Mimic displays, which shall depict the plant electrical power system network in graphical form and shall cover all the process areas being monitored.
- Alarm monitoring/reporting, generation of logs, calculations, printing of logs & reports etc.
- Suitable Interface with stations wide LAN for two way transfer of data.

The OWS shall be an IBM compatible Desktop Computer with the latest and highest configuration (not less than i10) and of required sufficient capacity (not less than 1 (one) TB),

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RAM capacity shall not be less than 16 GB, Key board, Mouse, Telephone set and headphone comprising hands free type microphone & speakers, Operator's chair and Any other equipment/ device/ peripheral required for efficient operation, monitoring and control.

4.9 Engineering Work Station (EWS)

Each EWS shall consist of a 64 bit workstation with full graphics, 2 (two) nos. 32 inch high resolution flat screen LED displays and shall be fully equipped with the required hard disc space, keyboard, mouse and shall be connected via the redundant networking facilities to the substation control units.

Each OWS shall be assignable to EWS mode for software maintenance, configuration work, demonstration and training purposes without interrupting the main system supervision and control functions depending on login password access definitions. In EWS mode, the control functions shall normally be disabled in order to prevent interference with the on-line activities.

The access to the engineering mode shall be allowed to the system engineer(s), dependent on defined user rights, which are checked by the system during log in.

The EWS shall be used for the following purposes:

- Program entry,
- Program testing,
- Configuration work,
- Setting of parameters,
- Fault tracing,
- Program amendment,
- Graphical program documentation,
- Loading and dumping of programs,
- Commissioning,
- Reading of values in the data base,
- Changing peripheral parameters,
- Other subjects depending on the requirements during engineering design stage.

The EWS shall be an IBM compatible Desktop Computer with the latest and highest configuration (not less than i10) and of required sufficient capacity (not less than 1 (one) TB), RAM capacity shall not be less than 16 GB , Key board, Mouse, Telephone set and headphone comprising hands free type microphone & speakers, Operator's chair and Any other equipment/ device/ peripheral required for efficient operation, monitoring and control.

A service aid shall be able to monitor data in the running substation control system and to present changing variables on the display screen, selectable in tabular form or in graphic representation. This service aid has to be supplied at the beginning of the commissioning period and shall be available for training of the OWNER personnel.

4.10 Global Positioning System (GPS) Receiver

GPS satellite receiver modules in redundant configuration with optical ports shall be provided with antenna cable. The module shall provide time synchronization of the ECMS and FMS (System/PC) and protection equipment in order to guarantee a system wide accuracy of time related data of better than 1ms.

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4.11 I/O racks

Input/Output racks shall be installed at different Substations with redundancy at I/O level. 20% spare capacity shall be provided in each I/O Panel for future use.

All input/output modules shall be 16 channel types. One I/O rack shall be wired for I/O rack consisting of maximum 256 channels (for 16 nos. 16 channel cards.)

I/O racks shall be spacious to accommodate number of cables from switchgears.

Output module shall be suitable to energize 110 V DC/240 AC coil, interposing relay (contactor) shall be used for the purpose. The coil voltage of the interposing relay / contactor shall be suitable for 24V DC control supply and Interposing relay contact rating shall be suitable for 220VDC / 240VAC at 5 Amps. Each Interposing relay shall have minimum 2 CO contacts.

All I/O cubicles shall be provided with forced cooling for uniform heat dissipation.

4.12 Transducers

Analog transducers shall be located generally within the I/O cubicles itself.

Minimum response time of transducers shall not be more than 100 milliseconds.

Voltage transducers shall be suitable for nominal input of 115 V AC.

The range of calibration of various transducers shall be as follows:-

- Frequency : 45-55 Hz - 50 Hz corresponding to 20 mA.
- Voltage : 0-100 V DC - 100 V corresponding to 20 mA.
- Voltage : 0-100 mV DC - 100 mV corresponding to 20 mA.
- Voltage : 0-130 V AC - 130 V corresponding to 20 mA.
- Current : 0-1.2 A - 1.2 A corresponding to 20 mA.
- Power : 0-110 V & 0-1.2 A AC - 228.6 Watts corresponding to 20 mA.
- RTD Transducers : PT 100

4.13 System Input and Output Module

I/O Module interface

IO modules and CPU should be of same manufacturer, make, same series and form factor.

I/O modules shall be of high density, modular, rack based and hot swappable.

Redundant Power supply shall be provided at each I/O Rack Level.

Input/ Output Modules

- a) The PLC / RTU system should be designed to suit the location of the input/ output cabinets. (Exact location shall be finalised during detailed engg..)

The Contractor shall consider in their offer, Input Output modules, as required in the Control System for all type of field input signals viz 4-20 mA, RTD, Thermocouple, non changeover/ change over type of contact inputs etc. and outputs from the control system viz non changeover/ change over type of contacts, 24/48 VDC output signals for energizing interface relays, 4-20 mA output etc.

Electrical isolation of 1.5 kV with optical couplers between the plant input/ output and controller shall be provided on the I/O cards. The isolation shall ensure that any inadvertent voltage or

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voltage spikes (as may be encountered in a plant of this nature) shall not damage or mal-operate the internal processing equipment.

The Input/ output system shall facilitate modular expansion in fixed stages. The individual input/ output cards shall incorporate indications on the module front panels for displaying individual signal status.

Individually fused output circuits with the blower fuse indicator shall be provided. All input/output points shall be provided with status indicator. Input circuits shall be provided with fuses preferably for each input; alternatively suitable combination of inputs shall be done and provided with fuses such that for any fault, fuse failure shall affect the particular drive system only without affecting other systems.

All input/output cards shall have quick disconnect terminations allowing for card replacement without disconnection of external wiring and without switching of power supply.

System shall have following monitoring features:

- (i) Power supply monitoring.
- (ii) Contacts bounce filtering.
- (iii) Optical isolation between input and output signals with the internal circuits.
- (iv) In case of power supply failure or hardware fault, the critical outputs shall be automatically switched to the fail-safe mode. The fail-safe modes to be considered shall be finalized during detailed engineering.

Keying-in of individual wire connectors shall be provided to ensure that only the correct card is plugged on the I/O module. It shall be possible to remove I/O module without disconnecting wiring from field inputs or outputs.

At least 20% spare capacity shall be made available on input, output and memory modules, over and above the system requirement.

Binary Output modules shall be rated to switch ON/OFF coupling relays of burden 3 VA at 24 VDC (approx)/ actual requirement whichever is more. Analog output modules shall be able to drive load impedance of 500 Ohms minimum.

Output module shall be capable of switching ON/OFF inductive loads like solenoid valves, auxiliary relays etc. without any extra hardware.

Only one contact shall be provided in the panels for control and interlock requirement. Further multiplication, if required, shall be done by the Contractor in PLC system.

All input field interrogation voltage shall be 24V DC or 48 V DC.

All digital input and outputs shall be through relays

In case of loss of I/O communication link with the main processing unit, the I/O shall be able to go to predetermined fail safe mode with proper annunciation.

4.14 Terminal Blocks

Terminal blocks shall be 1100 V grade, 20 amps rated, one-piece moulded, complete with screw type terminals, mounted on C channel and clip on type. Markings on the terminal strips shall correspond to wire numbers on the wiring diagrams.

20% spare terminal blocks shall be provided for each function.

All spare contacts and terminals of the panel mounted equipment and devices shall be wired to terminal blocks.

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Fused isolating TBs with visual indication of fuse down shall be provided for each digital input and output terminals.

For analog inputs/outputs, knife edge type isolating TBs shall be provided to isolate field input and output for maintenance purpose.

Every terminal shall be uniquely identified within the terminal cabinet by means of a terminal number.

Separate terminal blocks shall be provided for

- a) Connections from field equipment
- b) Inputs to PLC / RTU
- c) Outputs from PLC / RTU
- d) Inputs from/ outputs to HV/ MV switchgear
- e) Circuits/ Signals carrying different voltages.

4.15 **Printer**

The printer-cum-copiers shall deliver alphanumerical and full graphical documentation of the work such as printouts of the application program and of the station mimic diagrams in graphical form. The printers shall be of the laser and color type. For each substation (except than MRSS and OUSS) following shall be provided:

- 1 (two) A4 printers.

4.16 **Large Screen**

For the Station overview display one modular large LED TV shall be provided in CCU (ECMS control room in Main substation).The minimum size of the display shall be 2500 x 1500 mm (W x H) approximately .

The display shall be aesthetically integrated in a panel and into the ECMS environment in a manner that maximizes operator ergonomics. The system shall be capable of displaying any graphic screen available in the ECMS and special graphic displays created for the large screen projection system. It shall be possible to display a single picture such as the network overview display across all screens. The selection shall be possible from any of the operator consoles.

The independent system shall be seamlessly integrated into the ECMS system providing the same basic functionality as any other CRT-based ECMS display. It shall be possible to use the system as one screen or as a multi-screen system.

4.17 **Facilities to Authorized Personnel**

The following functions shall be available via password protected security levels through the EWS:

- Opening and closing of selected non-motor circuit breaker.
- Programming of all protection parameters.
- Monitoring of all measured actual values.
- Reporting of motor and/or circuit data following a trip including circuit current, earth current and percentage phase unbalance.
- Historical reports including running time, number of starts and number and causes of trips.

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- Trend analysis of motor variables including motor current, earth current and I2t heating effect, also switchgear load surges and transients when available in MCU.
- Recording of all events, date and time stamped for all circuits connected, with printout facilities including running/stopped/alarm/trip (including pre-trip variable and reason for trip).
- Saving and Loading of each MCU / FCU / IPR protection parameters.
- Communications reliability monitoring facilities to classify and quantify identifiable communication errors including overrun, quality, response time and system scan time. Processor percentage loading assessment.
- Active Single Line representation of the electrical system shall be provided at an overall and individual bus level facilitating visual and “Click” interrogation of the network status and MCUs / FCUs / IPRs parameters.

4.18 Test Facilities

Facilities shall be provided to allow functional testing of the BCU, MCU and FCU modules, without having to run the motor or energize the feeders.

For test and training facilities, ECMS Vendor shall include a simulation unit to simulate all possible signals/controls for the testing/training function.

This facility shall be provided by a test setting on the switchgear and/or by means of a standalone test rig to simulate all possible control functions, including the automatic restart function.

It shall also be possible to conduct tests from the DCS to the individual MCUs and FCUs.

The simulation unit with a training tool is required for training purposes. With this unit, situations can be simulated to train operators (both new / inexperienced and experienced ones) on what to do and when, and to become familiar with new applications and / or with changes in the power system. The most important aspect of the simulator is its ability to simulate a real time operator environment without influencing the network so that the operator actions will not decrease the availability and security of the network.

The simulation for communication between ECMS / DCS / ACC should be demonstrated during FAT / SAT as an inter-operability test.

The simulation unit shall also be used for carrying out the communication test between ECMS and SWGR's / DCS / ACC / Other Third Party Equipment's (i.e. VSD, UPS, EDG, HVAC control panel, Transformers RTCC panel, Thyristor Heaters and Other electrical Control panels).

5.0 SOFTWARE (DEVELOPMENT APPLICATION)

5.1 For control, interlocking, monitoring, load management, data logging and printing of status of all important electrical equipment and feeders, a Programmable Logic Controller (PLC) / RTU shall be provided.

5.2 PLC / RTU in hot back-up configuration along with colour graphic unit, printers and operator interface shall be located at Sub-Station / Control Room. However, the input/output racks housing the various digital and analog I/O modules shall be located in different sub-stations / switch rooms and fields as required.

5.3 The various functions of PLC / RTU shall be as follows: -

5.3.1 Control :

The control function shall generally include the following: -

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- Automatic switching ON/OFF of grid supply and various feeders for load management depending on availability of generators and grid supply under various operating conditions.
- Manual ON/OFF switching of grid supply, various 220 kV, 33kV, 11kV, 3.3. kV feeders, 415 V Breaker Feeders and other important feeders from keyboard.
- Interlocking and auto-changeover of Incomer and bus coupler feeder breakers of various 220 kV GIS, 33kV GIS, 11kV switch boards, 3.3kV switch boards 415V power control centers and motor control centers
- Capacitor Control

5.3.2 Monitoring :

The monitoring function shall generally cover the following: -

- Measurement of current and active power of the incoming feeders from generators and grid and all outgoing feeders of 220 kV GIS, 33 kV GIS , 11KV & 3.3 KV boards, and 415 V Breaker Feeders .
- Measurement of voltage, frequency and power factor of the grid and generators.
- Mimic diagram for complete 220kV GIS, 33kV GIS, 11KV switchboards, 3.3 KV switchboards and 415 V Switchboards i.e. PCC/PMCC/MCC incomers indicating position of various breakers and load flowing through them

5.3.3 Data Logging :

The data logging function shall generally cover the following

- On demand type real time information and printing of KVA demand, energy consumption, voltage, frequency, current etc., and also fault logging such as tripping of important feeders and equipment.

5.3.4 Indication and alarm for tripping on fault of various monitored feeders and equipment

5.3.5 The software shall be programmed for simultaneous display of ladder logic diagrams along with pictures for loads required to be monitored.

5.3.6 The software shall be capable of control, monitoring, load management, data logging, overviews, data tables, bar charts, trends, close to alarm, sequence of events and alarms with date and time in printable output etc. and printing of status of all important electrical parameters, equipments and feeders.

5.3.7 It shall be MANDATORY on part of the contractor to associate owner engineers in software installation & testing work

6.0 COMMUNICATION& MONITORING REQUIREMENTS.

6.1 Optical Fiber cable shall be used as data bus.

6.2 The Fiber optic cable shall be single mode. The maximum allowable loss shall be 0.5 dB/Km at 1300 nm. The inner sheath shall be of HDPE and outer sheath (Minimum 3 mm thick, orange colour) shall be HDPE-FRLSZH. The armoring shall be polymer coated corrugated steel. The temperature rating shall be -10 to + 90 ° C. Temperature cycling test shall be carried out in accordance with IEC 60794-1 (latest issue). The F/O cable shall be suitable for outdoor/tray/conduit/direct buried applications. The F/O cable shall be as per IEC60793-2-10.

6.3 The Ethernet cable shall be armoured CAT-6 pair shielded with overall braided screen. The conductor shall be of 4 pair STP cable 23 AWG annealed bare stranded copper. The primary insulation shall be HDPE and outer sheath shall be HDPE-FRLSZH. Armoring over inner sheath is required. The cable shall be screened to ensure protection against EMI and for cross talk compliance. The Ethernet cable shall be suitable for outdoor/tray/conduit/direct buried

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applications. The maximum permissible length from one point to another point shall be 70 Mtr.

6.4 If required Contractor shall provide a separate but integrated GPS communication module for time synchronizing with Satellite clock with the accuracy of better than 1 milli-Second.

6.5 COMMUNICATION WITH FOREIGN DEVICES

a) Foreign devices like numerical relays and communicable meters etc. shall communicate with ECMS for intended plant monitoring and control

6.6 COMMUNICATION WITH PLANT DCS SYSTEM

a) The proposed ECMS system shall exchange data bilaterally with the plant DCS of the complex as defined. ECMS supplier may seamlessly integrate plant DCS into ECMS to achieve the same. If this is not feasible, an OPC link as defined below shall be supplied

b) 1 no. redundant point to point connection over Ethernet (TCP/IP) from one of the proposed plant DCS nodes at control room shall be provided for connectivity between proposed ECMS and plant DCS. ECMS end node shall be an OPC server. The media shall be twisted pair cable of 100 base T specification. The plant DCS end node shall be configured as a Master. The ECMS node is required to operate as a Slave for communication control on this link. The volume of data exchange between proposed ECMS to plant DCS shall be on “as required” basis. Any hardware (including redundant firewalls) and software required at the ECMS end shall be provided by vendor including termination of the cable at both the ends

c) The communication scheme should not be a bottleneck for the successful operation of all control systems with defined functionalities during the lifetime operation of the system. If a different protocol for digital transmission of bilateral data is chosen, the ECMS supplier shall appropriately select the interface hardware, protocol and suitable networking software for this transmission and coordinate suitable with the plant DCS provider for the proper functioning of the data link.

6.7 COMMUNICATION WITH STATE ELECTRICITY BOARD LOAD DISPATCH CENTER

a) The proposed ECMS system shall exchange data bilaterally with the Load Dispatch centers of the Powergrid/ State Electricity board as defined. ECMS supplier may seamlessly integrate Load Dispatch centers into ECMS to achieve the same. If this is not feasible, an IEC-60870-5-101/ 104link as defined below shall be supplied

b) 1 no. redundant point to point connection over Ethernet (TCP/IP) and/ or serial (RS232/422/485) from Load Dispatch Center SDH (Serial Data Highway)equipment located at switchyard control room shall be provided for connectivity between proposed ECMS and Load Dispatch Center. ECMS end node shall be an IEC-60870-5-101 / 104 Slave. The Load Dispatch Centers shall be configured as a Masters. The ECMS node is required to operate as a Slave for communication control on this link.

c) There will be multiple such Load Dispatch Centers (maximum 6 nos.) which shall simultaneously communicate with proposed ECMS system. Accordingly proposed ECMS to ensure simultaneous communication with all systems in parallel.

d) The volume of data exchange between proposed ECMS to Load Dispatch Centers shall be on “as required” basis. Any hardware (including redundant firewalls/switches) and software required at the ECMS end shall be provided by vendor including termination of the cable at both the ends

e) There shall be physical isolation between ethernet switches and ethernet networks of ECMS and ethernet switches and ethernet networks for communication between ECMS to Load Dispatch centers. This is ensure that any interference or network outages on Load Dispatch Center SDH equipment shall not have any interference in communication and data exchange of ECMS system and functionalities.

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- f) The communication scheme should not be a bottleneck for the successful operation of all control systems with defined functionalities during the lifetime operation of the system. If a different protocol for digital transmission of bilateral data is chosen, the ECMS supplier shall appropriately select the interface hardware, protocol and suitable networking software for this transmission and coordinate suitable with the Load Dispatch Centers for the proper functioning of the data link.

6.8 Analysis and Diagnosis of Communication System

For commissioning and trouble-shooting of the communication system, a software package resident in a LAPTOP computer shall be provided for each area. Operation must be simple and menu-guided. Tasks to be performed with this software shall include:

- Simulation of master and remote stations,
- Several protocol and profile variants: IEC 61850, IEC870-5-101, IEC870-5-103, and any other applied in the system,
- Long-time observation and archiving (i.e. for later analysis of intermittent faults),
- Plausibility check of user inputs when tele-control messages are edited,
- Documentation of test sessions in a data file or on the printer,
- Listing and recording with and without filtering function,
- Editing of messages and sequences,
- Receiving and transmitting of messages,
- Transmitting of sequences,
- Automatic test sequences,
- ON-LINE and OFF-LINE operation,
- Channels with a freely selectable protocol variant.
- Filter function with:
 - Channel overlapping filter,
 - Channel specific, protocol dependent filter functions i.e. for the station number,
 - Programmable system reaction,
 - ON-LINE and OFF-LINE, which allows filtering of archived data.
- Storing of messages sent with time signals, with the interpreting and display of the content,
- Detection and interpreting of faults (telegram and procedure faults),
- Passive check with transmit and receive,
- Active test with automatic send mechanism,
- Filtering.

The laptop workstation shall be configurable in software by the system manager. As required, it shall also be configurable to access relay / fault recording function data available at the engineering workstation. The modem / communication system shall be of the 'dial up' type, suitable for connecting to a public switched telephone network.

7.0 **LOAD CONTROL AND TIE LINE CONTROL (Future Provision)**

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- 7.1 Total load of the plant at any given time is dependent on the number of process units on line and their production. Load control software shall be aimed at managing the power requirement of the plant by generating set points for the TGs. This software shall have provision to load a generator within a minimum and maximum loading regime and load ramping rates recommended by machine manufacturer.

When the plant is running isolated from grid, this software shall dictate the load sharing between generators and isochronous/ droop mode of operation of the machines. When the plant is running parallel with the grid, the software shall also ensure import/ export to/ from grid within predetermined limits. This tie limit shall be operator settable and shall be fixed in such a manner as to maximize power plant capacity utilization.

7.2 LOAD SHEDDING REQUIREMENTS (Future Provision)

ECMS shall be PLC / RTU based having provision of actual measurement of power and load shedding based on predetermined logic or command to maintain healthiness and availability of plant Electrical system. Priority of load shedding shall be decided by the Contractor in consultation with Owner/consultant.

ECMS shall have provision of ambient temperature based load shedding.

The scope shall include installation of Fast load shedding functions including frequency based load shedding, manual load shedding & overload shedding to avoid bogging down of complete system in case of tripping of any source or system disturbance for different modes of operation of Grid and CPP – STGs (Future Provision) under various load scenarios

7.3 Basic Features of Load Shedding (Future Provision)

- 7.3.1 Type of load shedding desired - Overload / contingency based / frequency based / manual load shedding / maximum demand load shedding (peak shaving) (combination of all of above).
- 7.3.2 Response time desired from Load shedding scheme in case of contingency based load shedding- max 150mSec including breaker tripping time.
- 7.3.3 Load shedding System offered shall have user programmable software to implement the load shedding logic at site and shall be flexible to change the logic / priority table as and when required to meet the operational requirement as mentioned below:-
- 7.3.4 Bypassing of any feeders from the load shedding scheme for maintenance and other requirements
- 7.3.5 Necessary operator intervention when major maintenance activities are carried out, like bus shutdown, overhauling of DG set etc
- 7.3.6 The load shedding scheme is based on predefined contingencies. In case of shutdown, overhauling etc which may result in an undefined contingency, the same needs to be handled by the operator manually.
- 7.3.7 Bypassing the complete load shedding scheme for specific requirement
- 7.3.8 The load shedding scheme shall have the flexibility of addition and deletion of load and also to change / edit the priority list in future.
- 7.3.9 The scheme shall have necessary interlocks against false tripping when Generator breaker is closed in Test position
- 7.3.10 During need to shed load, Total system load (MW) shall be considered from the last updated value while calculating the amount of load that is required to be shed.
- 7.3.11 The amount of load to be shed shall be calculated by the ECMS and the load shed shall be based on the measured values from each feeder.

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7.3.12 The reset command for breakers tripped on load shedding shall also be generated from the ECMS so that a load tripped on load shedding is not allowed to be restored until the exigency leading to load shed has been attended to. Hence a latched changeover type contact 'DO' shall be provided for each breaker feeder, which shall inhibit closing of the circuit breaker, tripped on load shedding.

7.3.13 During a load shed sequence, if a feeder fails to trip then the ECMS does not try to trip this feeder again. Instead other loads are tripped if the system remains in load shed condition.

7.3.14 The loads shall be shed automatically such that the generators are not overloaded and frequency shall not fall below the trip set value.

7.4 Load Shedding Functions

The ECMS shall provide three load shedding functions,

1. Contingency based (Fast)
2. Df/Dt based (backup to fast contingency)
3. Overload based (Slow)

7.4.1 Overload Based

The Overload based load shedding function shall be as follows:

7.4.1.1. In the event of gradual overload then the ECMS will initiate an integrating counter proportional to the magnitude of the overload per running generator set. In the event that the overload exceeds a preset figure then load shedding is commenced until the overload is removed.

7.4.1.2. The ECMS shall continually calculate and determine the maximum power available from each supply source, and therefore know the maximum capacity of the overall plant electrical power supply at any given time

7.4.1.3. The ECMS shall continually calculate and determine the total plant load by adding up the measured loads for each operating drive.

7.4.1.4. The ECMS system shall continually calculate and determine the difference between the maximum power available and the total plant demand load and where the demand is greater than the availability, trip sufficient drives and feeders to address the capacity deficit.

7.4.1.5. The STGs will have a varying spinning reserve dependent on site ambient and varying operating conditions. The capability curve of the machine will continually be adjusted in the ECMS in accordance with these conditions. The spinning reserve and calculated load to be shed will be continually updated in accordance with these constraints.

7.4.1.6. It is envisaged that the STGs spinning reserve will be available from the STGs control panel interface. However, if this is not available the contractor will calculate the STGs spinning reserves.

7.4.2 Contingency Based Fast Load Shedding

7.4.2.1 In the event of sudden loss of a generator or any other contingency then the ECMS will initiate a fast acting load shed sequence, if sufficient generating reserve is not available to meet site demand.

7.4.2.2 The contingency based load shedding will be based on repeated contingency analysis of all source/tie circuits and other identified circuits with load shedding programmed for each contingency in a priority based load shedding tripping philosophy which will be pre-determined for ready execution under a particular contingency tripping event. The contingency analysis results will be updated with analysis carried out under each load/status/topology change.

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7.4.2.3 Fast load shedding may also be initiated by a rate of fall of frequency device after an operator defined time delay.

7.4.3 Frequency /Df/Dt base (backup to fast contingency)

7.4.3.1 Provision of load shedding based on monitoring the rate of change of frequency (df/dt) by use of frequency relay shall be provided for tripping the grid supply during grid disturbance.

7.4.3.2 The frequency based load shedding function shall continually monitor the frequency of the system. Any fall monitored in the system frequency, due to the demand being higher than the capacity, shall be detected. Depending on the rate of fall of the frequency and in order to regain generator stability, sufficient load shall be tripped in the priority order as configured in the priority table.

7.4.3.3 Load shedding is also carried out in the event of a sustained 'under frequency' condition according to a pre-set frequency level and elapsed time.

7.4.3.4 Conceptually df/dt relay shall have following four steps for load shedding, however it has to be finalized during detail engg. in consultancy with Owner/Consultant

1st Step:

In case the grid is running in parallel with STG supply, the grid supply shall be isolated by tripping the incomer breakers of grid bus on operation of df/dt relay.

2nd Step:

Even after isolating the grid supply, if the df/dt relay continues to operate, loads of non-essential plants like Product Handling, Ammonia Storage, Town-ship etc., shall be shed.

3rd Step:

If further operation of relay df/dt continues, loads of other essential plants like Ammonia and Urea including Cooling Tower, Steam Generation Plant, Coal Gasification, Air Separation, Purification Plant, D.M. Water and Raw Water etc. shall be shed.

4th Step:

If further operation of relay df/dt continues, the incoming breakers from STG Sets would be tripped.

7.4.3.5 The time delays to the initiation of the shedding and the percentage of load to be shed shall be adjustable from Engineer workstation.

7.4.3.6 The loads shall be shed automatically such that the generators are not overloaded and frequency does not fall below the critical value.

7.4.3.7 No load shedding shall be envisaged on grid bus when the grid is running in isolation to the in-plant generation.

7.4.3.8 In case of under voltage on both sections of buses, starting impulse to the Diesel Generator Set shall be given by under voltage relay with timer. After the D.G. Set is ready to take loads, the emergency loads would be re-accelerated for safe shutdown of the plant.

7.4.3.9 Provision of back-up of load shedding based on monitoring the rate of change of frequency (df/dt) by use of frequency relay shall be provided for tripping the loads.

7.4.3.10 df/dt relay shall have predefined steps for load shedding according to the priority to be approved by Owner/Consultant.

7.4.3.11 The loads shall be shed automatically such that the generators are not overloaded and frequency shall not fall below the trip set value.

7.4.4 Maximum demand limit control

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- a) This software shall calculate a demand limit error when the generators are connected to the tie line, to predict the error that would be experienced at the end of the preset 15 minutes (or a user defined set period) if nothing were to be change. The maximum demand limit shall be an operator-entered value.
- b) The method of calculation is
 - i. Time into the present period
 - ii. The integrated energy consumed during the period expressed as $MWh / h = MW$
 - iii. The present tie-line power is MW, i.e., the slope of the line to the right chosen point
 1. From this information, the predicted overshoot of maximum demand at the end of the period shall be computed. Load shedding shall be initiated at an appropriate instant within the demand interval whenever warranted so as to limit the power exchange with grid within stipulated limits. The ECMS supplier shall offer the above scheme, or a suitable modified scheme, to satisfy the above requirement
 2. The software shall have to work under situations where the demand limit start period is not defined (sliding window)

7.4.5 Synchronisation

- a) The synchronizing facility for synchronization of circuit breakers shall be provided in the ECMS
- b) List of circuit breakers where synchronization facility is to be provided shall be as specified elsewhere.
- c) ECMS supplier shall provide full software based synchronisation scheme. If this is not possible the ECMS supplier shall use a software-cum-hardwired combination to achieve the objective. Synchronising facility shall be LCD monitor screen based and user friendly
- d) In the part hardware and part software based scheme, the hardware shall mainly consist of dual-redundant auto-synchroniser and check-synchronising relay. With this facility, it shall be possible to synchronise all sources from a centralized location without the necessity of moving around with a synchronising trolley
- e) The ECMS supplier shall provide appropriate graphic displays with standard keyboard functions for synchronising manually and automatically all sources of unsynchronised power that are likely to be synchronised. Plant operator shall be required to carry out course control of the voltage and frequency of the controller source. Once the voltage and frequency of controlled source is brought within a reasonable band of that reference source, the auto-synchroniser shall be activated and synchronise the circuit breaker without further operator intervention
- f) Graphic displays shall be user-friendly and shall assist the plant operator in proper selection of control source and reference source once a circuit breaker has been selected for synchronisation
- g) The ECMS supplier shall note that the control voltages of various machine controllers and circuit breakers could be different and shall design the scheme accordingly
- h) It shall be possible for operator to select circuit breaker synchronisation in “11 o'clock” and “1 o'clock” positions and monitor the same in real time during synchronisation

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7.4.6 Capacitor feeder switching for power factor improvement

ECMS supplier shall supply software that will advise the plant operator to Switch ON / Switch OFF the capacitor banks provided in HV switchboards. The software, while advising switching ON of a capacitor bank, shall check that none of the other circuit breakers in the network is likely to be subjected to leading power factor interruption duty. If a capacitor feeder has been switched ON and subsequently, due to load change, the same is found likely to be subjected to leading power factor interruption duty, then the software shall advise the operator to switch OFF the capacitor bank. The software shall take into account the changes in power flow arising out of automatic bus transfers in the switchboards

8.0 Testing

8.1 ECMS Testing

All the equipments of ECMS system shall be routine tested as per relevant IS / IEC in the presence of Owner's / PMC representative.

8.2 Factory Acceptance Test (FAT)

The complete scope of supply and each modification/extension shall be subject to acceptance tests at the supplier's works to confirm that they comply with the design standards.

OWNER reserves the right to witness all tests. The Supplier shall provide OWNER with at least 5 weeks' notice prior to the testing date. A detailed test procedure of factory acceptance tests shall be submitted at least 5 weeks in advance of any testing for OWNER's review and approval.

The ECMS components and equipment shall be completely assembled and tested only at the Supplier/Vendor workshop prior to shipment.

The following tests shall be carried out in the manufacturer's workshop:

- Complete functional test of the assembled system,
- Performance of operation including switching-over of all redundant components,
- Functional test with the PCS, if not available (e.g. supplied by another manufacturer) this system shall be simulated,
- Factory availability test for not less than 200 hours and in periods not less than 50 hours.
- Testing the Communication of the CCU, SCU, EWS and OWS.
- The Vendor of the ECMS shall allow a full functional communication test with the ECMS system equipment including the CCU, SCU, EWS, OWS, etc.
- The test is to check the complete communication between the ECMS equipment. All functions of the ECMS shall be tested and verified.
- Testing of the ECMS and the HV / LV Switchgear's.
- Testing the Communication of the ECMS and Third Party Equipment's
- The Vendor of the ECMS shall allow a full functional communication test with the third party equipment's i.e., VSD / EDG / UPS / thyristor Heater / Transformer RTCC Panel / HVAC control panels / Electrical control Panels, etc. ECMS VENDOR shall carry out the tests at each of the Vendor's work shop through the simulator test unit. The test is to check the complete communication between the ECMS equipment. All functions of the ECMS shall be tested and verified.
 - Test in fail-safe capacity
 - Program test by simulator

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- Voltage test

8.3 Type Tests which will not be later than last 5 years

- Burn- in test
- Climate Chamber Test
- Vibration Test
- Noise Immunity Test
- Voltage Test

Other Type test certificates as required shall be provided by the ECMS supplier. After installing & completing programming, as required, functional test at site shall be done.

8.4 **Site Tests**

Site Acceptance Test (SAT)

After installation at Site, complete functional tests of the system including the connection with all switchgears and other equipment as well with the PCS/DCS (if required) shall be carried out.

This test shall be performed on the complete ECMS system. All functions shall be tested. The SAT could be an integral part of the overall test of the electrical network installations. All control functions shall be tested as close to reality as reasonably practicable. All measurement and control function shall therefore be connected and operational.

Site Tests shall be performed, comprising as a minimum the following tests:

- Installation checks.
- Wiring, termination and earthing.
- Secondary injection for all analogue and testing operation of all digital signals.
- Checking of the system functions.
- Checking the communication facility up to the regional master station as well as up to the Master evaluation station.
- Integrated Site Acceptance Test (ISAT) shall be performed for DGA Monitor with ECMS, FMS, DAU, signals from switchgear and transformer mounted devices.

9.0 **DRAWINGS AND DOCUMENTS**

9.1 Drawings and documents as per Annexure-1 shall be supplied unless otherwise specified.

9.2 The contractor shall submit following drawings and documents for approval before commencement of manufacturing and / or programming activity:

- System architectural drawing
- System description with details of displays / HMI / messages / alarms / events / reports
- Variables Text for all typical type signals required as per Owner.
- Events Text for all typical type signals as per Owner's requirement.
- All Signal lists
- Text / Color codification / operating philosophy for signals
- Typical Report sheet
- Log sheet

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- Single Line Diagram
- System layout drawing.
- System interconnection schedule.
- Interconnection cable schedule from ECMS system to all Switchboards / equipments as applicable.
- System grounding drawing.
- Complete bill of material with technical purchase specifications.
- Operator / Engineer's manual.
- Maintenance manual & spare parts manual
- Detailed list and specification sheet for all component parts of sub-assemblies.
- Site preparation and installation instruction.
- Inspection and Test plan / Functional test schedule.
- Contact Details: Name, e-mail, phone / mobile and addresses of each major item Supplied [For Eastern region head office & Country head office]

9.3 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

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 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

10.5 The Vendor shall provide full spare part capability and support, including software for at least 10 years after installation.

11.0 **PACKING**

11.1 The panel shall be properly packed before despatch to avoid damage during transport, storage and handling.

11.2 The packing box shall contain a copy of the installation, operation and maintenance manual.

11.3 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.

12.0 **DEVIATIONS**

12.1 Deviations, if any, from this standard shall be clearly indicated in the offer with reasoning.

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12.2 Deviations, if any, from the data furnished in specification sheet shall be indicated therein beside the data by encircling it.

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ANNEXURE - I

DRAWING AND DOCUMENTATION FOR ECMS

Sl. No.	Document Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification / Data sheet	N	Y	Y
2.	General Arrangement Drawings	N	Y	Y
3.	System Block Diagram	Y	Y	Y
4.	Foundation Plan	N	Y	Y
5.	Schematic & Wiring Diagram*	N	Y	Y
6.	Interconnection Diagram	N	Y	Y
7.	Cable Routing / Cable Details	N	Y	Y
8.	Descriptive Literature	N	N	Y
9.	Installation, operation & maintenance manual	N	N	Y
10.	Test Certificate	N	N	Y
11.	Guarantee Certificate	N	N	Y
12.	Spare parts list	N	N	Y

* - Schematic diagram indicating I/O racks, PLC processor, interconnection.

Note:

1. 4 hard copies & 1 soft copy shall be supplied with bid.
2. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
3. 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

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TECHNICAL SPECIFICATION
FOR
CLOSED CIRCUIT TELEVISION (CCTV) SYSTEM

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ABBREVIATIONS

BIS	: Bureau of Indian Standard
CCOE	: Chief controller of Explosives
CIF	: Common Image Format
CMRI	: Central Mining Research Institute
ERTL	: Electronics Regional Testing Laboratory
DGMS	: Director General of Mine safety
IEC	: International Electro technical commission
IP	: Internet Protocol
MPEG	: Motion Picture Experts Group
PAL	: Phase Alteration by Line
TCP	: Transmission Control Protocol
UDP	: User Datagram Protocol
CCD	: Charge Coupled Device

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1.0 GENERAL

1.1 Scope

1.1.1 This specification, together with the Technical Spec. attached herewith, covers the requirements for the design, materials, nameplate marking, inspection, testing and shipping of Closed Circuit Television (CCTV) system.

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;

BS: 2004 Electric cables for working voltage up to and including 1100 volts

BS EN 62676 series Video surveillance systems for use in security applications

BS EN 62676-1-1 Video System Requirements

BS EN 62676-1-2 Video Transmission – General Video Transmission – Requirements

BS EN 62676-2-1 Video Transmission Protocols – General Requirements

BS EN 62676-2-2 Video Transmission Protocols – IP Interoperability implementation based on HTTP and REST services

BS EN 62676-2-3 Video Transmission Protocols – IP Interoperability implementation based on web services

BS EN 62676-3 Analog and Digital Video Interfaces



BS EN 62676-4 Application guidelines

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) Technical specifications
- c) Standard Specification
- d) Codes and Standards

1.1.4 In addition to compliance to purchaser's specification, Vendor's extent of responsibility shall include the following:

- a) Purchaser's data sheets indicate the minimum requirements of camera, video management system, video recorders etc., however, this does not absolve the vendor of the responsibility for proper selection with respect to the following:
 - i) Selection of lens focal length, camera, encoding techniques, selection of hardware and appropriate software for video management, selection of video recorder and its sizing to meet the storage requirements mentioned In the datasheets, accessories etc for proper monitoring and control.
 - ii) Selection of equipment suitable for the environmental conditions.
- b) Carryout complete application engineering so as to achieve the desired objectives with the stated performance requirements.

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- c) Provide all hardware and software, as necessary, to meet functional requirements specified in the purchaser's specification.

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 Vendor's technical offer shall include the following:

- a) Compliance to the specifications.
- b) Detailed specification sheet for each item providing all the details regarding make and model, type, construction, Maximum and minimum viewable distance, Maximum tilt or pan angle possible, Pan and tilt speed, Allowable Voltage and frequency variations, Interconnecting cable and transceiver module specifications, utility requirement, Network Bandwidth requirements and calculations to support the same considering bus loading as' 50% maximum, Hardware, software and licensing requirements, Storage calculations for video recorders.
- c) Detailed dimensional and sectional drawings including mounting details for all the units offered. All dimensions shall be in millimeters.
- d) Block-diagram showing all units with model numbers
- e) Interconnection wiring diagram between the various components of CCTV system, including location of each item. The diagram shall show the size of cable and brief specification of the cable
- f) Proven references for the offered model of CCTV system in line with clause 1.2.3 of this specification
- g) A copy of approval from local statutory authority, as applicable, such as Petroleum and Explosives Safety Organization (PESO)! Chief Controller of Explosives CCOE), Nagpur or Director General of Mines Safety (DGMS) in India, for the Camera, JB's etc. instruments installed in hazardous area along with:
 - i) Test certificate from recognized test house like CIMFR/ERTL etc. for flameproof enclosure, as specified in the data sheet, as per relevant standard for all Indian manufactured equipments or for items requiring DGMS approval.
 - ii) Certificate of conformity from agencies like LCIE, Baseefa, PTB, CSA, FM, UL,CE etc. for compliance to ATEX directives or other equivalent standards for all equipments manufactured outside India.
- h) Power consumption for the complete CCTV system including accessories.
- i) Deviations on technical requirements shall not be entertained. In case vendor has any valid technical reason, they must include a list of deviations clausewise, summing up all the deviations from the purchaser's data sheets and other technical specifications along with the technical reasons for each of these deviations

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- j) Catalogues giving detailed technical specifications model decoding details and other information related to hardware and software for the items covered in the bid.
- 1.2.3 The integrated CCTV system comprising of Cameras, encoders, video management system, video recorder etc, 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 conditions similar to those as specified in the purchaser's data sheets. Items with proto-type design or items not meeting proveness criteria specified above shall not be offered.
- 1.2.4 Vendor's quotation, catalogues, drawings, installation, operation and maintenance manuals shall be in English language.
- 1.2.5 Vendor shall also quote for the following:
- a) All associated accessories and cables.
 - b) Two years operational and maintenance spares for all items including their accessories as per vendor's recommendation which shall include the following as a **minimum**:
 - i) Each type of electronic module
 - ii) Fuses
 - h) Any special tool or test equipment needed for calibration and maintenance work.
- 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, installation manual, operation and maintenance manual etc. shall be submitted by vendor after placement of purchase order shall include the following as a minimum:
- a) Specification sheet for each camera and its accessories.
 - b) Certified drawings for the CCTV system which shall provide the following information:
 - i) Overall dimensions in millimetres
 - ii) Detailed interconnection diagram identifying each component with terminal number, cable type, cable size and cable entry details. The interface details shall be clearly identified in the drawing
 - iii) Grounding detail of each item
 - iv) Power supply distribution details
 - v) Clearance space required for maintenance work
 - vi) Weight of camera and other accessories
 - c) Configuration data.

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- d) Power consumption.
- e) Installation procedure of camera and other accessories.
- f) Maintenance procedure including replacement of its parts/ internals.
- g) Copy of type test certificates.
- h) Copy of the test certificates for all the tests indicated in clause 4.0 of this specification.

2.0 DESIGN AND CONSTRUCTION

2.1 The Closed Circuit Television (CCTV) system shall consist of the following units as a minimum:

- a) Camera Unit.
- b) Video management ,Video analysis system along with LCD monitors
- c) Video Recorder
- d) CCTV System cabinet
- e) Power supply distribution board
- f) Cables, cable glands, connectors and other accessories
- g) Network switches

2.1.1 CAMERA UNIT

Camera unit shall consist of Video Camera, 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.


2.1.1.1 Video Camera

The video camera shall be colour type comprising of 1/3" CCD/CMOS sensor with wide dynamic range and resolution with Full HD 2MP minimum resolution, optical zoom 35X or better.

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.

The camera shall be able to operate satisfactorily under varied light intensity levels. The light sensitivity of the CCTV camera to be considered as Color :0.07 Lux, Mono:0.05 Lux,& with IR 0.01Lux.

Automatic lens iris control facility shall also be provided as per the background light levels.

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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.

The camera shall have feature of backlight compensation.

2.1.1.2 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.

2.1.1.3 Pan and Tilt Unit

The pan and tilt arrangement shall be able to adjust camera within an angle of 0° to 360° horizontally (i.e. pan range) and a minimum of 180° (±90 deg) 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 IP-65 as per IS13947.

2.1.1.4 Wiper

Whenever camera is for outdoor installation or the application necessitates, the glass window shall be provided with a wiper unit.

2.1.1.5 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.



2.1.1.6 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.

2.1.1.7 Camera Mounting

Cameras shall be provided with suitable mounting accessories for mounting on structures, roofs, poles as indicated in the datasheets. Whenever specified, the height of the support poles shall be as per the datasheets. The pole shall have ladder for camera maintenance.

2.1.3 VIDEO MANAGEMENT SYSTEM| VIDEO RECORDING| VIDEO ANALYSIS

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2.1.3.1 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.

2.1.3.2 The video management system shall be able to permit online selection of:

- a) Camera Units
- b) Monitors
- c) No. of **tiles** on one monitor
- d) Recording Commands
- e) Pan-tilt Control
- f) Sequential Switching of image on monitors
- g) Focus, wiper, and zoom operating for each camera unit.

2.1.3.3 The monitors shall be 26" colour LCD monitors with necessary controls like colour brightness, contrast adjustment and monitor ON/OFF control. These functions shall be possible from the monitor front.

2.1.3.4 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.

2.1.3.5 The operator shall be able to view cameras through simple drag and drop commands.

2.1.3.6 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.



2.1.3.7 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.

2.1.3.8 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.

2.1.3.9 The operator shall be able to perform pan/ tilt/ zoom/ washer and wiper unit control for PTZ cameras.

2.1.3.10 The operator shall be able to enable/ disable Motion detection for cameras.

2.1.3.11 The operator shall be able to write macros/scripts for the cameras to do the following as a minimum:

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- (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

2.1.3.12 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.

2.1.3.13 VIDEO RECORDER

- a) Whenever specified the system shall also be 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.

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- 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.
- l) Video Recorder shall Possess Compression Techniques, Frame rate Changes etc.

2.1.3.14 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.



2.1.4 ALARMS & EVENTS

- a) The operator in the control room shall be able to get an Audio & Visual 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 and description.
- 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.

2.1.5 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.

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- 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 1.3 MP, 2 MP HD.
- 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.

2.1.6 INTERFACING WITH DCS/LMS

Interfacing with DCS/LMS shall be done to allow DCS/LMS operators for Audio & Visual Indication of Alarm

2.1.7 CCTV CABINETS

- 2.1.8.1 The CCTV cabinet(s) 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.
- 2.1.8.2 The cabinet(s) shall be fitted with lockable doors and shall have front and rear access. All system cabinets shall be completely wired.
- 2.1.8.3 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.
- 2.1.8.4 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 2 mm thickness. Cabinets shall be thoroughly de-burred and all sharp edges shall be grounded smoothed after fabrication.
- 2.1.8.5 Each cabinet shall be of maximum 2100 mm height and 1200 mm width. Construction shall be modular preferably to accommodate 19" standard electrical

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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.

- 2.1.8.6 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.
- 2.1.8.7 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 110v 50Hz normal power supply.
- 2.1.8.8 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.
- 2.1.8.9 The color of the CCTV cabinets shall be matched with the existing cabinets at control room.
2. 1.8.10 Cable glands shall be provided for cable entry into the CCTV cabinet. Spare cable entries shall be plugged.

2.1.8 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 HDPE and outer sheath of HDPE Preferably FRLS.
- c) Optical fibers shall be single mode fibers compliant to ITU-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 ≤ 0.37 dB/km for 1310 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 of 9.81 W Newton with attenuation change ≤ 0.05 dB/km at 1310 nm. W is weight of OFC/km.

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2.1.9 NETWORK SWITCH

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.

2.1.10 POWER SUPPLY

2.1.10.1 The system shall operate on 110 VAC (as specified in the datasheets) with the following specifications:

Voltage variation $\pm 10\%$

Frequency 50 Hz ± 3 Hz

Any other power supply required shall be derived from this power supply by the vendor.

2.1.10.2 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.



2.1.10.4 The CCTV system shall have the capability for future expansion to add cameras and additional storage in video recorders.

2.1.10.5 All cable glands, as required, for camera enclosure, pan/ tilt unit, junction boxes, CCTV cabinet etc. shall be Nickel plated brass, dual compression type, suitable for area classification specified in datasheets.



3.0 SPECIFICATIONS:

- I. Technical Specifications of IP Day-Night Colour PTZ Dome Camera 30X Zoom, with IR illuminator (weatherproof,Outdoor) :-

S.No.	Functionality/ Description	Minimum Specifications

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1	Camera Type	IP Day-Night Colour PTZ Dome Camera
2	Image Sensor Type	1/9" CMOS
3	Signal Format	PAL
4.	Ambient Temp & Humidity	0- 55 DegC, 90 Percent
5	Day-Night	Yes, Automatic
6	Lens	f/1.4 (Focal Length: 4 to 114 mm or better) Optical Zoom : 35X or better Auto Iris & Auto focus Motorised Zoom Lens Automatic Varifocal
7	Sensitivity (Lux) at 50 IRE	Colour: 0.6 Lux or better B- W: 0.01 Lux or better
8	Resolution	Min. 1920 x 1080 (2MP)
9	Prepositions/ Presets	Yes
10	Pan/ Tilt/ Zoom	Integrated positioning system. Pan: 360 degree endless rotation Tilt: ±90 degree or better Digital Zoom: 16X or better
11	Panning Speed (Manual & Preset)	Bidder to specify
12	Tilting Speed (Manual & Preset)	Bidder to specify
13	IR Sensitive	Min. 120 mtr.
14	White Balance	Automatic with manual override
15	Iris Control	Automatic with manual override
16	Gain Control	Automatic
17	Signal to Noise Ratio	> 50 dB
18	Image Settings	Wide Dynamic Range, Electronic Image Stabilisation, Image enhancement, Integrated Video Motion detection, Configurable brightness & sharpness features to be available.
19	Other features	Window blanking, Zone blanking
20	Digital Compression/ Multistreaming	H.264 or better


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21	Ethernet	Built-in interface 10 Base T/ 100 Base-TX (RJ-45)
22	Supported Protocols	Bidder to specify
23	Network Security	Password protection and IP filtering
24	Lightning and Surge Protection	Required

25	Input Voltage :	110 VAC, $\pm 10\%$,50 Hz ± 3 Hz, or PoE option Any power supply converter required for Camera with given input supply is included in bidder's scope (shall be of industrial grade only).
26	Power Consumption	Bidder to specify
27	Enclosure	Weatherproof NEMA-4X/ IP66 Weather proof Certification to be submitted.
28	Outer Enclosure material of construction	Die cast, extruded and sheet aluminum or Stainless Steel hardware. Corrosion resistant, suitable for outdoor installation.
29	Mount	Required. Suitable for mounting the camera system on building roof / tower/ structure. Suitable mount with pole shall be supplied with the camera.
30	Product Safety	To comply with CE Regulations, UL/ IEC etc. standards
31	Compatibility	Support ONVIF protocol and should be integrate with any ONVIF supported viewing software/system
32	Additional Inbuilt Features	Electronic Image stabilisation, Defog, Electronic Shutter, Temper Detection

II. Technical Specifications of integral IR illuminator of IR Camera



S No	Functionality/ Description	Minimum Specifications
1	Make	As per camera make/standard
2	Purpose	Designed for use with the CCTV Cameras for low light/ night time surveillance



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3	Function	Automatic On/ Off System controlled by a adjustable photocell with time delay feature
4	Type	LED type
5	Number of LEDs	Bidder to specify
6	Beam Width	Suitable as per site requirement. Bidder to specify details. Bidder shall submit beam width & field of view calculations during detailed engineering stage,.
7	Assembly	Shall be inbuilt in PTZ camera
8	Input Power	Same as of PTZ Camera
9	Effective lighting distance	Bidder to offer IR Illuminator as per site lay-out & requirement. The range, type & beam-width of IR Illuminator shall be finalised during detailed Engineering stage.
10	Wavelength	Bidder to specify
11	Power Consumption	Bidder to specify
12	Dimensions & Weight	Bidder to specify
13	Accessories	All required cables, connectors & interfaces, mounting arrangement/ bracket.

III. Technical Specifications of IP Day-Night Color Fixed Bullet Camera with IR Illuminator:

S.No.	Functionality/ Description	Minimum Specifications
	Camera Type	IP Day-Night Colour Fixed Camera with IR Illuminator
2	Purpose	Surveillance of Main Gate
3	Image Sensor	1/3" C MOS
4	Signal Format	PAL
5	Ambient Temp & Humidity	0-55 Deg , 90%
6	Day-Night	Yes, Automatic



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7	Lens(Inbuilt)	f/1.4 (Focal Length: 5 to 50 mm or better) Manual focus adjustment			
8	Working Illumination	Full Daylight to Zero Lux (100 ft range under zero lux)			
9	Resolution	Min. 2MP			
10	Iris Control	Automatic with manual override			
11	IR Sensitive	Min. 50 Mtr			
12	White Balance	Automatic with manual override			
13	Gain Control	Automatic			
14	Signal to Noise Ratio	> 50 dB			
15	Digital Compression	H.264			
16	Ethernet	Built-in interface 10 Base T/ 100 Base-TX (RJ-45)			
17	Supported Protocols	Bidder to specify			
18	Network Security	Password protection and IP filtering			
19	Lightning and Surge Protection	Required			
20	Input Voltage	110 VAC, $\pm 10\%$,50 Hz ± 3 Hz OR PoE Any power supply converter required for Camera is included in bidder's scope (shall be of industrial grade only).			
21	Power Consumption	Bidder to specify			
22	Enclosure	Weatherproof NEMA-4X/ IP66			
25	Outer Enclosure material of construction	Die cast, extruded and sheet aluminium or Stainless Steel hardware. Corrosion resistant, suitable for outdoor installation.			

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26	Mount	<p>Required.</p> <p>At unattended locations, the cameras shall be installed at a suitable location in the wall of building by making a hole in it. Camera to be supplied with a 6 mm thick transparent toughened glass which shall be fixed in the wall to cover the camera from external damage.</p> <p>At attended locations, the camera shall be installed on building roof/ suitable structure. Suitable mount with pole shall be supplied with the camera.</p>
27	Sabotage detection	Required
28	ONVIF Conformance	Required
29	Product Safety	<p>To comply with CE Regulations/ UL/ CSA/ EN/ IEC standards</p> <p>(Supporting documents to be submitted)</p>

IV. Technical Specifications of IP Megapixel Day-Night Colour Fixed box Camera



S.No.	Functionality/ Description	Minimum Specifications
1	Camera Type	IP Megapixel Day-Night Colour Fixed Camera
2	Purpose	Surveillance at Security Gate
3	Image Sensor Size	1/3" CMOS
4	Signal Format	PAL
5	Ambient Temp & Humidity	0-55 Deg , 90%
6	Day-Night	Yes, Automatic
7	Lens	f/1.4 (Focal Length: 4 to 8 mm or better)
8	Sensitivity (Lux) at 35 IRE	Colour: 0.6 Lux or better B-W: 0.2 Lux or
9	Resolution	Minimum 2 Megapixel
11	White Balance	Automatic
12	Gain Control	Automatic

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13	Digital Compression	H.264
14	Ethernet	Built-in interface 10 Base T/ 100 Base-TX (RJ-45)
15	Supported Protocols	Bidder to specify
16	Network Security	Password protection and IP filtering
17	Lightning and Surge Protection	Built-in/ external
18	Input Voltage	110 VAC, $\pm 10\%$,50 Hz ± 3 Hz or PoE
19	Power Consumption	Bidder to specify
20	Enclosure	Weatherproof NEMA-4X/ 1P66
21	Outer Enclosure material of construction	Die cast, extruded and sheet aluminium or Stainless Steel hardware. Corrosion resistant, suitable for outdoor installation.
22	Mount	Required. Suitable for mounting the camera system on suitable structure/ building roof
23	ONVIF Conformance	Required
24	Product Safety	To comply with CE Regulations/ UL/ CSA/ EN/ IEC standards (Supporting documents to be submitted)

V. Technical Specifications of Day-Night Colour PTZ Explosion-proof Camera for Pump Shed/ Field Area

S.No.	Functionality/ Description	Minimum Specifications
1	Camera Type	IP Day-Night Colour PTZ Explosion proof Camera
2	Purpose	Surveillance of Pump Shed / Field Area
3	Image Sensor Size	1/3" CMOS
4	Signal Format	PAL
5	Ambient Temp & Humidity	0-55 Deg , 90%

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6	Day-Night	Yes, Automatic
7	Lens	Focal Length: 5 to 100 mm or better Optical Zoom : 30X or better Auto Iris & Auto focus Motorised Zoom Lens Automatic Varifocal Lens
8	Prepositions/ Presets	Yes
9	Pan/ Tilt/ Zoom	Integrated positioning
10	Panning Speed (Manual & Preset)	Bidder to specify
11	Tilting Speed (Manual & Preset)	Bidder to specify
12	Sensitivity (Lux) at 35 IRE	Colour: 0.1 Lux or better B-W: 0.02 Lux or better
13	Resolution	Min 2MP
13a	IR Illuminator	Inbuilt, Min 100 Meter.
14	Iris Control	Automatic with manual override
15	Gain Control	Automatic
16	Signal to Noise Ratio	> 50 dB
17	Accessories	Integrated Receiver Driver, Pan-tilt unit with cables & connectors for power, video, data control, alarm inputs (except Power, Cat 6 cable which shall be laid from Control Room to Pump Shed)
18	Supported Protocols	ONVIF
19	Lightning and Surge Protection	Required
20	Input Voltage	110 VAC, $\pm 10\%$, 50 Hz ± 3 Hz or PoE Any power supply converter required for Camera is included in bidder's scope (shall be of industrial grade only).

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21	Power Consumption	Bidder to specify
22	Cable entry	Cable Entry suitable for power, Cat-6 cables along with suitable FLP/ WP brass, nickel coated double compression cable glands & FLP/ WP plugs.
23	Enclosure	Integrated Explosion-proof & Weatherproof (NEMA-4X/ IP66) enclosure with suitable size & number of entries required for the system. Suitable for Area Classification Zone-1 ,Gr.IIC T6 for Hazardous Area. ATEX & CCoE Certification to be submitted
24	Outer Enclosure material of construction	Stainless Steel hardware. Corrosion resistant, suitable for outdoor installation. Housing shall be integrated Factory fitted of same Make as of Camera.
25	Mount	Required. The cameras shall be installed at a suitable location on the pump shed structure. Suitable mounts & adaptors, anchors, stainless steel bolts, washers etc. are included in scope of bidder to ensure firm fixing of the camera on the pump shed structure.
26	Product Safety	To comply with CE Regulations, IEC etc. standards



VI. Technical Specifications of Keyboard & Joystick

S.No.	Functionality/ Description	Minimum Specifications
1	Features	Precise Pan, Tilt, <i>Zoom</i> Focus Control of Cameras Programmable Keypad for selecting cameras Easy to install & configure



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		Durable high quality 3 axis joystick Ergonomically designed keypad		
2	Connection	Suitable interface for connection with Client <i>PC</i> Work Station		
3	Accessories	Power Supply, all required interfaces, cables and connectors for connection with Client PC, Documentation: Installation guide, Operation & Maintenance Manuals, Installation, Driver CDs		

VII. Technical Specifications of Network Video Recorder (NVR)

S.No.	Functionality/Description	Minimum Specifications
1	Type	Dedicated Network Video Recorder with hardware suitable to connect up to 40 Cameras (minimum) or as per datasheet whichever is higher.
2	Processor	32 bit Intel Xeon Quad Core Processor with 2.8 GHz or higher, Intel Xeon W3680 / Intel Xeon 3600 series
3	Cache	8 MB cache or higher

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4	Video Storage Capacity	<p>SCSI hot-swappable hard disks (Minimum Capacity 20 TB usable excluding RAID or better).</p> <p>Bidder to note that minimum requirement has been specified. However, the Storage capacity of offered NVR should be sufficient for 30 days backup with 24 hours recording at CIF resolution and 25 frames per second. 100% time motion detection recording for PTZ Cameras, 35% time motion detection recording for Fixed cameras and 10 fixed cameras & 30 PTZ cameras under jurisdiction of respective NVR to be considered for calculation purpose.</p> <p>Bidder to specify capacity with detailed storage Calculations.</p>
5	Fault Tolerance	RAID-5
6	Optical Drive	16X DVD +/- RW with dual layer write capabilities
7	Network Card	Dual Gigabit Ethernet (RJ-45 port)
8	Operating System	Licensed Windows 7 Professional/ Windows 2008/ Linux/Operating System suitable for NVR
9	Security/ Virus protection	Required. (Minimum 2 years subscription) Bidder to specify details
10	Video Compression	H.264
11	Recording Rate	Bidder to specify
12	Recording Resolution	Min. 2MP

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13	Minimum Features	Function/ a)The offered NVR shall be based on open platform and shall be capable to interface other vendor CCTV cameras also. b)ONVIF compliant with latest version. c) Simultaneous recording & playback feature. Should support simultaneous playback streams & queries. d) Pan Tilt Zoom (PTZ) preset positions, PTZ go-to preset position on events. Motion detection sensitive PTZ patrolling e) Set multiple patrolling schedules per camera per day: i.e. different for day/night/weekend. f) Capable of pre & post alarm, event & motion recording. g) Recordings can be scheduled for the various video sources with different frame rates. h) Playback of recorded material, fast forward, fast reverse, single step forward and reverse. i) Search for recordings based on date and time. j) Security Multiple user access levels with password protection. k) Integrated Web Server functionality. HTML based graphical user interface that can be viewed in a web browser and can be easily accessed for programming, playback and backup of recording by authorised user. l) The recorder should be manageable remotely over a local area network with user authentication privileges. m) Authorised user from the Client PC should be able to define recording rates, quality settings, define recoding programs & schedules, select & playback recorded video etc. n) Shall support descriptive names for each camera. o) Shall allow the user to print a recorded image to a local or network printer. p) Facility to prompt for archive dump of stored images at pre-defined user settings.
14	Accessories	SCSI Controller, all required cables and connectors, Documentation: Installation guide, Operation & Maintenance Manuals, Installation CDs for licensedsoftware.
15	Input Voltage	110 V AC +/- 10%, 50 Hz (Redundant power supply for CPU required)
16	Power Consumption	Bidder to specify
17	ONVIF Conformance	Required
18	Product Safety	To comply with CE Regulations/ UL/ CSN EN/ IEC standards



VIII. Technical Specifications of Video Monitoring, Control & Recording Software

S.No.	Functionality/ Description	Minimum Specifications
1.	General	<p>Video Monitoring, Control & Recording Software for the CCTV Surveillance System shall provide full access to operations through user-friendly and highly intuitive Graphical User Interface. It should be capable to display and manage the complete surveillance system. It should manage multiple groups of users to access videos in a controlled manner. It should be a complete scalable CCTV system software with motion detection, alerting, remote web interface with features like Pre and Post Event Recording, viewing and recording multiple cameras.</p> <p>The software should facilitate viewing & playback of video up to 2MP resolution on the monitors of Client PCs/ Work Stations. It should also support controlling and recording up to 25 fps the video stream that is transmitted over LAN. The offered software shall have in-built capability/ provision and shall be licensed to support minimum 40 cameras.</p> <p>Bidder to note that combined specifications of Video Monitor Control and Recording Software have been indicated below. However, it shall be vendor's responsibility is to offer suitable software for each of the Computer Systems i.e. Client PCs an Network Video Recorder so as to achieve the following minimum functionalities:</p> <ul style="list-style-type: none"> • Management, monitoring , and control of the entire CCTV system • Recording and playback management of video and data. • User interface for CCTV system configuration and management • User interface for CCTV system monitoring and operation • Video Analytics (Camera Sabotage detection & Motion Detection)
2.	Features & Functions	<ol style="list-style-type: none"> a. ONVIF compliant with latest version. b. Plug-and-Play Installation and Detection of Cameras and Devices. c. Flexible, user friendly and easy to use d. Digital Zoom in Live or Playback Video e. Inbuilt Image enhancement feature f. Shall allow users to view live video; control cameras; record video; and search, play back, and export recorded video. g. Facilitate users with the proper authority to



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		<p>perform administrative functions, such as configuring devices, setting up users, adjusting network settings, and creating recording schedules. Access to these functions and all other system services shall be configurable.</p> <p>h. Users shall be able to monitor & control only those devices and features to which they have been granted user rights and permissions.</p> <p>i. System-wide health monitoring, including <u>cameras</u>, computers, software, and network equipment.</p> <p>j. Multiple Display Views for Live or Playback Cameras or Devices.</p> <p>k. On-Screen PTZ and Device Property Controls.</p> <p>l. Camera Call-up and PTZ Control from a Keyboard & Joystick.</p> <p>m. Advanced Search Capabilities Including Search for Motion, Alarm, or Event Video.</p> <p>n. Customizable User and Device Permissions.</p> <p>o. Access to system resources individually controlled per user group.</p> <p>p. User group priority assignment for PTZ control and camera access.</p> <p>q. Individual per-camera privileges assignable per user group for live access, playback.</p> <p>r. Event list/ Alarm list with device events (e.g. video loss), system events, network events, user events (e.g. logon failure) etc.</p> <p>s. Device states shown by icons, including network connection loss, video loss etc.</p> <p>t. Per camera, per recording schedule frame rate and quality settings for live, normal recording, motion recording, and alarm recording.</p> <p>u. Shall provide the ability to change video quality, bandwidth and frame rate parameter on a per camera basis for both live and recorded video.</p> <p>v. Shall provide the capability to assign password to each users and set access rights to the various client application and its functions.</p> <p>w. The software shall have remote interface features for configuration, display & control of cameras remotely over the network. These features shall be password protected at many levels to provide a powerful security system</p>
3.	Live Video	<p>b. Quad view of up to four cameras</p> <p>c. Sequence view of camera preset positions</p> <p>d. Modifying settings for a camera including PTZ control</p> <p>e. Modify recording settings for a camera</p>



- f. Adding and deleting cameras
- g. Creating schedules for recordings and video motion detection.
- h. Video Loss Alarm: The software shall support the Video Loss Alarm feature. The Video Loss Alarm feature shall provide operators with a notification when the video signal from any camera is lost.
- i. Modifying Video Analytics settings and tuning for:
- j. Video Motion Detection:
 - Object Tracking
 - Object Classification

Single Camera

From this display, the user shall be able to:

View the live output from the selected camera.

Pan, tilt, zoom and focus the camera using a joystick attached to the Client PC

- Pan, tilt, zoom and focus the camera using the mouse attached to the Client PC.
- Manually record live video. Recording will continue for the configured period of time.
- Manually store the current frame of video(snapshot) as a bitmap image file.

Multiple Camera View

The software shall support multiple camera views Simultaneously on a single display.

Live view of up to 16 cameras @ 1080P.

Further video split of 1/4/8/9/16 & customize to be supported.

Sequence View

The software shall support sequence views. A sequence view consists of a single camera view, which can be cycled on a time basis.

Camera settings

Only the authorized users are permitted to modify camera connection details, camera PTZ control or delete cameras



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4.	Security	<p>The following parameters shall be configurable for each camera :-</p> <p>a. <i>Area</i>: Allows the system to be configured to only allow users to view specified cameras.</p> <p>b. <i>Control Level</i>: Determines if a user is allowed to operate the PTZ controls for a camera. Also used to allow higher-level users to take control of cameras. The "Delete" function shall allow a user with authorisation to delete the camera from the system</p> <p>c. <i>Control Reservation Period</i>: Once a particular user has controlled the camera no other user can control the camera until this reservation period has expired. If this user controls the camera again within the period, the reservation period is reset. Users with higher security permissions shall be able to take control of the camera at any time.</p> <p>Camera Deletion The "Delete" function shall allow a user with authorization to delete the camera from the system.</p>
5.	Recording	<p>The following methods of recording live video shall be supported:</p> <p>a. <i>User activated</i>: The user shall be able to configure</p> <ul style="list-style-type: none"> • Pre-Record Duration: The amount of pre-recorded video that will be associated with a user request for recorded video. • Frame Rate: Video quality required for user activated recording. • Record Duration: User activated recordings shall terminate after this period. <p>b. <i>Event activated</i>: Prioritization of Events, low priority alarms, high priority alarms . Pre-Record duration, PostRecord duration and Frame rate shall be configurable for each alarm and each camera.</p> <p>c. <i>Scheduled</i>: Start time, Stop time and frame rate shall be configurable for each camera</p> <p>d. Continuous background recording: for all / selected cameras</p> <p>e. Snapshot: Video to be stored as bitmap / jpg. The software system must provide every operator (client) with the ability to record the current frame of video.</p> <p>f. Video Motion Detection</p> <p>g. Object Detection / Track</p>
6.	Video Motion Detection and Camera Sabotage Detection	<p>The system must be able to support video motion detection & camera sabotage detection algorithms</p> <ul style="list-style-type: none"> • <i>Detection Type</i>: Continuous or scheduled • <i>Actions to Perform when Motion is Detected</i>: When motion is detected, the system shall automatically generate an alarm in the System. Alarm Window shall pop up on the screen and audible alarm shall be sounded





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		<p>at the respective Client PC. It shall also start a recording, with the pre-record duration & post-record duration, frame rate etc. configurable settings.</p> <p>• <i>Actions to Perform when camera sabotage is Detected:</i></p> <p>The camera sabotage detection facility has been envisaged for unattended stations only. The system/ camera shall be capable of detection sudden contrast changes in the field of view. An alarm is triggered if the lens is obstructed with spray paint, a cloth, or a lens cap.</p> <p>Any unauthorized repositioning of the camera also triggers an alarm. The system shall automatically generate an alarm in the System. Alarm Window shall pop up on the screen and audible alarm shall be sounded at the respective Client PC. A hooter/ wailer with predefined reset time shall also start sounding in such sabotage attempt. The hooter/ wailer shall be installed inside the building. Bidder has an option to offer common hooter/ wailer with the hooter/ wailer envisaged for Electronic Perimeter Security System sabotage</p> <p>The said analytic features shall</p> <ol style="list-style-type: none"> adapt to a changing outdoor environment Ignore environmental changes including rain, hail, wind, swaying trees, moving birds/ insects and gradual light changes.
7.	Search	Feature for providing a simple and an advanced search for all recorded videos. The user selects the time indicator which calendar and time line. The user selects the required search. The search shall be based on recording time, camera and details.
8.	Recordings Playback	The recorded video shall be available to all users, who have adequate authorization. Each user shall only be able to view recordings from cameras they have security access to view
9.	System and User Audit Trail	It is a requirement that all user actions on the Client PC be recorded in a log file in the System. User actions include: <ol style="list-style-type: none"> Interventions such as manual recording and configuration setting changes. Cameras viewed Video replayed Video exported Cameras Pan/ tilt/ zoomed. This log must also contain a history of the status of the system components including when they were disabled or failed.



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4.0 NAMEPLATE

- 4.1 Each camera shall have a SS label name plate attached firmly to it at a visible place furnishing the following information:
- Manufacturer's model no. and serial no.
 - Manufacturer's *name* /trademark.
 - Type and Resolution of Camera
 - Lens Focus Length
 - Pan and Tilt Range
 - Type of explosion protection and certificate number
 - Power Requirement.
- 4.2 Each item of Close Circuit Television and its accessory shall have SS labels attached firmly to it at a visible place, furnishing the following information:
- Manufacturer's model no. and serial no.
 - Manufacturer's *name* /trademark.
 - Type of explosion protection and certificate number
 - Power Requirement.

5.0 INSPECTION AND TESTING

- 5.1 Unless otherwise specified, purchaser reserves the right to test and inspect the system at vendor's works. Vendor shall provide facilities like competent manpower, equipment and utilities required for the purpose to Purchaser's representative for inspection. Vendor shall test and demonstrate 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 The Purchaser reserves the right to get involved and satisfy himself at each and every stage of project execution. The purchaser shall be free to request any specific test considered necessary by him although not listed specifically .The cost of performing all tests shall be borne by the vendor.
- 5.3 Vendor shall submit the following test certificates and test reports for purchaser's review:
- Dimensional verification certificate
 - Manufacturer's test reports as per Type 3.1 of EN 10204
 - Minimum light intensity testing
 - Power supply variation check

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e) Certificate from Statutory authority for flame proof and weather proof enclosure, as applicable

5.4 Witness Inspection

5.4.1 All items shall be offered for pre-dispatch inspection for following, as a minimum, unless otherwise specified:

- a) Physical dimensional verification and workmanship.
- b) Bill of material check
- c) Effect of variations in power supply, voltage and frequency
- d) Performance testing and verification of integrated CCTV system.

e) Review of all certificates and test reports.

5.4.2 In case, the witness is waived off by the owner / Consultant, the test report of test carried out by vendor as indicated shall be forwarded by vendor for review. The equipment shall be dispatched only after it is cleared by owner / Consultant for dispatch.

5.0 SHIPPING

5.1 All threaded openings and cable entries shall be suitably protected to prevent entry of foreign material.

5.2 Any glass item shall be protected with foam sheet to protect against damage during transportation.

5.3 Each panel and accessory shall be suitably packed and protected from damage due to transportation, unloading and loading.

5.4 Each component part requiring identification for proper assembly at site shall be piecewise marked.

6.0 REJECTION

6.1 Vendor shall submit their offer in detail, as per clause 1.2 of the specification and shall attach these documents, which are specifically indicated in the material requisition. Vendor shall make offer w.r.t every clause of this specification.

6.2 Any offer not confirming to the above requirements shall be summarily rejected.

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TECHNICAL SPECIFICATION MAINTENANCE & TESTING EQUIPMENTS

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21.0	ARC FLASH SUIT

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1.0 SCOPE

- 1.1 This standard covers the technical requirements of design, manufacture, testing at works and delivery in well-packed condition of Maintenance & Testing.
- 1.2 This standard shall be read in conjunction with relevant part of Design Philosophy – Electrical etc.

2.0 BDV TEST KIT

- The equipment shall be suitable for determination of electrical strength (break down voltage) of insulating oil confirming to IS-335 up to 100 kV when measured in accordance with IS:6792. The equipment shall be used in laboratory.
- The test cell shall be as per IS:6792 and IEC-156-1995 suitable for BDV up to 100Kv without external flash over.
- HV chamber interlocking and zero start interlocking shall be provided.
- The unit shall have motorized drive to increase voltage linearly as per the rate specified in IS: 6792 . Provision shall also be available for manual increase of voltage.
- The unit shall be complete with motorised test cell stirrer, calibrator and necessary gauges for adjusting the gap.
- It shall be suitable for 230V, single phase, AC, 50Hz supply with variations of $\pm 10\%$ and $\pm 5\%$ in voltage and frequency respectively.
- Kit shall be supplied along with all accessories operating manual, spare fuses , indication lamps, power supply chord etc. all that is required for carrying out measurements. It should offer repeatability of test results.
- It should have overload and short-circuit protection.
Acceptable Make: AVO, Meggar, Fluke ,Doble,Baur

3.0 AUTOMATIC TRANSFORMER TURNS RATIO TESTER

The equipment offered shall be used for measurement of turns ratio of various power and distribution transformers automatically displaying the ratio without requiring any manual balancing of decades.

3.1 Technical Requirement:

Input Supply Voltage: 230 Volts, 50 Hz, single phase a.c. with variations of $\pm 15\%$ & $\pm 5\%$ in voltage and frequency.

3.2 Measuring Principle

- It should display actual turns ratio of different vector groups in three phase transformers without conversion.
- Measuring range 1 to 200
- Accuracy $\pm 5\%$ of FSD
- The kit should be supplied with 15m of test lead.

3.3 General Requirements

- It should offer repeatability of test results.
- The test kit shall be compatible for EMI/EMC environment as per IEC 1000.
- As per requirement of ISO-9001, calibration certificate for each testing instrument covering entire range shall be supplied with the test kit at the time of supply.
- The testing equipments are generally meant for carrying out testing at site and movement from one place to another is unavoidable. Therefore equipment shall be robust in design so that it gives desired performance even in adverse site conditions. Environmental conditions such as temperature, humidity, vibration, bump etc. shall be as per IS-9000 and IS 9001 or

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equivalent standards. Required certificates confirming to above standards shall be furnished along with the offer.

Necessary transport packing arrangement shall be supplied along with the equipment. The equipment shall generally comply with the requirement of relevant Indian standard or equivalent International standard such as IEC, BS, ASTM, ISO, etc. The supplier should have adequate "After Sales Service" facility in India.

Acceptable Make: AVO, Meggar, Fluke ,Doble

4.0 TRANSFORMER DC WINDING RESISTANCE MEASUREMENT

- The instrument shall be used for measuring DC winding resistance of the large transformers/reactors upto 400kV class where high inductance is present.
- The test kit shall be able to withstand inductive kicks from transformer winding.
- Variation in test current shall not result in loss of accuracy.
- The display or resistance should be through LED/LCD without requiring any balancing of decades to obtain stable readings.
- It should employ four wire method and no lead compensation shall be required for the measurement.
- Built-in-discharge circuit should be provided to discharge the specimen when test is completed or when current lead accidentally disconnects or when instrument power supply is lost.

4.1 Technical Parameter

- Test current: Min 25 Amp DC in range of 0-2000 milliohm with Resolution 1 milliohm
- Range: 0 to 10 ohms
- Accuracy: +-0.5 % of full scale reading or better
- Open circuit voltage minimum 30 volts DC.
- The instrument shall contain all standard accessories including test leads of 20m with suitable clamps/connectors and carrying case.
- It shall be suitable for 230V, single phase AC, 50 Hz supply with variations of $\pm 15\%$ and $\pm 5\%$ in voltage and frequency respectively.

4.2 General Requirements

- It should offer repeatability of test results in charged switchyard.
 - The test kit shall be compatible for EMI/EMC environment as per IEC 1000. As per requirement of ISO-9001, calibration certificate for each testing instrument covering entire range shall be supplied with the test kit at the time of supply.
 - The testing equipments are generally meant for carrying out testing at site and movement from one place to another is unavoidable. Therefore equipment shall be robust in design so that it gives desired performance even in adverse site conditions.
 - Environmental conditions such as temperature, humidity, vibration, bump etc. shall be as per IS-9000 and IS 9001 or equivalent standards. Required certificates confirming to above standards shall be furnished along with the offer.
 - Necessary transport packing arrangement shall be supplied along with the equipment.
 - The equipment shall generally comply with the requirement of relevant Indian standard or equivalent International standard such as IEC, BS, ASTM, ISO, etc.
- Acceptable Make: AVO, Meggar, Fluke ,Doble

5.0 AUTOMATIC CAPACITANCE AND TAN DELTA KIT

The equipment shall be suitable to measure capacitance and tan delta of EHV class transformers (1/2/3 windings), bushings, CT, windings of shunt reactors, bus & line CVT's and grading capacitors of CB's at site in a charged switchyard up to 400 kV AC. The kit should have the feature of suppression of electrical and magnetic interference due to line frequency and it should also have the feature of measuring tan delta and capacitance at different

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frequencies than line frequency. The kit shall be capable of measuring capacitance and tan delta of each winding of 315 MVA transformers in suitable switching mode so that capacitance of other windings does not affect the reading etc. With arrangement for measurement of inductance, transformer turns ratio, transformer leakage reactance and loss ,winding resistance etc . The kit shall be able to measure the ambient temperature and relative humidity with inbuilt/optional arrangement.

The equipment shall be complete with measuring bridge, HV power supply unit of 12 KV, Standard Capacitor, PC/Video Screen etc. The effects of induced voltage on instrument during testing for getting final measurement should be compensated automatically. The kit shall be capable of measuring excitation current of transformer winding at 12 KV.

The kit should have the facility of generation of test frequency independent of power line frequency for measurement of tan delta and capacitance.

The equipment shall be robust enough to sustain the jerks during the transportation in local condition.

The kit should be light weight, its packing and transportation cases/trolley shall be such that the shifting of kit from one substation to other will not affect its performance and accuracy in measurement of the kit.

Specification

- Output Voltage and 0 - 12 KV and 100 mA (Min) continues and 200mA Current & above intermittent @ frequency range 45 Hz to 70 Hz
- Tan Delta (DF) Range - 0 to 100%min Accuracy -1% or better, of the reading Resolution - 4 digit or better
- Power Factor Range - 0 to 100%min Accuracy - 1% or better of the reading Resolution - 4 digit or better
- Capacitance Range - 1pf to 2 μ f min Accuracy - 0.5 % min + 0.1 pf of the reading. Resolution - 6 digit
- Power supply(Input) 230V \pm 10% AC, 50Hz \pm 5%
- Induction suppression Fully automatic
- Display/Operation VGA LCD, Front panel/key pad mounted on control unit.
- Data Store Facility for data storing in the kit & down loadig to PC
- Safety features Short circuit protection Over voltage protection Interlock for HV output.
- Reliable ground connections etc.
- Indications HV supply ON, Ground open, Power supply ON etc.
- Cables and HV/LV screened cable set – 20 meters (min) with clamps & connectors. Power supply cable, Grounding cable with clamps, One set of interconnecting cables. Other cables and accessories required for carrying out measurement. One set of fuses and indicating lamps and other consumables shall be supplied with kit.
- Software Data analysis software in windows 98/2000/latest version with the features of Storing and downloading of files in data base for further analysis in PC. Facility of drawing graphs between voltages tan δ with temperature correction of tan δ values, frequencies etc. Comparing of different value of same parameter at different period/time
- Repeatability It should offer repeatability of test results in charged switchyard.
- Environment The kit shall be compatible for EMI / EMC requirement as per relevant IEC .
- Operating conditions Shall operate at Temperature -5 to 50 deg C, Humidity not condensing up to 95%,
- Demonstration/ Acceptance of the kit shall be subjected to the Inspection arrangement of successful demonstration by supplier at prescribed site.
- Calibration Calibration certificate from/traceable to, NABL accredited lab or internationally reputed lab, shall be submitted. Date of calibration shall not be older than one month from the date of supply of Kit.
- **Acceptable Make: AVO, Meggar, Fluke ,Doble**

6.0 Circuit Breaker Test Kit (Circuit Breaker analyzer with DCRM including transducer):

Functional Requirement:

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- This instrument shall have microprocessor-based operation with LCD display for testing of EHV Circuit Breakers in the charged switchyard environment. (200 kV AC / DC).
- To measure the CB contact movement during opening, closing, auto-reclosing and make/break operation, contact speed at various stages of operation, travel of contacts, Main and auxiliary contacts (wet and dry), opening time, closing time and make break time, closing resistor pre-insertion time etc.
- Dynamic contact resistance measurement of Arcing and Main Contact with minimum 100 Amp DC current while closing/opening of CB.
- The kit should also be capable of indicating trip/closing coil currents (analogue values).DCR measurements shall be carried out for minimum one pole (two breaks) at a time.
- In case, to meet the functional requirements as mentioned above if more than one units are required, the facility to co-relate/interface various parameters, shall be supplied along with the kit.
- Contact channels :24 (4 each for main and PIR)
- Auxiliary contacts: 2 dry + 2 wet
- Current and Voltage: 3 each .

Ranges & Accuracy:

- Main/Auxiliary Contacts: 0 to 4000 ms minimum
Accuracy : ± 0.1 % or better
Resolution : ± 0.1 ms at 10 Kc.
- Contact Travel : 0 to 10 m/s speed, 350 mm minimum
Accuracy : ± 0.1 % or better
Resolution : ± 2 mm or better
- Dynamic Contact Resistance : 0 to 2000 microhm
- Coil currents : 0 to 25 Amps
- Sampling rate Selectable – 100 Hz,1 Khz,10 KHz or better.
- Power Supply 230VAC $\pm 10\%$, 50Hz $\pm 5\%$ with variations in voltage and frequency respectively.
- Software Window based software for analysis of data shall be supplied along with the equipment.
- The kit should have enough data storage capacity not less than 2 MB with battery backup.
- Repeatability : The instrument should have proven for repeatability of test results in charged switchyard conditions. Documentary evidence for this should be furnished .
- Rs 232 port to down load data to external PC .The kit should have facility to get hard copy through plain paper printer by directly connecting printer to test kit
- Travel Adapter and Travel adapter and Transducers (Rotary/Linear) along with various clamps/fixtures to suit any type of model of CB.
- Accessories All standard accessories including test leads of 15 meters with suitable clamps, connectors, cables, power supply cords, printer, travel transducers, fuses, carrying case, manual etc. all those required for carrying out testing of CB and DCRM
- Environment :
 - Temp- 0 to 50 Deg C.
 - Humidity – 95 % non Condensing
- The test kit shall be compatible for EMI / EMC environment as per relevant IEC
- Demonstration The acceptance of kit is subjected to successful demo to the satisfaction of the owner site.
- Calibration certificate Calibration certificate from/traceable to, International/govt. approved lab shall be submitted.

Acceptable Make: AVO, Meggar, Fluke ,Doble

7.0 OMICRON SECONDARY INJECTION KIT SUTIALE FOR TESTING OF NUMERICAL RELAY:

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- 64 A / 860 VA per channel, Powerful current sources for testing both Numerical & high-burden electromechanical relays
- High current amplitudes for 5 A relay testing
- High accuracy and versatility for testing static and numerical relays of all types
- Integrated network for testing IEC 61850 IEDs
- 10-channel analog measurement and transient recording functionality
- Along with all accessories , laptop & necessary software.
- The testing equipments are generally meant for carrying out testing at site and movement from one place to another is unavoidable. Therefore equipment shall be robust in design so that it gives desired performance even in adverse site conditions.
- Necessary transport packing arrangement shall be supplied along with the equipment.
- Demonstration The acceptance of kit is subjected to successful demo to the satisfaction of the owner site.
- Calibration certificate Calibration certificate from/traceable to, International/govt. approved lab shall be submitted.

Acceptable Make: OMICRON (Model CMC 356 or latest)

8.0 Digital Micro ohm meter – For measurement of very low resistance

- Range: 1 $\mu\Omega$ - 200 Ω
- Accuracy: 0.02%
- Output: Digital
- Resolution: 1 $\mu\Omega$
- Accessories: Leads, Instruction manual, Heavy duty clip

Acceptable Make: AVO, Meggar, Fluke ,Yokogawa

9.0 Primary Injection Kit

- Ranges
 - 0 – 500 Amps.AC
 - 0 – 1000 Amps.AC
- Open circuit Voltage- 0 to 6 Volts(minimum) at 1000 Amp.
- Ranges selectable by change of link connections.
- Continuous Current control by variable Auto Transformer
- Current measurement by Ammeter of accuracy 1%
- Input Power Supply 230 V \pm 10% ac 50 \pm 5%Hz
- Provided with metallic enclosure.
- Mobility – Kit should be sturdy and mobile on metal surface in switchyard.
- Kit shall be supplied along with all accessories and cable set (15 mtr. length), clamps
 - ,connectors, spare fuses ,indication lamps, power supply cable, etc. all that is required for carrying out measurement for one unit.
- Kit shall have safety features like fuses/MCBs, ON indications etc.

10.0 Megohm meter– 5KV Digital Battery operated.

- Type 5 KV Digital Battery Operated.
- Insulation test voltage 5 KV in steps of 0.5,1,2.5,5 KV DC
- Short Circuit Current 1.5 mA minimum
- Accuracy(test voltage) \pm 3% of nominal voltages or better
- Range of Measurement 0 to 200 G Ohm minimum
- Additional features Shall be able to compute and displayPolarisation Index and Dielectric
- Absorption Ratio as per Indian Standards.

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- Accuracy(resistance) $\pm 5\%$ of reading ± 3 digits or better
- Operation by mains/batteries
- Display & scale length Digital and Analog in bargraph, with autoswitch off feature
- Power Supply $230 \pm 10\%$, 50 Hz
- Batteries 12 V/1.2 AH Rechargeable
- Battery Charger Automatic Inbuilt for AC voltage 110 to 240 V
- Response time Less than 3 sec
- Capacitive Discharge Automatic after insulation test is over, <
- Guard termination To be provided
- Accessories Test leads, Power supply leads, charger leads, Carrying case, Manual etc. required for testing
- Demonstration Acceptance of kit subject to successful demonstration in charged switchyard environment to the satisfaction of PDD.
- Calibration Certificate Calibration Certificate from NABL accredited lab or internationally reputed lab, shall be submitted. Date of calibration shall not be older than one month from the date of supply of Kit.
- Environmental and Shall conform EMI/EMC and Statutory requirement environmental protection requirement as per relevant International standard. Copy indicating conformation shall be enclosed.
- Temp- -5 to 50 deg C.
- Humidity-upto 95% non-condensing
- Functional requirement. The instrument shall work in charged switchyard environment conditions.
- Additional safety The kit and accessories shall be robust and Requirement rugged enough, so that it can be transported safely at different locations. The transportation case and packing of the kit shall be such that the transportation from one station to other will not affect the performance and accuracy of measurement of kit.
- Acceptable Make: AVO, Meggar, Fluke, Doble

11.0 Digital Multimeter

- Heavy Duty, shock proof, splash proof, dust proof.
- Measurement Range: Description Range & Accuracy
 - DC Voltage 0 – 1000 Volts $\pm 0.25\%$
 - AC Voltage 0 – 750 Volts $\pm 0.75\%$
 - DC Current 0 – 10 Amp $\pm 0.75\%$
 - AC Current 0 – 10 Amp $\pm 1.5\%$
 - Resistance 0 – 30 Mohms min. $\pm 1.0\%$
 - Continuity Check 0 – 250 Ohms min
 - Diode Test Unit $\pm 1\%$
- Display 3 and $\frac{1}{2}$ digit, LCD, Bar graph.
- Polarity Automatic, No indication for positive polarity, Minus (-) sign for negative polarity. With Capacitance, frequency and Temp. measurement features
- Over range indication – Half digit display with other digits blank.
- Low battery indication
- Power Supply – Single Standard 9 V Battery.
- Transient Protection: 2 KV (DCV / ACV and Ohm Ranges).
- Environment: Operating 0 – 55 degree Centigrade, 80% RH at 35 degree C, Storage -20 to 60 deg. C, 70% RH at 40 deg. C.
- Accessories: Test leads set, temp. probe, High Voltage probe, Carrying case, spare fuses, Manual etc.
- The instrument shall work in charged switchyard environment conditions.
- Instrument shall confirm to International/Indian safety and EMC standards
- Acceptable Make: AVO, Meggar, Fluke, Doble, YOKOGAWA

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12.0 Earth Resistance Tester – For measurement of earth resistance

Technical Parameters:

- Battery operated
- Light Weight
- Portable and easy to use
- Measuring range: 0-20 Ohm / 0-200 Ohm / 0 – 2000 ohm
- Accuracy: $\pm 2\%$
- Accessories: Test Leads
- Auxiliary earth bars
- Heavy duty case
- Instruction manual
- Battery Indication: Low battery
- Open circuit indication
- Over range indication

Acceptable Make: AVO, Meggar, Fluke ,Yokowaga

13.0 Phase Sequence Meter - Required to check phase sequence

- Operation Voltage: 60 to 600 Volts Three Phase
- Operating frequency: 50 to 60 Hz
- Accessories: Test Leads
- Alligator clips
- Instruction manual

Acceptable Make: AVO, Meggar, Fluke ,Yokowaga

14.0 THREE PHASE VARIAC

The three phase variac is required for testing and maintenance purpose in Substation.

Technical Parameters:

Type: Variable Transformer (Manual)
 Primary voltage: 440 – 480 Volts AC
 Frequency: 50 Hz
 Phase: 3 (Three)
 Secondary Voltage: 0 to 480 volts AC
 Secondary Current: 5 Amps
 Termination: Screw terminals
 Cooling: Air cooled

15.0 Transformer Oil Filtration Plant

General:

- The ultra High Vacuum type oil treatment plant of capacity 3KL/6KL per hour will be
- mobile and will be suitable for treatment of new oil and reconditioning of used oil in EHV class transformer, shunt reactor and other oil filled equipments in order to achieve properties of treated oil within specified limits at the rated capacity.
- The plant will be capable of treatment of new oil (as per IEC 296/IS:335 and reconditioning of used oil as per IS: 1865/IEC:422 for oil in service) at rated capacity on single pass basis as follows:
 - Removal of moisture from 100 ppm to 3 ppm (maxm.)
 - Removal of dissolved gas content from 10% by vol to 0.1% by vol.
 - Improvement of dielectric strength break down voltage from 20 KV to 70 KV (min)

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- Vacuum level of degassing Not more than 0.15 torr (0.2mbar) Chamber at rated flow and max. At final stage. (degassing chambers of different degree of vacuum will have efficient surface areas to achieve the final parameters. A detailed justification as to how end parameters will be met with detailed calculations and test reports in support of the same will be submitted along with the offer.
- Filtering capacity: Max. particle size less than 0.5 micron in the filtered oil.
- (a) Processing temperature 40 deg C to 60 deg C
- (b) Maximum allowed temp. 60 deg C in oil to prevent oxidation (when oil is at atmospheric pressure)
- Contractor shall furnish detailed calculation to establish the sizing and capability of the vacuum pumping system with respect to moisture and gas removal as above.
- Contractor shall submit test reports, test methodology to prove the capability of the plant offered.
- The plant will also have two independent vacuum pumping systems one for evacuating the transformer for vacuum filling of oil in transformer and the other for degassing chamber. The blank off vacuum of each pumping system will be 10⁻³ torr less.
- The plant will be provided with control and indication panel with full automation.
- The plant will be fitted with hoses for connection of oil lines and vacuum lines to transformers and reactors. Hoses will have leakage rate of 10-12 torr ltr/ sec (max.)
- The plant will be suitable for cleaning and degassing of the oil stored in the storage tanks.
- All equipments required as above will be mounted on a towable road worthy trailer unit with 04 nos. pneumatic tyres.

Design & Construction

The features and construction details of each 3KL/6KL per hour capacity mobile outdoor type oil filtration & purification plant will be in accordance with the requirements stated hereunder.

Oil Pump (Inlet Side)

- Two (2) nos. electrically driven oil pumps with one (1) working and One (1) standby will be provided. Selection switch will be provided for selection of either of pumps.
- The pumps will be single stage positive displacement gear type. Suitable mechanical seals will be provided to ensure vacuum tightness. A built in pressure relief valve to recirculate the oil to suction side in case of accidental pressure rise will be provided.
- Suction lift of the pump will be at least 5 meters of transformer oil at atmospheric pressure and temperature. A separate bypass valve is provided across the gear pump so that the flow rate through the filter can be adjusted as required. The pump should be controlled by frequency drive. This should help to set the flow rating of filter plant from 2000-4000 LPH / 3000-6000 LPH.
- The pumps will be provided with an interlock with delay such that if there is no oil flow for 30 sec. through the heater, the pump will trip automatically and also if the pump is not operating the heater will not be energized.

Magnetic Strainer

- The plant will be provided with a suitable magnetic strainer with wire mesh to filter all particles of sizes above 0.5 mm and all magnetic particles. The strainer will be installed at the suction of the oil pump described above.

Heater

- An oil heater for heating up inlet oil will be provided at the discharge side of the oil pump.
- The oil heater vessel will be of Mild Steel welded construction and insulated with glass/mineral wool.
- The vessel will be constructed for ultra high vacuum and pressure application.

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- Electric heater will be provided inside the heater vessel to heat up oil from lowest ambient temperature to temperature required for filtration / degasification operation in single pass. The heater will also be rated for heating the inlet oil from lowest ambient temperature to 70 degC in single pass during filling up of transformers. Two separate temperature setting with thermostatic controllers will be provided for this purpose.
- The heating will be indirect type and specific heat load will not exceed 2.0 Watt / cm² in order to avoid local overheating.
- The total heating capacity will be divided into three independent thermostatically controlled heating stages evenly balancing the three phases of power supply. The control switches and knobs will be housed on a control panel.
- An additional preset temper proof safety thermostat set at the highest temperature will be provided on the heater to put off the heater and give audio and visual alarm to take care of accidental overheating.
- The heater body will be so designed as to follow replacement of heating elements without draining of oil. Suitable pressure relief valve, vent and drain valves and two (2) dial type temperature gauges at inlet and outlet of the heater will be provided.

Filter

- Cartridge filter as may be required to ensure maximum particle size of less than 0.5 micron in the filtered oil will be provided.
- The filter body will be fabricated of mild steel and designed for leak tightness at full vacuum and high pressures. The oil will flow from dirty oil chamber to clean oil chamber through filter elements.
- Cartridge type element used will be suitable for transformer oil in service and submicron filtration, the media will be non-hygroscopic and of high dirt holding capacity.
- The filter elements will be easily removable for replacement when required.
- Compound gauge to indicate pressure across the filter vent and drain with valves and other necessary accessories.

Coarse Filter

- For treating dirty oil, coarse filter of adequate rating may be supplied for supplementing the capacity of filter elements. These units will be designed for quick and easy replacement of media. A sludge outlet for receiving the solid impurities and cleaning the filter plate without opening the unit will be provided. The unit will also be provided with vent and drain valves, pressure gauges at inlet and outlet and other necessary accessories.

External Solenoid Operated valves

- Two valves will be provided at the inlet and outlet of the plant. The moment inlet and outlet pumps are switched on these valves open thus making way for oil to pass.
- In case of power failure, oil from the transformer will not enter the plant and the vacuum system.

Degassing chamber

- The degassing chamber will be of welded construction and will be suitable for operation under full vacuum. The fill of Raschig rings and trays for distribution will be designed for efficient distribution of oil over large areas. Incoming transformer oil will be spread over these rings in the form of film and over a longer surface area thus achieving better degassing and dehumidification.
- The degassing chamber will be either single stage or multi stage type suitable for ensuring the desired oil properties. Arrangement for condensing back lighter fraction (Aromatics) of the insulating oil into the system will be provided.
- The degassing channels will have adequate height to allow long enough free fall for complete degassing. Design will be such as to minimize foam formation.
- The degassing chambers will be provided with suitable level monitor for oil or foam level in the chamber and will trip the inlet gear pump when the level rises above the designed maximum

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level in order to prevent foam/ oil to enter the vacuum pumpingsystem. The oil inlet pump starts again automatically once the oil level in thedegassing chamber falls below the preset oil level.

- Necessary illuminated sight glass will be provided through which oil flow throughthe degasser can be viewed clearly.
- The degasser will be provided with vacuum gauges, vacuum breaking valves, mainand auxiliary vacuum connections and other necessary accessories.

Vacuum Pumping System

- The pump will be provided with a suitable vacuum pumping system for creatingadequate high vacuum in the degassing chambers. The pumping system will consistof suitable combination of Roots Blowers and Rotary vane vacuum pumps withinterstage condensing units.
- The Roots blowers will be of reputed make. Suitable built in labyrinth packingsystem, slinger rings, oil return chambers will be provided between bearings andworking chambers to prevent penetration of lubricating oil to the working chamber.
- The pumps motor will be dynamically balanced. The pumps will be suitable forstarting evacuation from atmospheric pressure and will be applied with necessaryoverflow valve.
- The rotary vane vacuum pumps will be installed after the roots blower. An automaticby pass valve across the roots blower will permit operation of rotary vane pumpalone to operate when so required. The rotary vane pumps are provided with gasballast valve to prevent contamination of vacuum pump oil with moisture. Thevacuum pump will also be provided with suitable non-return valve device such thatin the event of power failure the vacuum in the degassing chamber will bemaintained and the vacuum pump oil is not sucked back into the degassingchamber. A high vacuum safety valve (piston type) to prevent back streaming of oiland air intrusion will be provided. The pump motors will have return stop device.
- Necessary water cooled condensing units to condense the lighter fraction (Aromatics)and return the same to the transformer oil will be provided to reduce the loss ofaromatics. Condensing units will also be suitable for operation with broken ice forremote location operation where cooling water connection is not available.
- Vacuum Pumping System for Transformer Evacuation
- An independent vacuum pumping system will be provided for evacuating thetransformer for oil filling. The vacuum level required for transformer evacuation foroil transfer is about 0.76 torr (1 m bar) for transformer oil heated to 70-80 degC.The pumping system will be identical to that of the degassing vacuum system. Thecapacity will be adequate for evacuation of transformer in one hour. The vacuumsystems for degasser and transformer evacuation will be inter connected in such away that it will be possible to use either or both the systems for any of the purpose.A reinforced of 10 mts. Length will be provided. The hoses will be for vacuumleakage rate of 10-2 torrlitre/ sec.

Oil Extraction Pump

- Suitable pumping system will be provided for extracting oil from degasser undervacuum and supplying to transformer/ reactor etc., at discharge pressure of 1.5 Kg/cm² at the outlet hose nozzle of the plant, the pump will be either glandlesscentrifugal type with canned motors or a combination of gear pump and centrifugalpump with mechanical seals suitable for extracting oil from high vacuum degassingchamber. The oil extraction pump will be located at a suitable level below thedegasser chamber so as to ensure adequate suction head for the pump. The pumpwill be supplied with double check valve assembly and solenoid operated non-returnvalve. In order to stop reverse flow of the oil in case of power failure, thepumping system will preferably be self priming type alternatively priming devicewith safety interlock to protect pump against dry running will be provided.
- Sampling valves will be provided at the discharge of extraction pump for testing ofoil properties. A recirculation line with valves will be provided to recirculate a partof the purified oil to the inlet point if necessary during operation. The outlet pumpshould be control by frequency drive to give controlled output from range 2000-4000 LPH/3000 – 6000 LPH .

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16.0 Oil sampling Bottles

- Capacity - 1 Ltrs
- Container - Made of Stainless Steel.
- 2 Nos. of 0.25" of S.S. needle valve with SS T type handle one on each side.
- 2 Nos. of SS adopters with end caps one on each side.
- The valves should be 100 % leak proof .
- Suitable for Dissolved Gas Analysis Test.
- The design of bottle & seal shall be such that loss of Hydrogen shall not exceed 5% per week. Copy of type test report to be enclosed.
- Suitable for collecting oil samples from transformers and shunt reactors.
- Bottles shall be robust enough ,so that no damage occurs during frequent transportation of samples from site to laboratory.
- Reputed Make

17.0 Dew Point Kit for SF6 gas

- The Instrument shall be able to measure the Requirement dew point of SF6 and Nitrogen available in the electrical equipment or Cylinders.
- Measuring Range -80 to 0 °C minimum @ +/-2% or better Accuracy
- Display Digital
- Accessories Compatible inlet and out let couplings, Hoses, carrying case, Instruction manual, Power supply chord, Charger.
- Pressure during Atmospheric to 30 Mpa max.
- Flow Rate during 0.5 to 5 L/min Measurement
- Power Supply Internal rechargeable battery pack with charger. To be operated on 220 +/-10% V AC, 50+/-10% Hz. Or Equivalent
- Operating Temperature -20 to 50 deg C.
- Calibration certificate from/traceable to, NABL accredited lab or internationally reputed lab, shall be submitted. Date of calibration shall not be older than one month from the date of supply of Kit.
- Demonstration. Acceptance of kit subject to successful demonstration in charged switchyard environment to the satisfaction of PDD.
- Packing and The kit and accessories shall be robust and transport cases rugged enough, so that it can be transported safely at different locations .The transportation case and packing of the kit shall be such that the transportation from one station to other will not affect the performance and accuracy of measurement of kit.
- Acceptable Make: AVO, Meggar, Fluke ,Doble

18.0 ELECTRIC TORQUE WRENCH

- POWER SUPPLY: Single phase 230V ac
- INPUT POWER: 500 W (Minimum)
- NO LOAD SPEED: 500-1300 rpm
- TORQUE (CONTINUOUSLY SETABLE): 70-250 Nm
- DRIVE SIZE: 1/2 IN SQUARE DRIVE
- Double insulated polycarbonate body
- Cord Length: 2 meter (Minimum)
- Duty: Continuous
- SOCKETS REQUIRED: M6 TO M32
- EXTENSION BAR: REQUIRED
- ACCEPTABLE MAKE: Ralli Wolf / BOSCH / Hilti / Hitachi

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19.0 HYDRAULIC CRIMPING TOOL

- CRIMPING CAPACITY: 50 - 400 SQMM CU & AL CABLE
- DIE TYPE:HEXAGONAL
- NO OF DIE: 9 No (50, 70, 95, 120, 150, 185, 240, 300 & 400 sq mm)
- CRIMPING FORCE (MIN): 10T
- STANDARD ACCESSARIES:Die (01 set)
- ACCEPTABLE MAKE: DOWEL / SAPSONS / JAISON

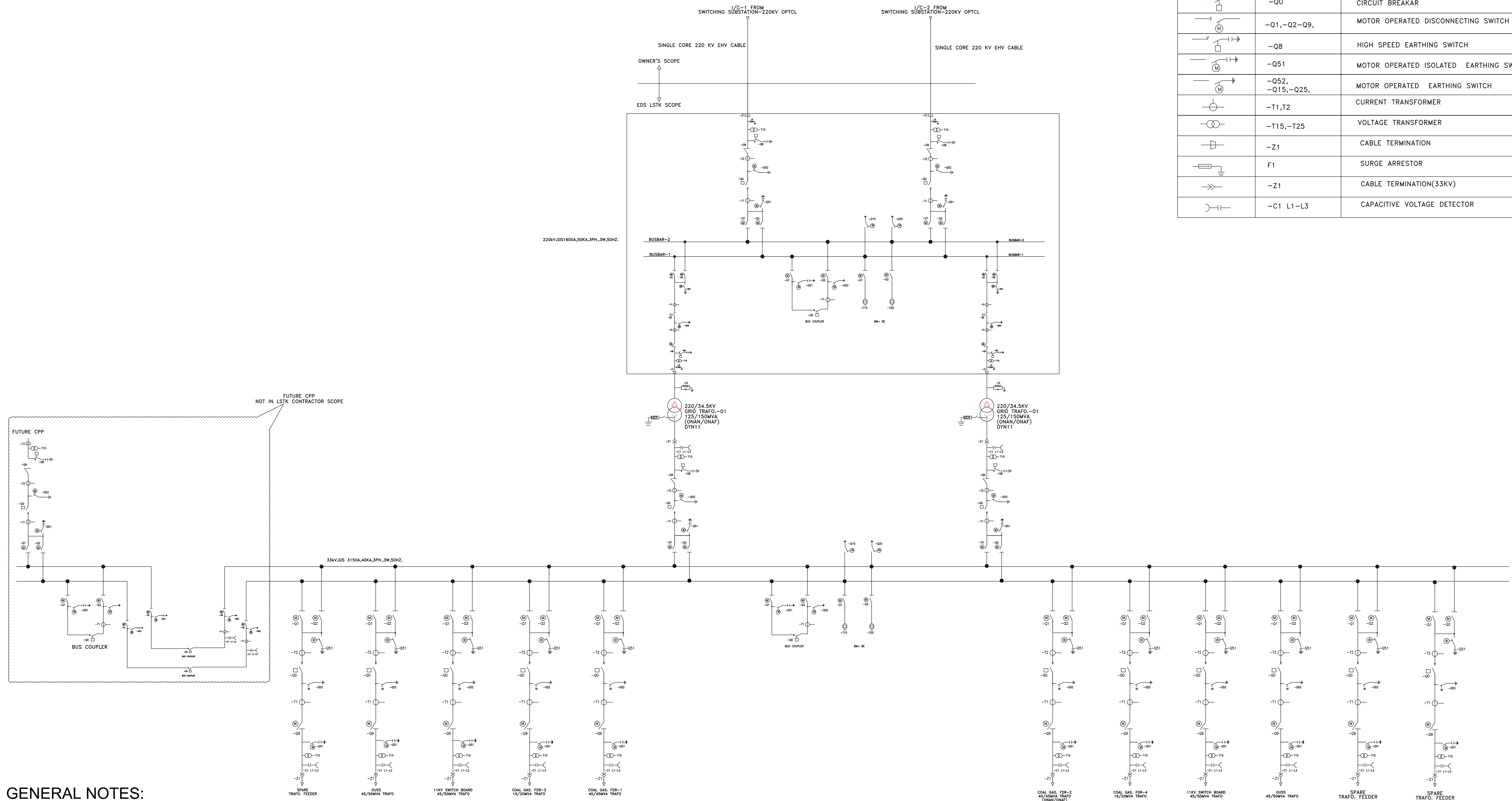
20.0 INDUSTRIAL VACCUM CLEANER

- POWER SUPPLY: Single phase 230V ac
- INPUT POWER :1200 W (Minimum)
- SUCTION/VACCUM:240 MBAR(MIN)
- AIR FLOW: 60LITER/SEC (MIN)
- TANK CAPACITY:50 LITER
- NOISE LEVEL: 70DBA (MAX)
- TANK MATERIAL: SS
- STANDARD ACCESSARIES:Extension pipe and attachment for cleaning of various surface are required.
- ACCEPTABLE MAKE: EUREKA FORBES / BOSCH / HILTI

21.0 ARC FLASH PERSONAL PROTECTION EQUIPMENT:

- Complete Arc Flash Personal Protection Equipment Kit , consisting of Coat, overall Bib & Arc flash hood.
 - Light Weight.
 - NFPA 70E-15 PPE CAT- 4
 - IEC 61482-2:2009
 - EN ISO 11612:2008 (A1 B2 C2)
 - Garment Testing: ASTM F2621-2012
 - Fabric Testing: ASTM 1959 / F1959M
- Acceptable Make: Honeywell,

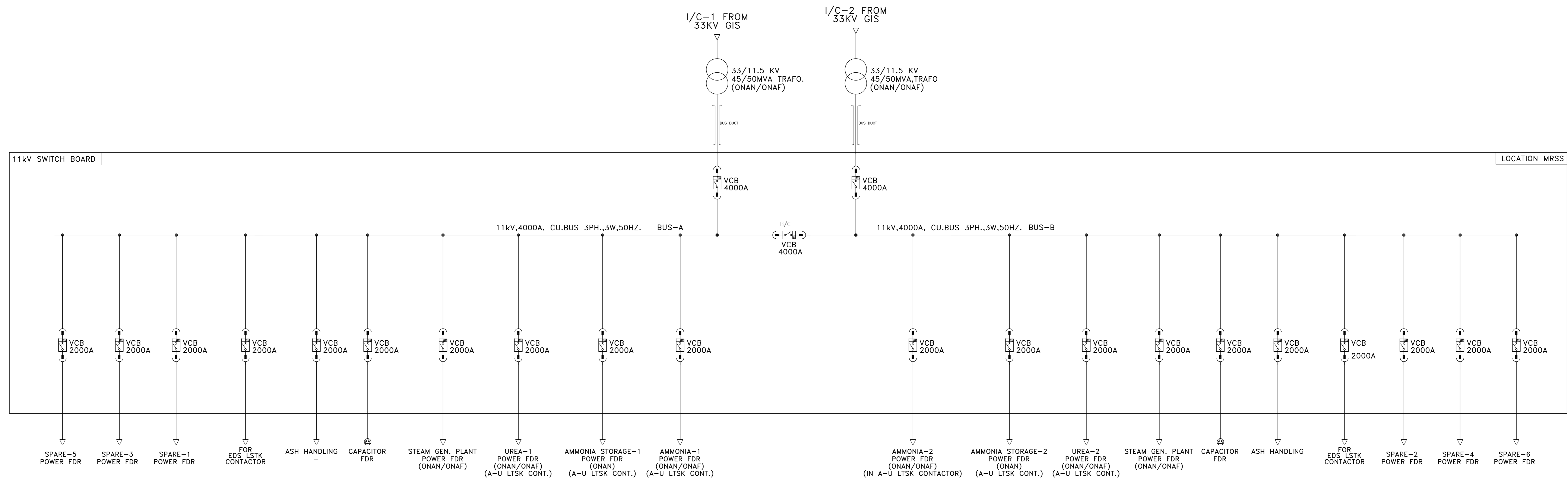
SYMBOL	DESIGNATION	DESCRIPTION
	-Q0	CIRCUIT BREAKER
	-Q1,-Q2-Q9,	MOTOR OPERATED DISCONNECTING SWITCH
	-Q8	HIGH SPEED EARTHING SWITCH
	-Q51	MOTOR OPERATED ISOLATED EARTHING SWITCH
	-Q52,-Q15,-Q25,	MOTOR OPERATED EARTHING SWITCH
	-T1,T2	CURRENT TRANSFORMER
	-T15,-T25	VOLTAGE TRANSFORMER
	-Z1	CABLE TERMINATION
	F1	SURGE ARRESTOR
	-Z1	CABLE TERMINATION(33KV)
	-C1 L1-L3	CAPACITIVE VOLTAGE DETECTOR



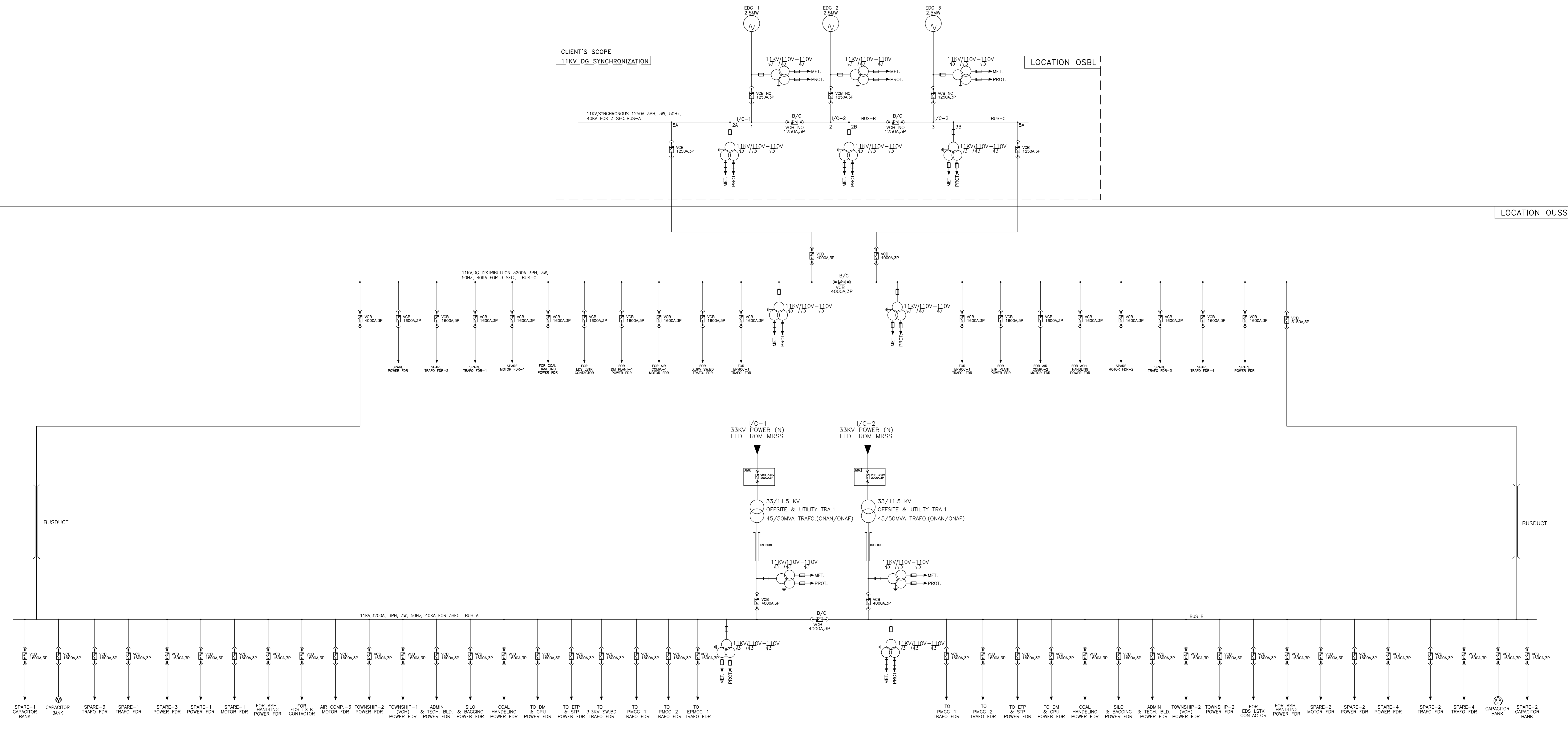
GENERAL NOTES:

1. RATED SHORT CIRCUIT WITHSTAND - CAPACITY (MIN.)
220KV- 50KA, 3 SEC
33KV- 40KA, 3 SEC
11KV- 40KA, 3 SEC
2. RATIO & ACC. CLASS OF CT,VT & METER
AS PER OPTCL / TPCODL REQUIREMENTS &
MAKE & MODEL NO. OF METER AS PER OPTCL
3. VECTOR GROUP INDICATED IS TENTATIVE SAME
SHALL BE FINALIZED WITH OPTCL
4. THIS SLD INDICATIVE ONLY AND BROADLY DEFINE THE
SCOPE OF DISTRIBUTION SYSTEM.

REV.	DATE	DESCRIPTION	PPD.	CKD.	APPD.
0	26.03.21	ISSUED FOR ENQUIRY	SS	RK	SKB
CLIENT:-- TALCHER FERTILIZER LIMITED			REV. 0	SHEET 1 OF 2	
PROJECT:-- COAL BASED FERTILIZER PROJECT			SCALE: N.T.S.		
TITLE:-- 220KV&33KV GIS SINGLE LINE DIAGRAM			DRG. NO.-- PC183-7411-0985A		
			प्रोजेक्ट्स एंड डेवलपमेंट इंडिया लिमिटेड नोएडा PROJECTS & DEVELOPMENT INDIA LTD.-NOIDA		



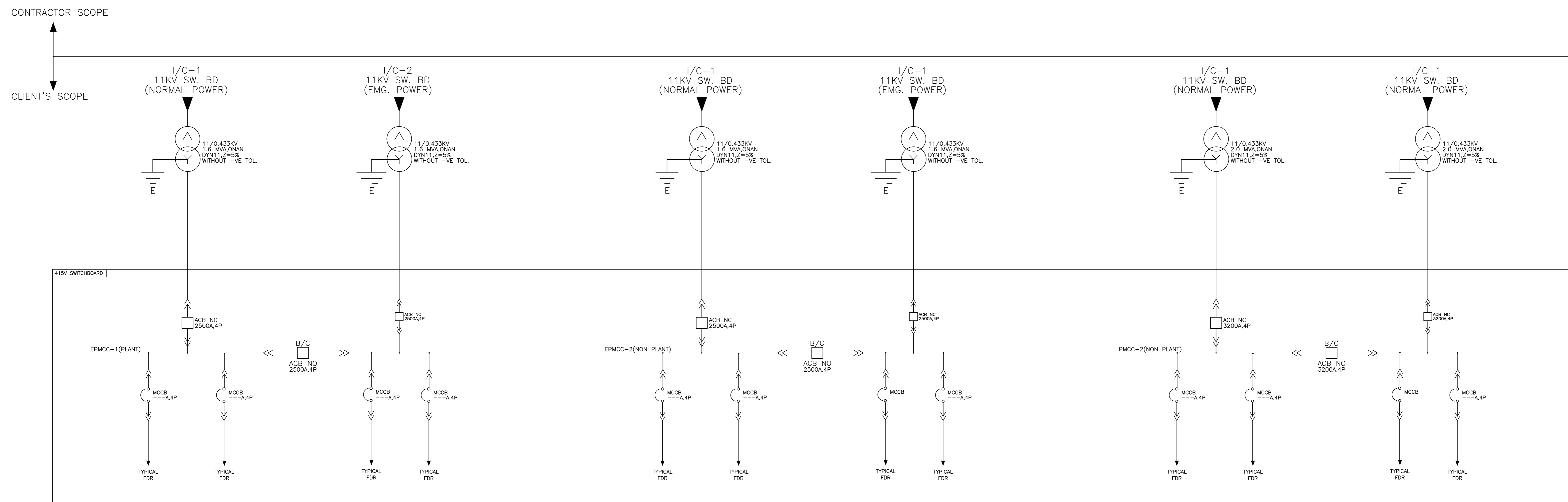
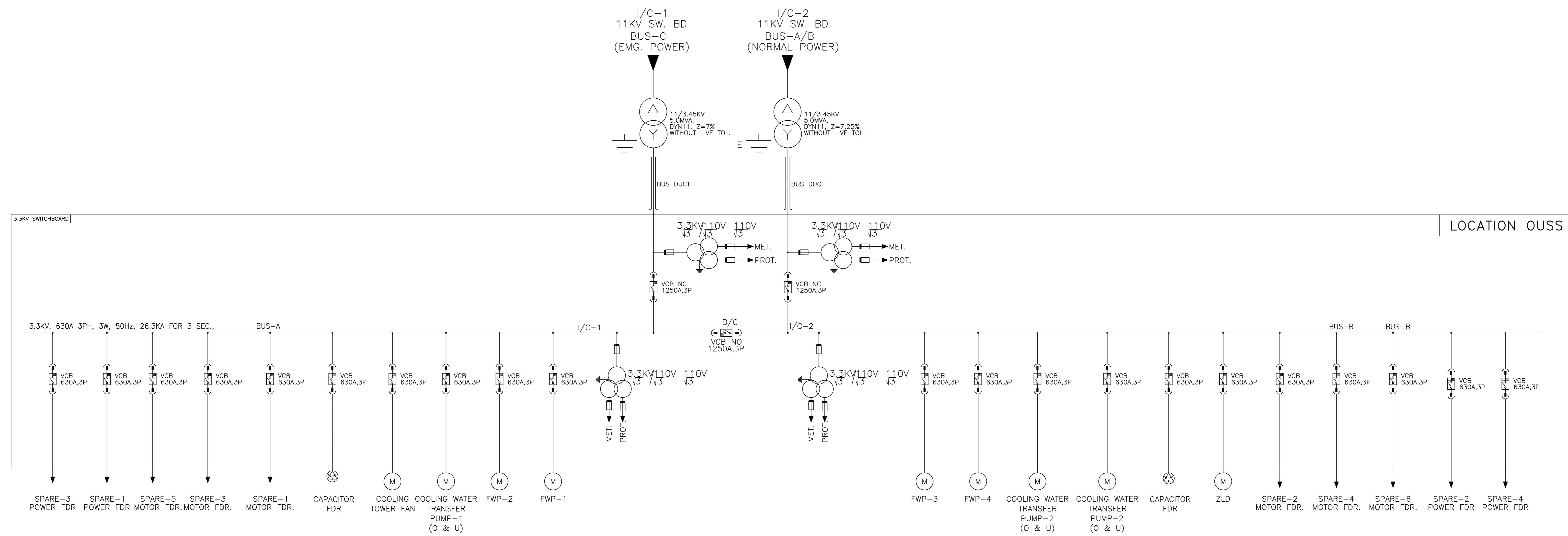
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REV.	DATE	DESCRIPTION	PPD.	CKD.	APPD.
		CLIENT:- TALCHER FERTILIZER LIMITED	REV. 0	SHEET 2 OF 2	
PROJECT:-		COAL BASED FERTILIZER PROJECT	SCALE: N.T.S.		
TITLE:-		11KV SINGLE LINE DIAGRAM MRSS	DRG. NO.- PC183-7411-0985A		
		प्रोजेक्ट्स एंड डेवलपमेंट इंडिया लिमिटेड नोएडा PROJECTS & DEVELOPMENT INDIA LTD.-NOIDA	FILE:		



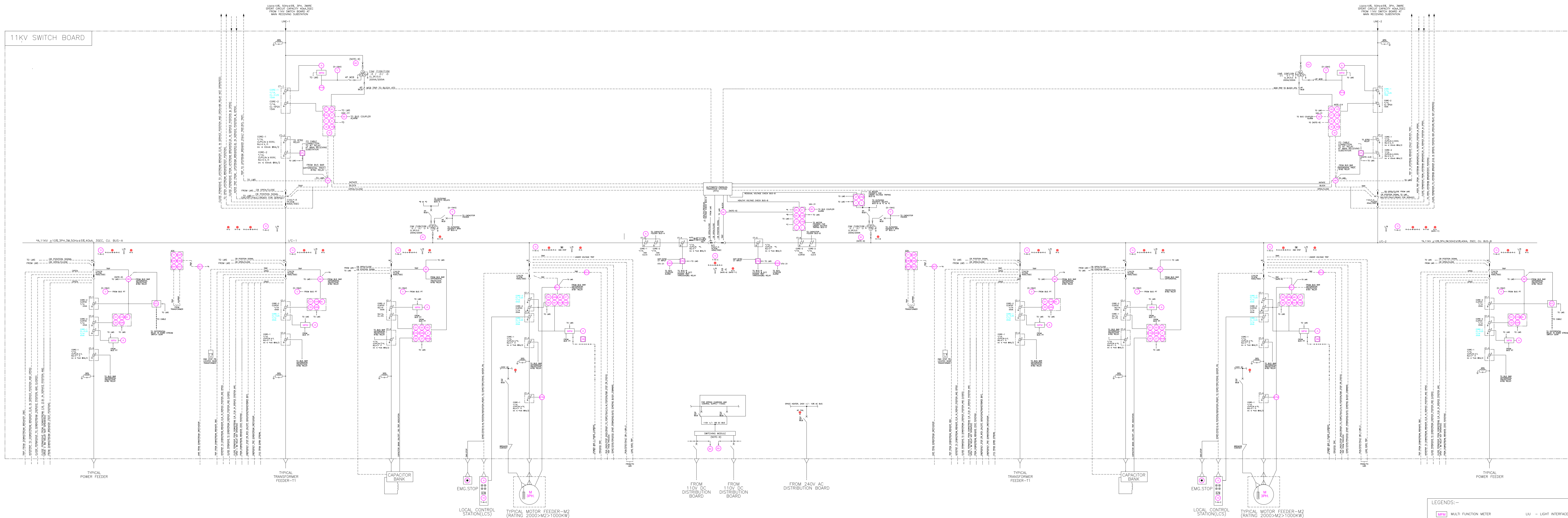
NOTE:-

- COMMUNICATION PROTOCOL SHALL BE AS FOLLOWS:-
 - NUMERICAL RELAY-IEC61850
 - MULTIFUNCTION METER (MFM)-MODBUS RTU
- AUTO CHANGE OVER LOGIC BETWEEN INCOMERS AND BUS COUPLER SHALL BE DEVELOPED IN NUMERICAL RELAY
- 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)
- LAMP TEST PUSH BUTTON SHALL BE PROVIDED.
- 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)
- 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'.

0	26.03.21	ISSUED FOR ENQUIRY	SS	RK	SKB
REV.	DATE	DESCRIPTION	PPD.	CKD.	APPD.
		CLIENT:- TALSCHER FERTILIZER LIMITED	REV. 0	SHEET 1 OF 2	
PROJECT:-		COAL BASED FERTILIZER PROJECT	SCALE: N.T.S.		
TITLE:-		11KV SINGLE LINE DIAGRAM	DRG. NO.- PC183-7411-0985B		
		प्रोजेक्ट्स एंड डेवलपमेंट इंडिया लिमिटेड नोएडा PROJECTS & DEVELOPMENT INDIA LTD.-NOIDA	FILE:		



0	26.03.21	ISSUED FOR ENQUIRY	SS	RK	SKB
REV.	DATE	DESCRIPTION	PPD.	CKD.	APPD.
		CLIENT:- TALCHER FERTILIZER LIMITED	REV. 0	SHEET 2 OF 2	
PROJECT:-		COAL BASED FERTILIZER PROJECT	SCALE: N.T.S.		
TITLE:-		3.3KV SINGLE LINE DIAGRAM	DRG. NO.- PC183-7411-0985B		
		प्रोजेक्ट्स एंड डेवलपमेंट इंडिया लिमिटेड नोएडा PROJECTS & DEVELOPMENT INDIA LTD.-NOIDA	FILE:		



THIS IS CONCEPTUAL SLD. DETAILS SLD SHALL BE PREPARED BY BIDDER & SUBMITTED WITH BID

LEGENDS:-

(MFM)	MULTI FUNCTION METER	(LUI)	LOAD INTERFACE UNIT
(OC)	OVER CURRENT RELAY	(LMS)	LOAD MANAGEMENT SYSTEM
(EF)	GROUND FAULT RELAY	(RTCC)	REMOTE TAP CHANGE CONTROL
(TR)	TRIP CIRCUIT SUPERVISION RELAY	(ES)	EARTH SWITCH
(UV)	UNDER VOLTAGE RELAY	(CODG.PNL)	INCOMING CUM OUTGOING PANEL
(TMR)	TEMPERATURE RELAY	(NGR)	NEUTRAL GROUNDING RESISTOR
(SC)	SYNCHRO CHECK RELAY	(VC)	VACUUM SENSOR RELAY
(LD)	LINE DIFFERENTIAL RELAY	(VSR)	VOLTAGE SENSOR RELAY
(DM)	DIRECTIONAL MOTOR PROTECT	(ABT)	AVAILABILITY BASED TARIFF
(DO)	DIRECTIONAL OVER CURRENT RELAY	(VM)	VOLTMETER ALONG WITH VSS
(BER)	BACKUP EARTH FAULT RELAY	(AM)	AMMETER ALONG WITH ASS
(LO)	LOCK OUT RELAY	(PFM)	POWER FACTOR METER
(TNC)	TNC SWITCH	(SPD)	SURGE PROTECTION DEVICE
(LI)	OIL LEVEL INDICATOR WITH CONTACTS		
(PR)	PRESSURE RELAY DAMPHRAM		
(TRM)	TEMP. RELAY FOR WINDING		
(TRO)	TEMP. RELAY FOR OIL		
(LOR)	LOCK OUT RELAY(RESET) 3-TRANSFORMER		
(OR)	INSTANT. OVER CURRENT		
(ORC)	INSTANT. OVER CURRENT		
(ORGR)	INSTANT. OVER CURRENT GROUND FAULT RELAY CONNECTED IN RESIDUAL WAY		
(ORV)	OVER VOLTAGE RELAY		
(DF)	DC SUPPLY FAILURE		
(UVR)	UNDER VOLTAGE RELAY TO INHIBIT MOTOR FOR TRIP		
(VF)	VF FAILURE		
(RDF)	RATE OF CHANGE OF FREQUENCY		

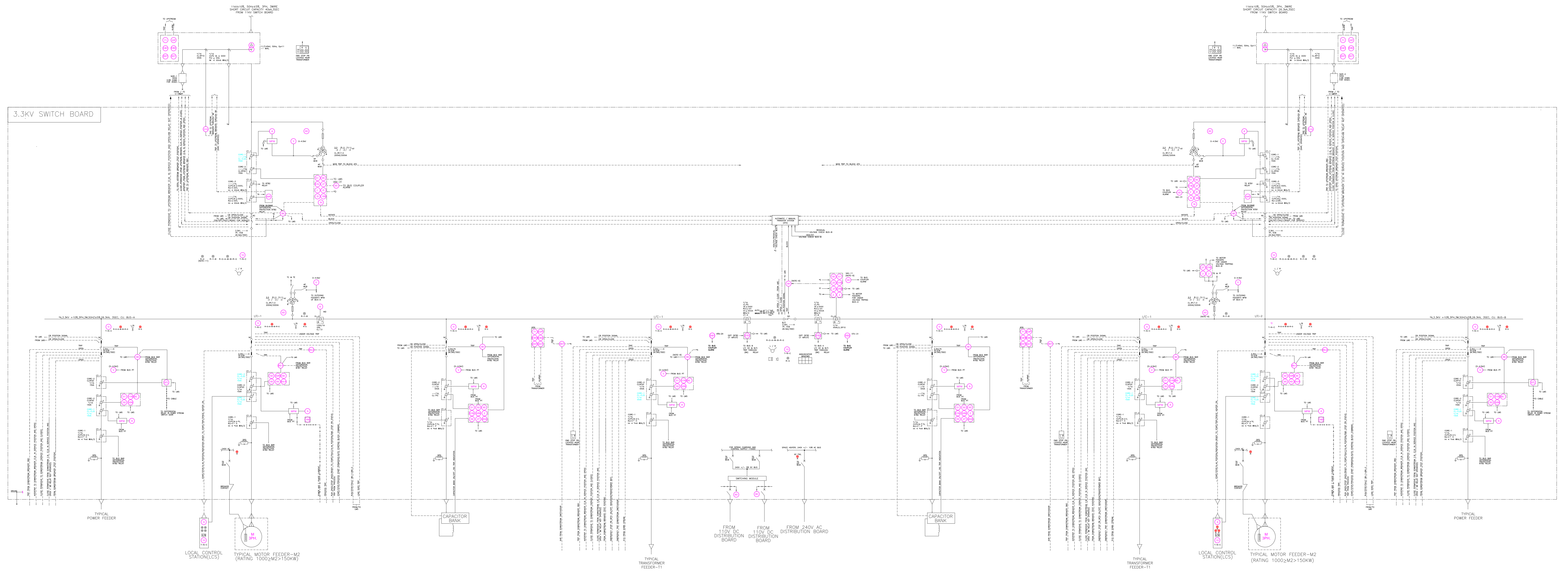
NOTE:-

- 12W ANNUNCIATOR SHALL BE PROVIDED ON TRANSFORMER FEEDER.
- COMMUNICATION PROTOCOL SHALL BE AS FOLLOWS:-
a. NUMERICAL RELAY-IEC61850
b. MULTIFUNCTION METER (MFM)-MODBUS
- AUTO CHANGE OVER LOGIC BETWEEN INCOMERS AND BUS COUPLER SHALL BE DEVELOPED IN NUMERICAL RELAY
- COMMANDS/INDICATION TO/FROM LMS SHOWN IN SLD ARE INDICATIVE.
- TNC SWITCH SHALL BE ABLE TO CLOSE ONLY IN TEST POSITION FOR ALL MOTOR FEEDERS
- 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)
- COMMON ALARM CIRCUIT FOR HOOTER & BUZZER SHALL BE PROVIDED IN BUS COUPLER.
- LAMP TEST PUSH BUTTON SHALL BE PROVIDED.
- 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)
- SIGNALS/INDICATIONS TO/FROM DCS SHOWN IN SLD ARE INDICATIVE. AND SHALL BE CONFIRMED DURING DETAIL ENG.
- 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'.

0	26.03.21	ISSUED FOR TENDER	SS	RK	SKB
REV.	DATE	DESCRIPTION	PPD.	CKD.	APPD.
		CLIENT:- TALCHER FERTILIZER LIMITED	REV. 0	SHEET 1 OF 1	
PROJECT:-		ELECTRICAL DISTRIBUTION SYSTEM FOR COAL BASED FERTILIZER PROJECT	SCALE: N.T.S.		
TITLE:-		TYPICAL 11KV SW. BD. SINGLE LINE DIAGRAM	DRG. NO.- PC183-1225		
		PROJECTS & DEVELOPMENT INDIA LTD.-NOIDA	FILE:		



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PROJECTS & DEVELOPMENT INDIA LTD.-NOIDA



NOTE:-

- 12W ANNUNCIATOR SHALL BE PROVIDED ON TRANSFORMER FEEDER, 8W FOR OTHER FEEDERS.
- COMMUNICATION PROTOCOL SHALL BE AS FOLLOWS:-
 - a. NUMERICAL RELAY-IEC61850
 - b. MULTIFUNCTION METER (MFM)-MODBUS RTU
- AUTO CHANGE OVER LOGIC BETWEEN INCOMERS AND BUS COUPLER SHALL BE DEVELOPED IN NUMERICAL RELAY
- COMMANDS/INDICATION TO/FROM LMS SHOWN IN SLD ARE INDICATIVE.
- TNC SWITCH SHALL BE ABLE TO CLOSE ONLY IN TEST POSITION FOR ALL MOTOR FEEDERS
- 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)
- COMMON ALARM CIRCUIT FOR HOOTER & BUZZER SHALL BE PROVIDED IN BUS COUPLER.
- LAMP TEST PUSH BUTTON SHALL BE PROVIDED.
- 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)
- SIGNALS/INDICATIONS TO/FROM DCS SHOWN IN SLD ARE INDICATIVE. AND SHALL BE CONFIRMED DURING DETAIL ENG.
- 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

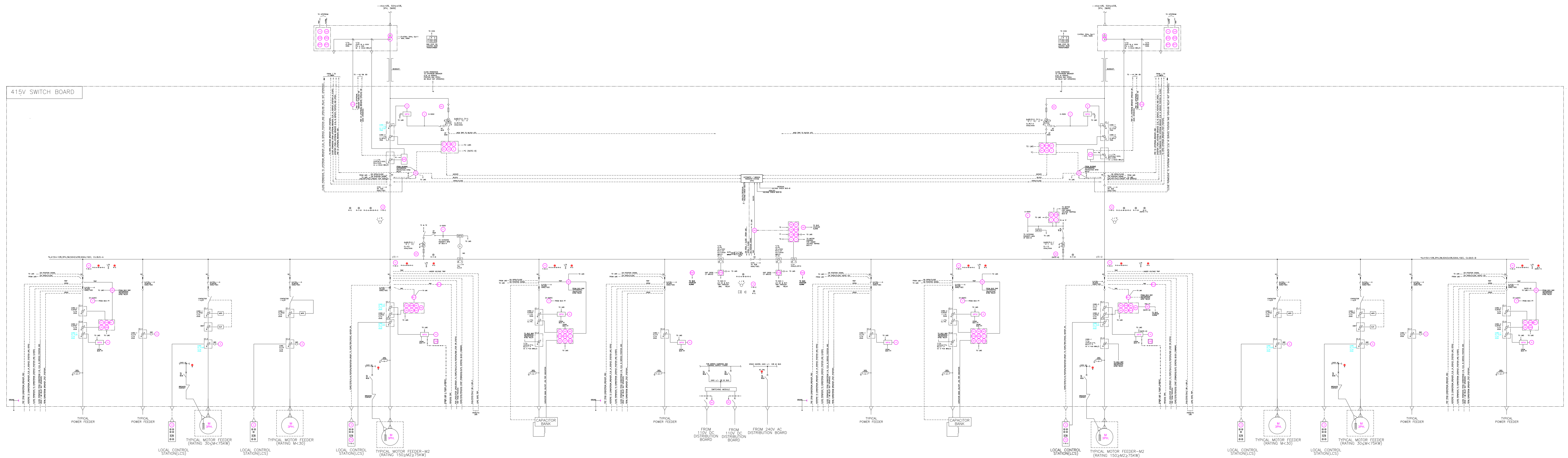
LEGENDS:-

MFM	MULTIFUNCTION METER	⊖	REVERSE POWER RELAY
OC	OVER CURRENT RELAY	⊖	DIRECTIONAL OVER CURRENT RELAY
EF	EARTH FAULT RELAY	⊖	RATE OF CHANGE OF FREQUENCY RELAY
TR	TRIP CIRCUIT SUPERVISION RELAY	⊖	UNDER/OVER FREQUENCY RELAY(WITH #/W)
UV	UNDER VOLTAGE RELAY	⊖	DIRECTIONAL EARTH FAULT RELAY
T	TIMER	LMS	LOAD MANAGEMENT SYSTEM
SC	SYNCHRO CHECK RELAY	ICOD	INCOMING CUM OUTGOING PANEL
LD	LINE DIFFERENTIAL RELAY	NGR	NEUTRAL GROUNDING RESISTOR
DO	DIRECTIONAL OVER CURRENT RELAY	VC	VACUUM SENSOR RELAY
BE	BACKUP EARTH FAULT RELAY	VSR	VOLTAGE SENSOR RELAY
LO	LOCK OUT RELAY	V	VOLTMETER ALONG WITH VSS
TNC	TNC SWITCH	D	DIGITAL AMMETER ALONG WITH ASS
DI	DI LEVEL INDICATOR WITH CONTACTS	SPD	SURGE PROTECTION DEVICE
PR	PRESSURE RELIEF DIAGHRAM		
TM	TEMP. RELAY FOR WINDING		
TO	TEMP. RELAY FOR OIL		
LR	LOCK OUT RELAY(HAND RESET)-TRANSFORMER		
IO	INSTANT OVER CURRENT		
IC	INSTANT OVER CURRENT GROUND FAULT RELAY CONNECTED IN RESIDUAL WAY		
OV	OVER VOLTAGE RELAY		
DF	DC SUPPLY FAILURE		
UV	UNDER VOLTAGE RELAY TO INIATE MOTOR FOR TRIP		
VF	VT FAILURE		

0	26.03.21	ISSUED FOR TENDER	SS	RK	SKB
REV.	DATE	DESCRIPTION	PPD.	CKD.	APPD.
		CLIENT:- TALCHER FERTILIZER LIMITED	REV. P		
			SHEET 1 OF 1		
PROJECT:-		ELECTRICAL DISTRIBUTION SYSTEM FOR COAL BASED FERTILIZER PROJECT	SCALE: N.T.S.		
TITLE:-		TYPICAL 3.3kV SW. BD. SINGLE LINE DIAGRAM	DRG. NO.- PC183-1226		
			FILE:		



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PROJECTS & DEVELOPMENT INDIA LTD.-NOIDA



NOTE:-

1. 12W ANNUNCIATOR SHALL BE PROVIDED ON TRANSFORMER FEEDER,8W FOR OTHER FEEDERS.
2. COMMUNICATION PROTOCOL SHALL BE AS FOLLOWS:-
 - a. NUMERICAL RELAY-IEC61850
 - b. MULTIFUNCTION METER (MFM)-MODBUS RTU
3. AUTO CHANGE OVER LOGIC BETWEEN INCOMERS AND BUS COUPLER SHALL BE DEVELOPED IN NUMERICAL RELAY
4. COMMANDS/INDICATION TO/FROM LMS SHOWN IN SLD ARE INDICATIVE.
5. TNC SWITCH SHALL BE ABLE TO CLOSE ONLY IN TEST POSITION FOR ALL MOTOR FEEDERS
6. 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)
7. COMMON ALARM CIRCUIT FOR HOOTER & BUZZER SHALL BE PROVIDED IN BUS COUPLER.
8. LAMP TEST PUSH BUTTON SHALL BE PROVIDED.
9. 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)
10. SIGNALS/INDICATIONS TO/FROM DCS SHOWN IN SLD ARE INDICATIVE. AND SHALL BE CONFIRMED DURING DETAIL ENG.
11. 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'.
12. EPMCC SHALL HAVE 3 NOS OF I/C.

LEGENDS:-

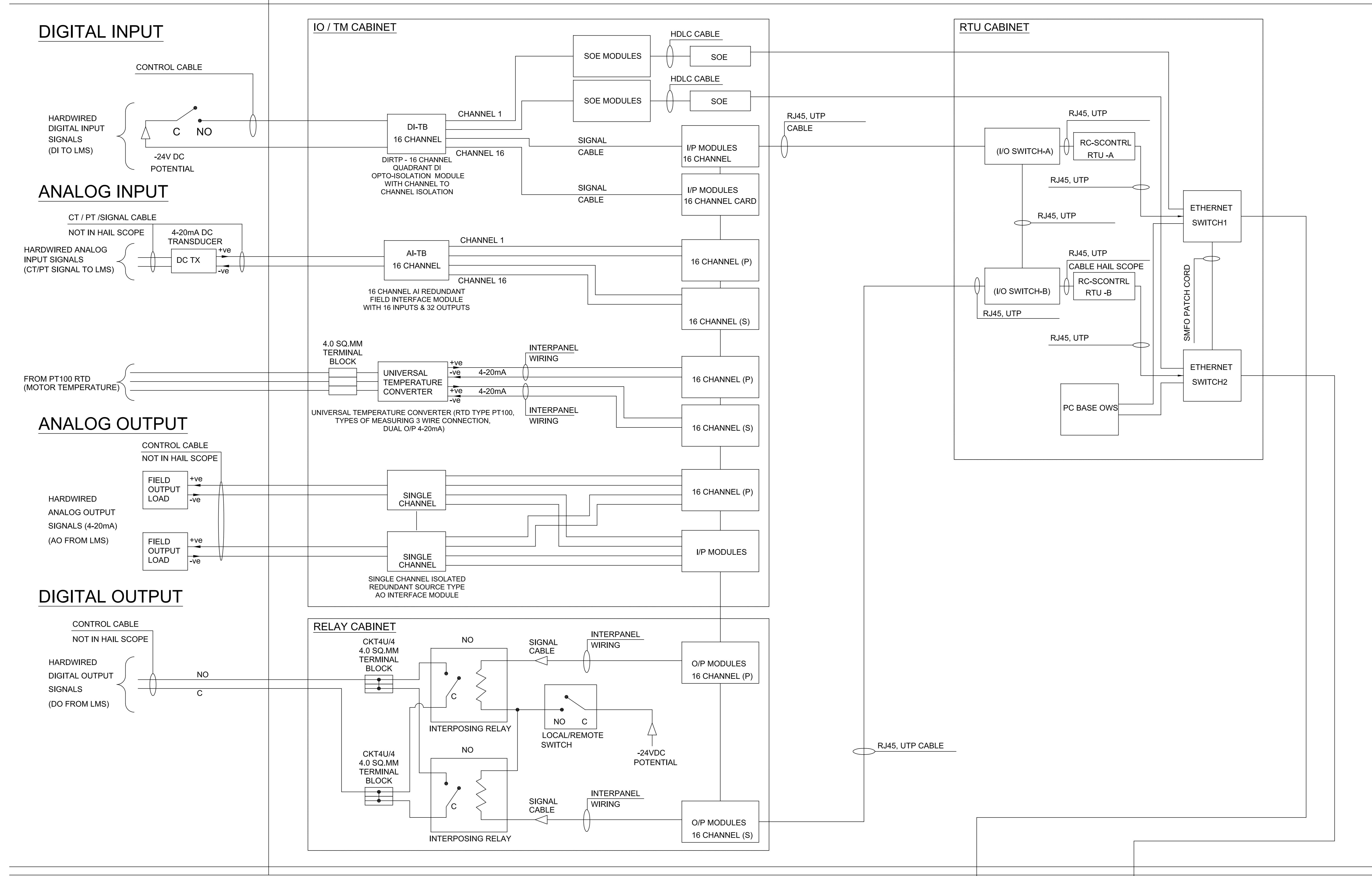
MFM	MULTI-FUNCTION METER	OP	OVER CURRENT RELAY
OC	OVER CURRENT RELAY	OC	DIRECTIONAL OVER CURRENT RELAY
EF	TEMP EARTH FAULT RELAY	ROF	RATE OF CHANGE OF FREQUENCY RELAY
TR	TRIP CIRCUIT SUPERVISION RELAY	UF/OF	UNDER/OVER FREQUENCY RELAY(40/60)
UV	UNDER VOLTAGE RELAY	DEF	DIRECTIONAL EARTH FAULT RELAY
TSR	TSR	LMS	LOAD MANAGEMENT SYSTEM
SC	SYNCHRO CHECK RELAY	ICOG-PNL	INCOMING CUM OUTGOING PANEL
LD	LINE DIFFERENTIAL RELAY	NDR	NEUTRAL GROUNDING RESISTOR
DOC	DIRECTIONAL OVER CURRENT RELAY	VS	VACUUM SENSOR RELAY
BER	BACKUP EARTH FAULT RELAY	VSR	VOLTAGE SENSOR RELAY
LO	LOCK OUT RELAY	VAV	VOLTMETER ALONG WITH VSS
TNC	TNC SWITCH	DA	DIGITAL AMMETER ALONG WITH ASS
OL	OIL LEVEL INDICATOR WITH CONTACTS	SPD	SURGE PROTECTION DEVICE
PR	PRESSURE RELAY DASH/RAM		
WR	TEMP. RELAY FOR WINDING		
OR	TEMP. RELAY FOR OIL		
LR	LOOK OUT RELAY(HAND RESET)-TRANSFORMER		
IO	INSTANT OVER CURRENT		
IG	INSTANT OVER CURRENT GROUND FAULT RELAY CONNECTED IN RESONANT WAY		
ORV	OVER VOLTAGE RELAY		
DS	DC SUPPLY FAILURE		
UV	UNDER VOLTAGE RELAY TO INHIBIT MOTOR FEED TRIP		
VF	VT FAILURE		

THIS IS CONCEPTUAL SLD. DETAILS SLD SHALL BE PREPARED BY BIDDER & SUBMITTED WITH BID

0	26.03.21	ISSUED FOR TENDER	SS	SS/RK	SKB
REV.	DATE	DESCRIPTION	PPD.	CKD.	APPD.
		CLIENT:- TALCHER FERTILIZER LIMITED	REV. 0	SHEET 1 OF 1	
PROJECT:-		ELECTRICAL DISTRIBUTION SYSTEM FOR COAL BASED FERTILIZER PROJECT	SCALE: N.T.S.		
TITLE:-		TYPICAL 0.415V SW. BD. SINGLE LINE DIAGRAM	DRG. NO.- PC183-1227		
		FILE:			
		प्रोजेक्ट्स एंड डेवलपमेंट इंडिया लिमिटेड नोएडा PROJECTS & DEVELOPMENT INDIA LTD.-NOIDA			

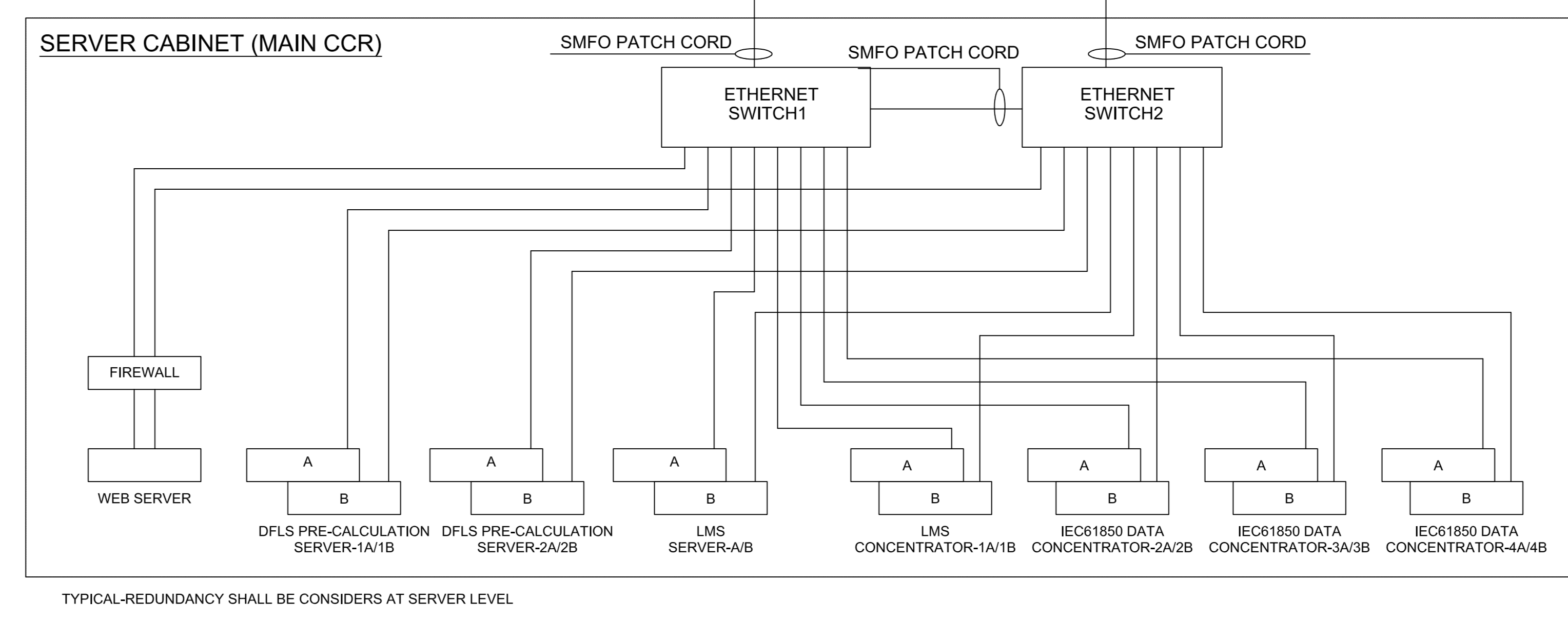
FIELD / SWITCH BOARD

TYPICAL ECMS SYSTEM IN SUBSTATION

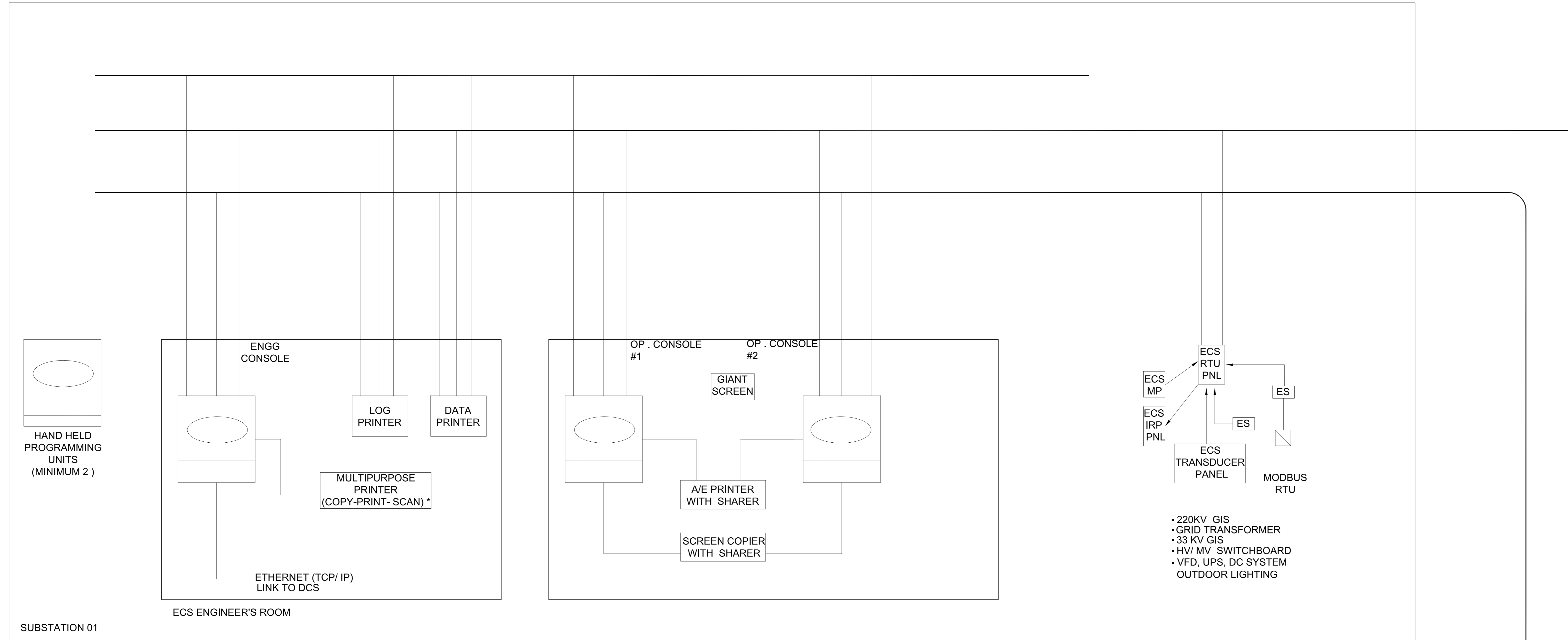


- NOTE**
1. REDUNDANCY
 2. DI ,DO, AI, AO 16 CHANNEL.
 3. OWS SHALL BE PC BASED 32 INCH.
 4. THIS IS A TYPICAL SCHEME FOR A SUBSTATIONS .
EACH SUBSTATIONS SHALL HAVE ITS OWN ECMS / RTU PANEL.
ALL ECMS/ RTU PANEL SHALL BE CONNECTED IN REDUNDANCY FO RING.
 5. NECESSARY HARDWARE FOR NETWORK REDUNDANCY SHALL BE CONSIDER.
 6. REDUNDANCY SHALL BE CONSIDERS I/O RTU AT NETWORK LEVEL
RTU (P) - PRIMARY RTU
RTU (S) - SECONDARY RTU

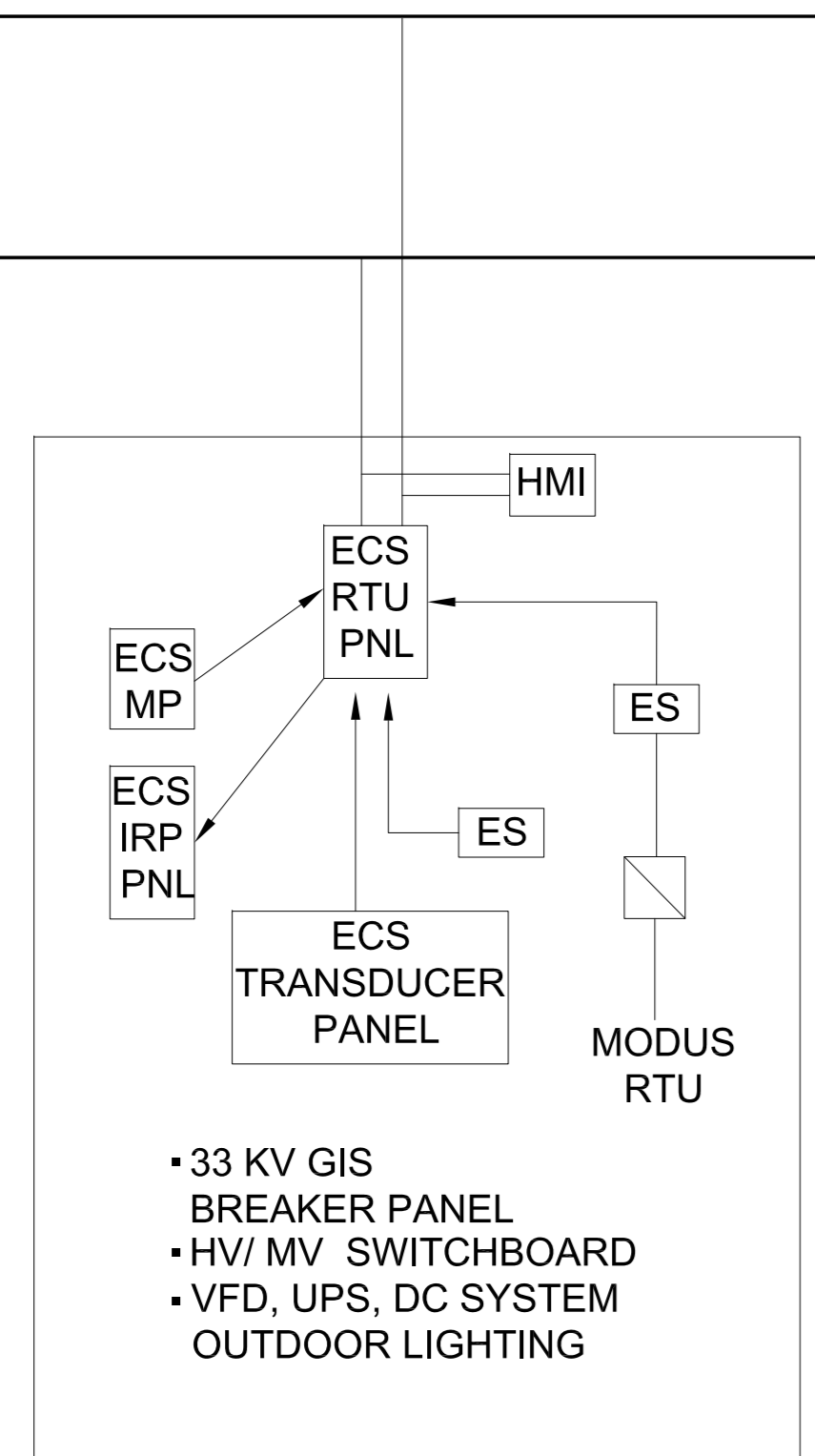
TYPICAL ECMS SYSTEM



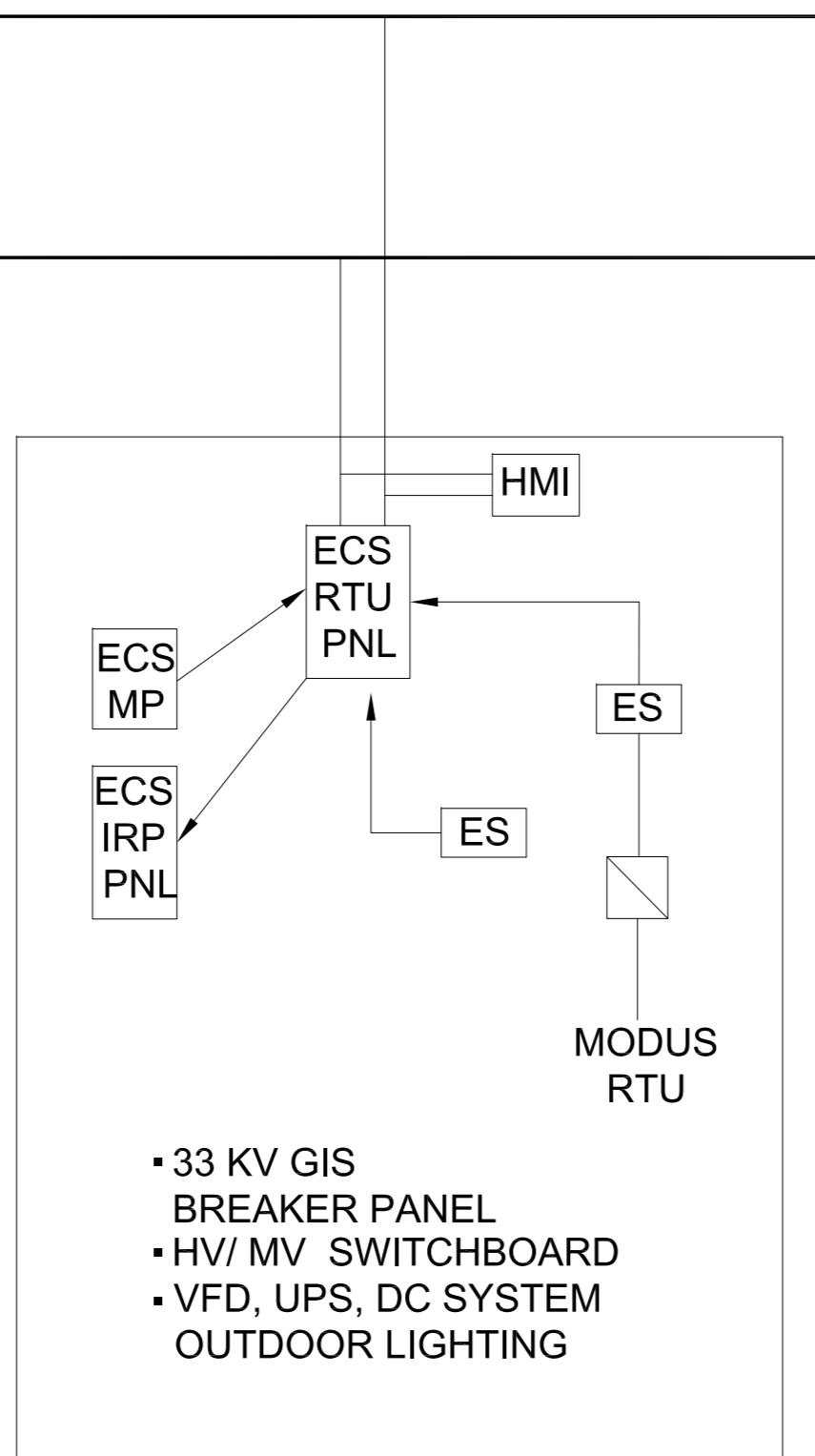
0	26.03.21	ISSUED FOR ENQUIRY	SS	RK	SKB
REV.	DATE	DESCRIPTION	PPD.	CKD.	APPD.
		CLIENT:- TALCHER FERTILIZER LIMITED	REV.	0	
PROJECT:-		ELECTRICAL DISTRIBUTION SYSTEM	SHEET 1 OF 3		
TITLE:-		ARCHITECTURAL -ECMS SYSTEM	SCALE: N.T.S.		
			DRG. NO.- PC183-1228		
			FILE:		
		प्रोजेक्ट्स एंड डेवलपमेंट इंडिया लिमिटेड नोएडा PROJECTS & DEVELOPMENT INDIA LTD.-NOIDA			



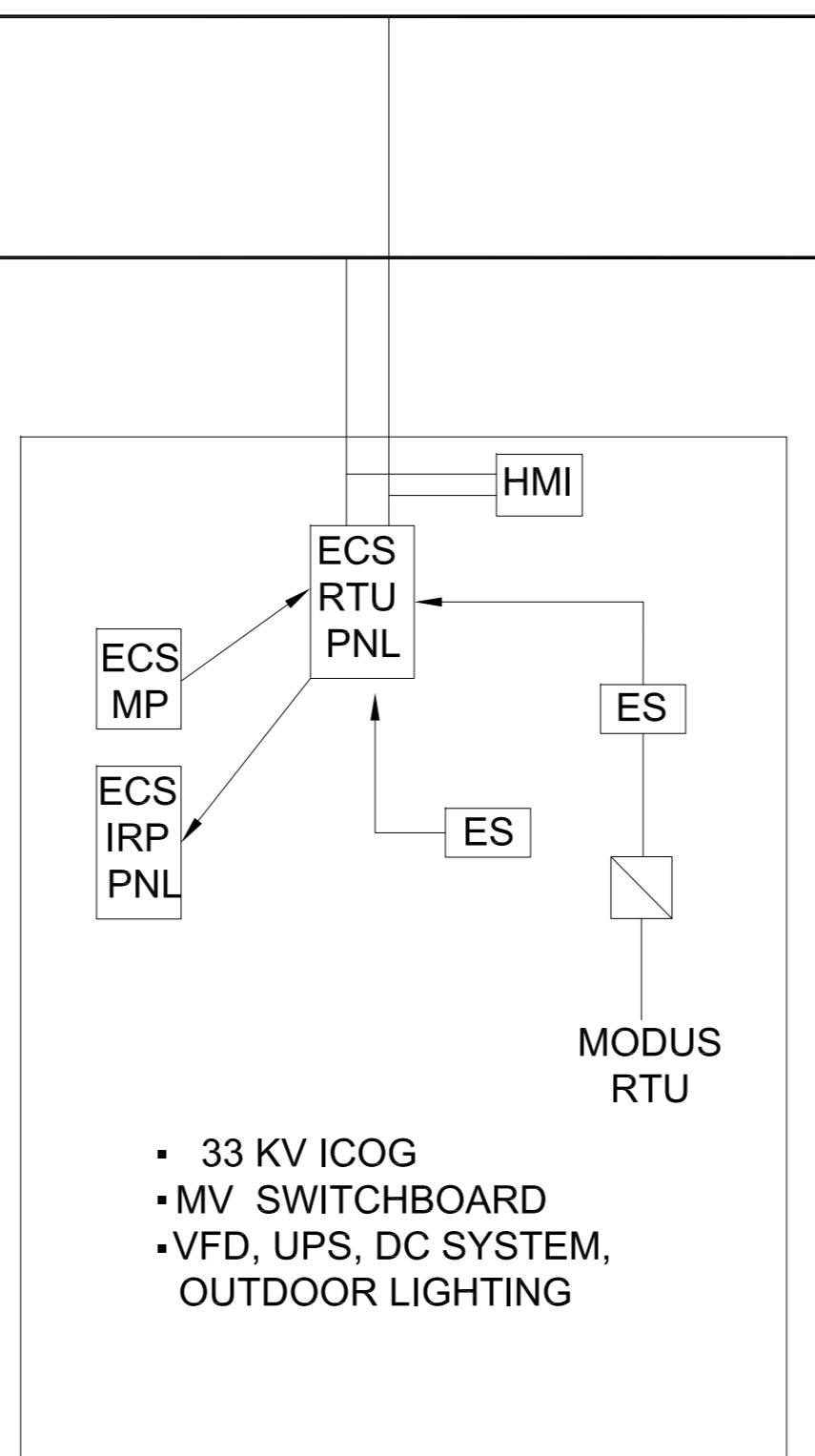
NOTE: DATA HIGHWAY CONFIGURATION SHOWN IS INDICATIVE. DATA HIGHWAY CONFIGURATION SHALL HAVE DUAL REDUNDANCY



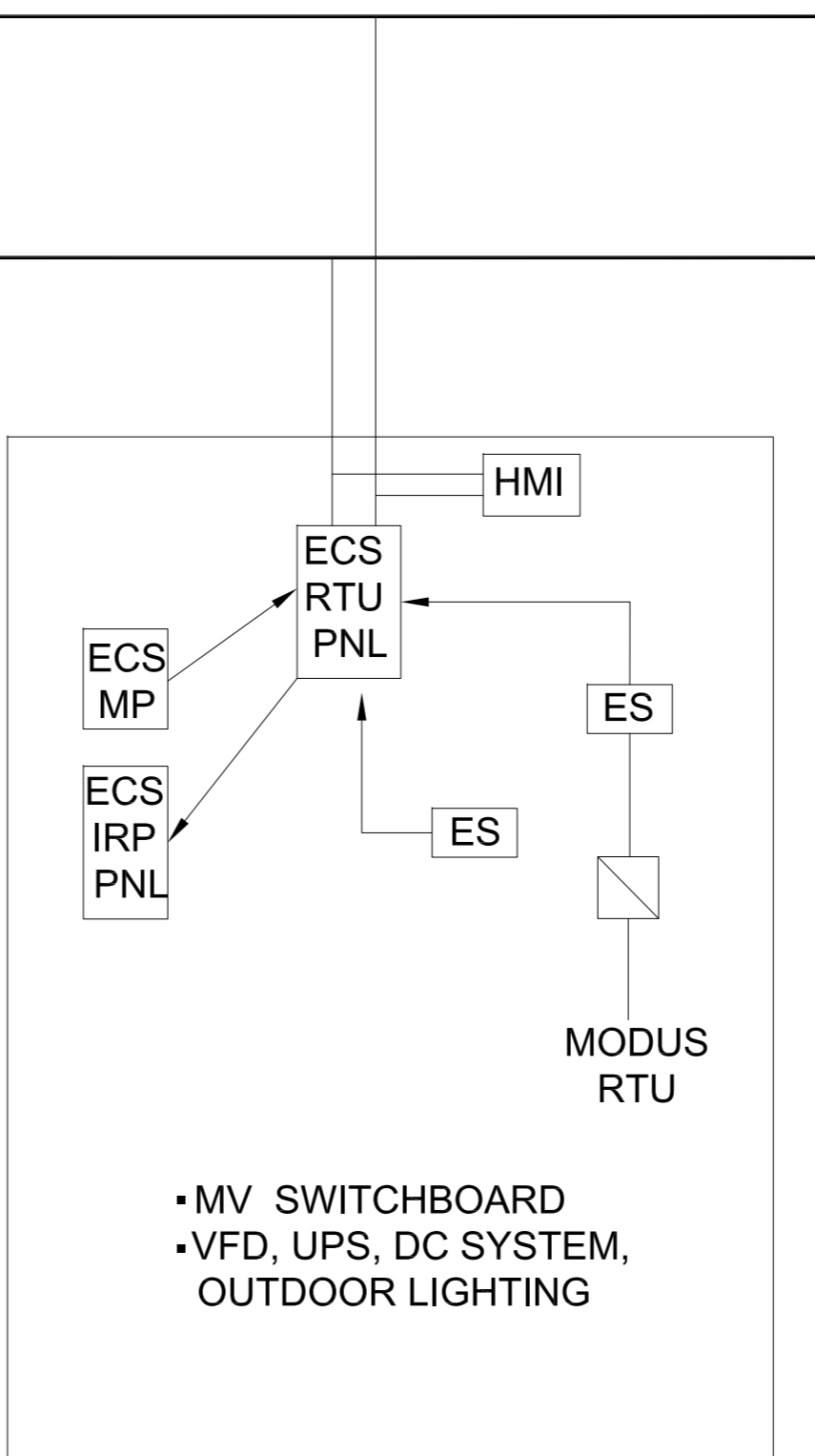
SUBSTATION



SUBSTATION

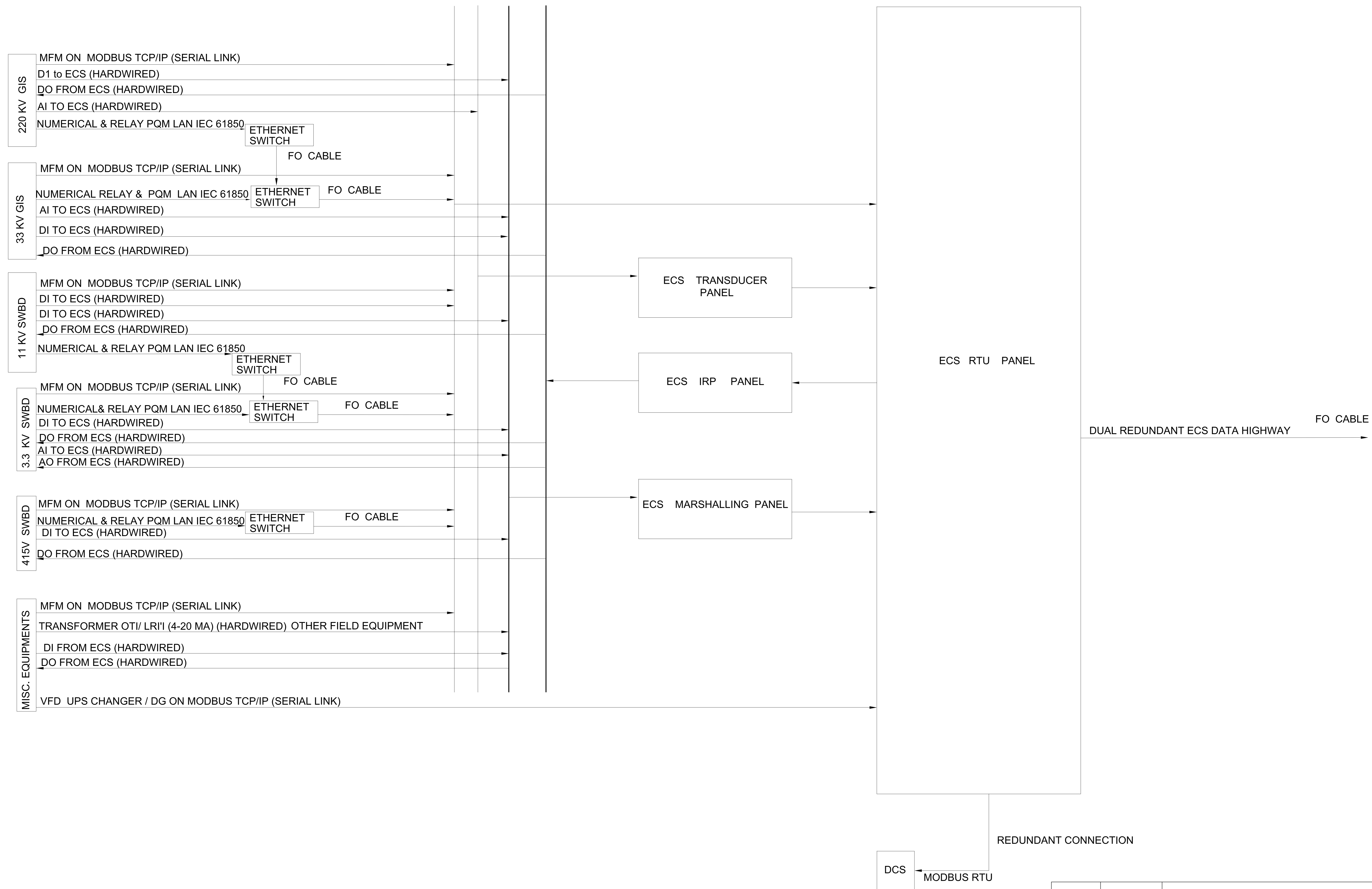



SUBSTATION



SUBSTATION

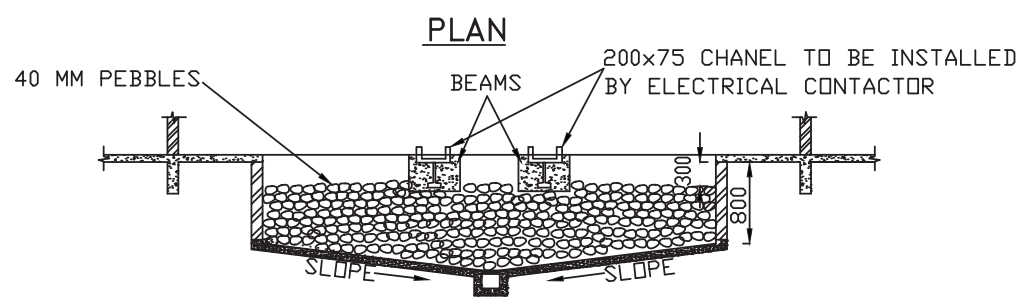
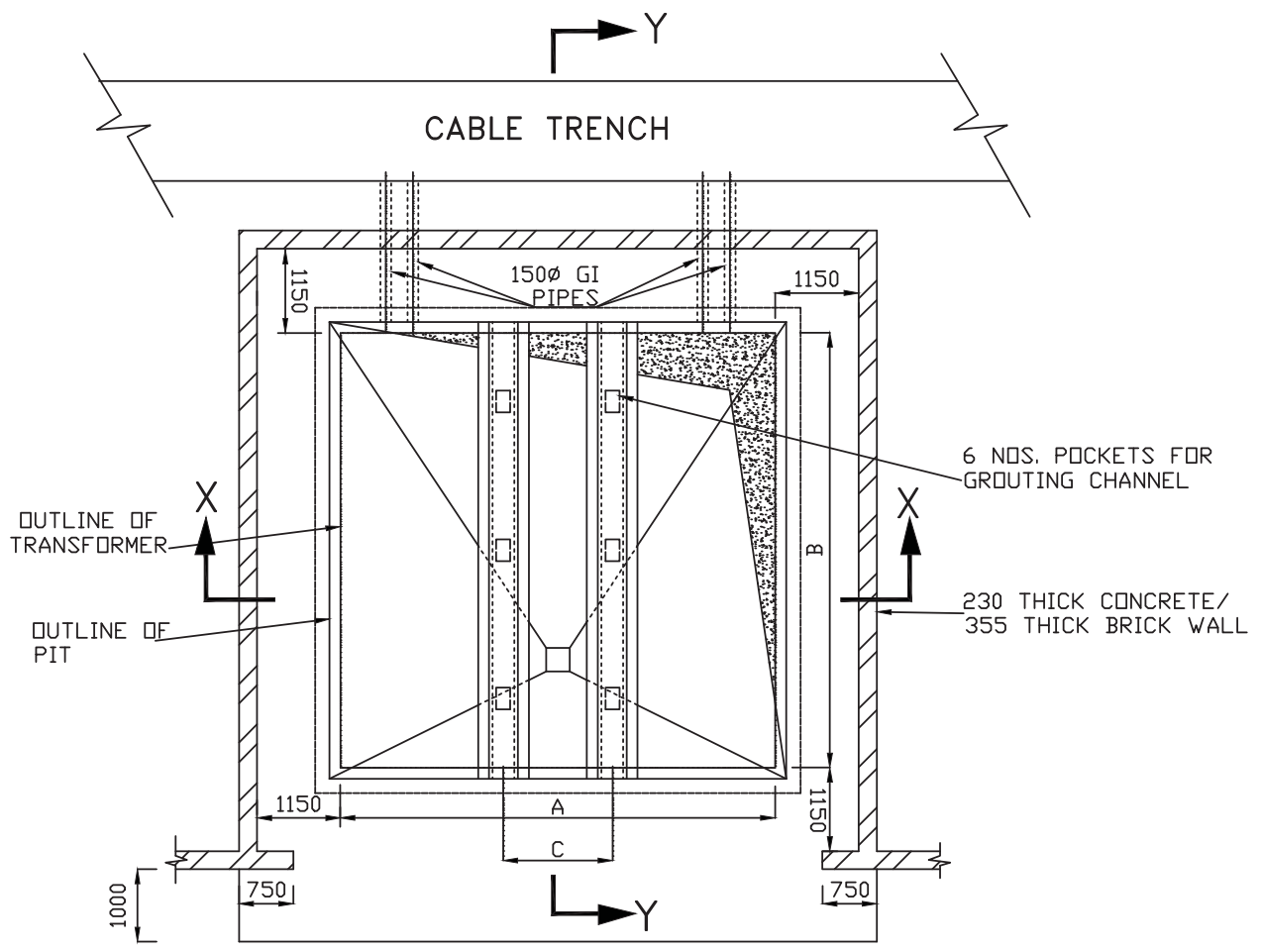
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REV.	DATE	DESCRIPTION	PPD.	CKD.	APPD.
		CLIENT:-	REV. 0		
		TALCHER FERTILIZER LIMITED	SHEET 2 OF 3		
PROJECT:-		ELECTRICAL DISTRIBUTION SYSTEM	SCALE: N.T.S.		
TITLE:-		TYPICAL ECMS SYSTEM IN SUBSTATION	DRG. NO.- PC183-1228		
		प्रोजेक्ट्स एंड डेवलपमेंट इंडिया लिमिटेड नोएडा PROJECTS & DEVELOPMENT INDIA LTD.-NOIDA			



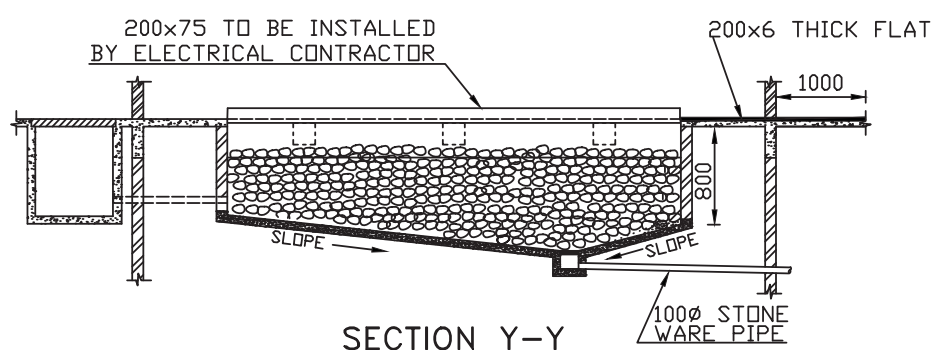
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REV.	DATE	DESCRIPTION	PPD.	CKD.	APPD.
 CLIENT:— TALCHER FERTILIZER LIMITED			REV.	0	
PROJECT:— ELECTRICAL DISTRIBUTION SYSTEM			SHEET 3 OF 3		
TITLE:— ECMS SYSTEM IN SUBSTATION			SCALE: N.T.S.		
			DRG. NO.— PC183-1228		
			FILE:		



प्रोजेक्ट्स एंड डेवलपमेंट इंडिया लिमिटेड नोएडा
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SECTION X-X



SECTION Y-Y

NOTE :

TRANSFORMERS RATED ABOVE 10MVA SHALL BE MOUNTED ON 200MM x 8MM THICK PLATES.



TYPICAL DETAILS OF
TRANSFORMER ROOM DOOR

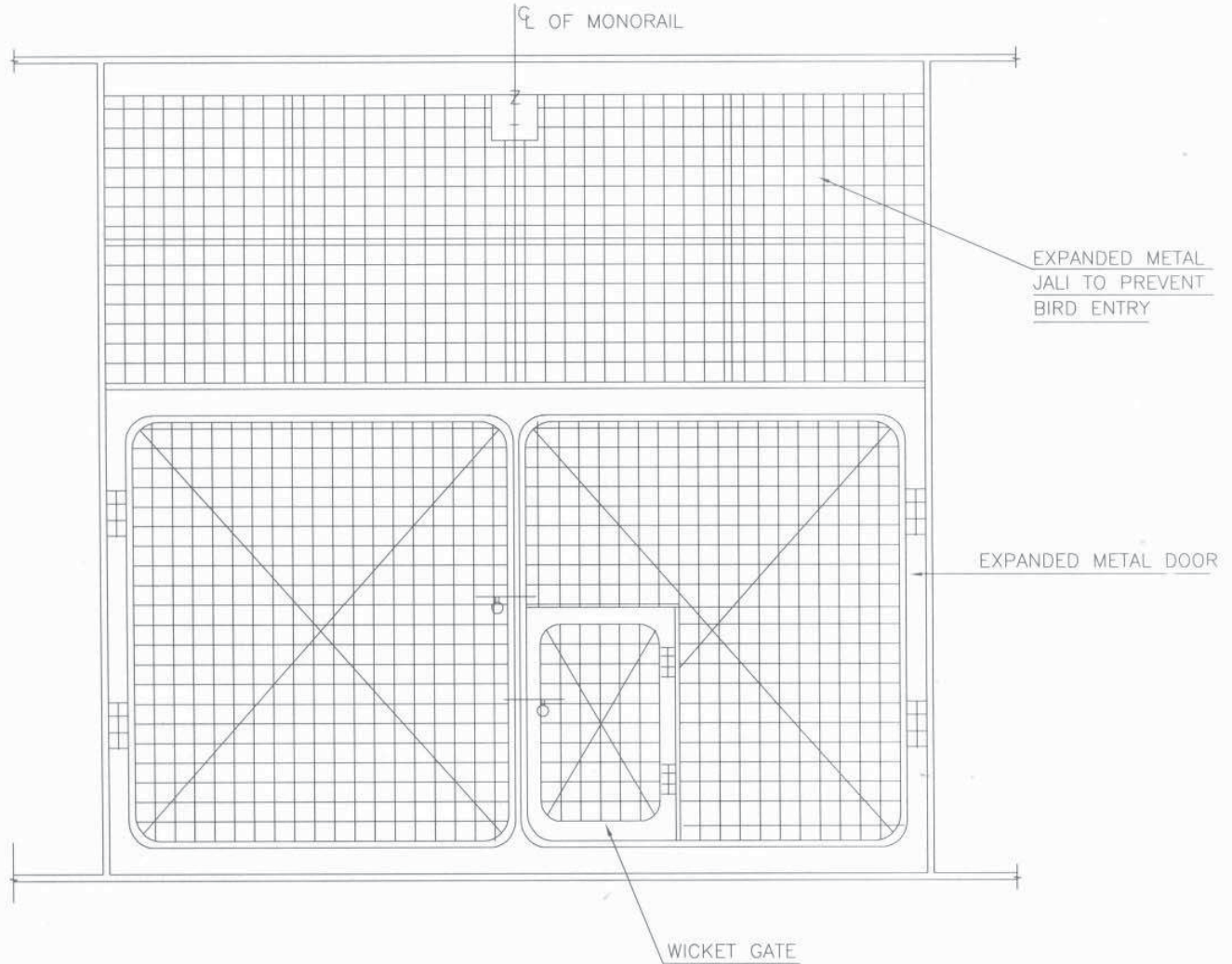
PC183 E 115

0

DOCUMENT NO.

REV

SHEET 1 OF 1



NOTE :-

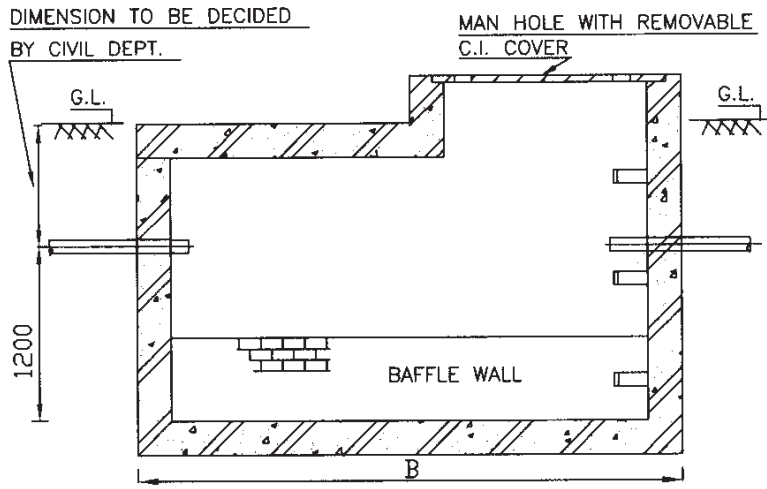
1. THIS STANDARD IS INDICATIVE ONLY, THE EXACT DIMENSIONS SHALL BE DECIDED AS PER TRANSFORMER SIZE & SUB-STATION LAYOUT.
2. TRANSFORMER GATE HEIGHT SHALL BE 250MM MORE THAN THE TRANSFORMER HEIGHT AND SHALL BE OPENABLE OUTSIDE.

0	20.01.07	01.02.07	ISSUED FOR IMPLEMENTATION	<i>Shree</i> RUNDA/AV	<i>SC</i> SC	<i>BB</i> BB
REV	REV.DATE	EFF.DATE	PURPOSE	PREPD	REVWD	APPD

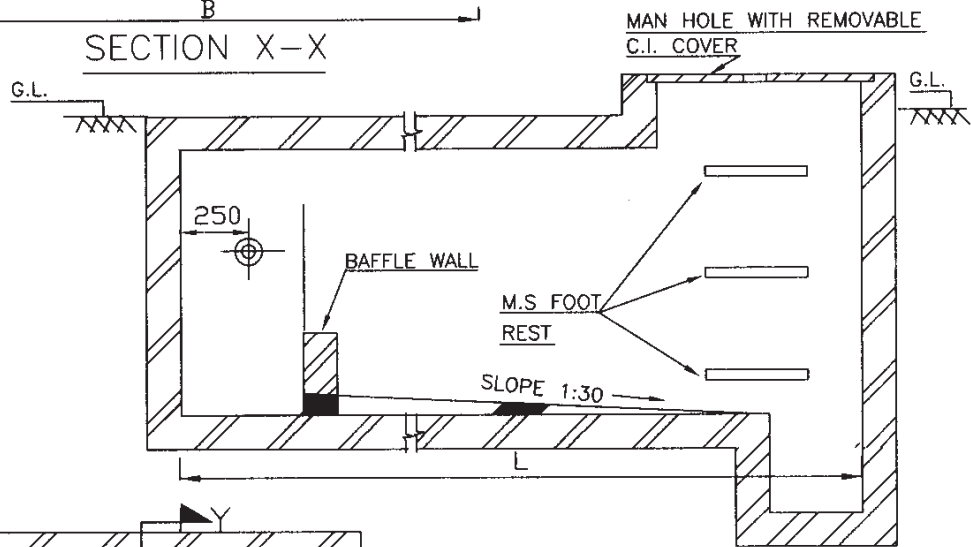


SUMP PIT FOR TRANSFORMER OIL

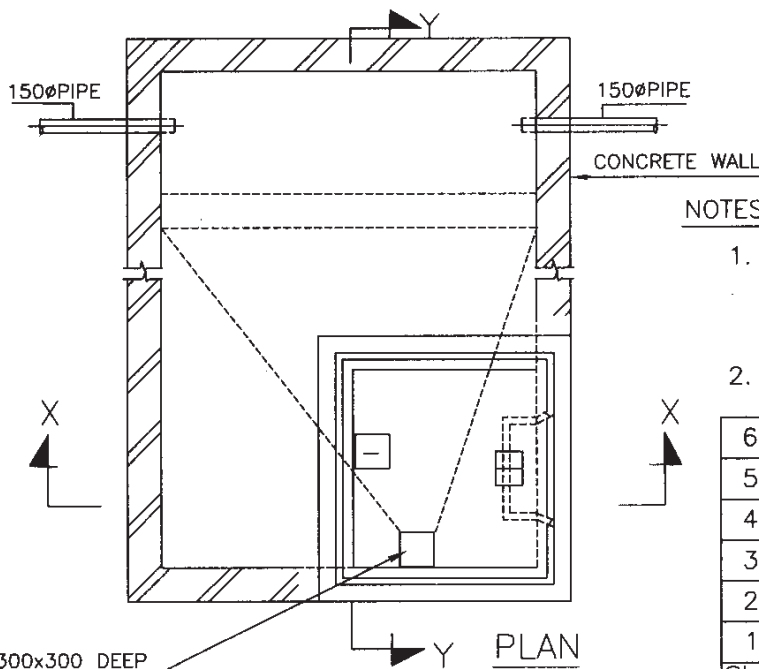
PC183 PDS: E116	1
DOCUMENT NO.	REV
SHEET 1 OF 1	



SECTION X-X



SECTION Y-Y



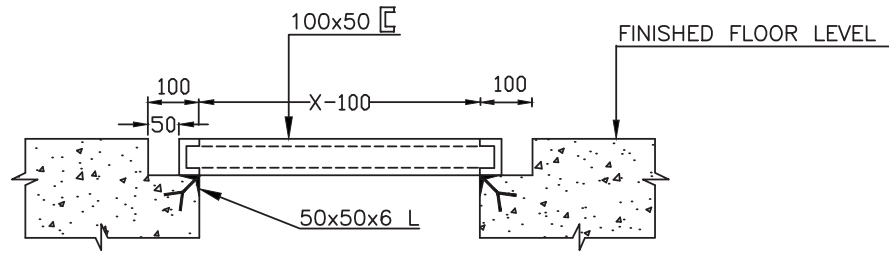
300x300x300 DEEP
SUNCTION PIT

PLAN

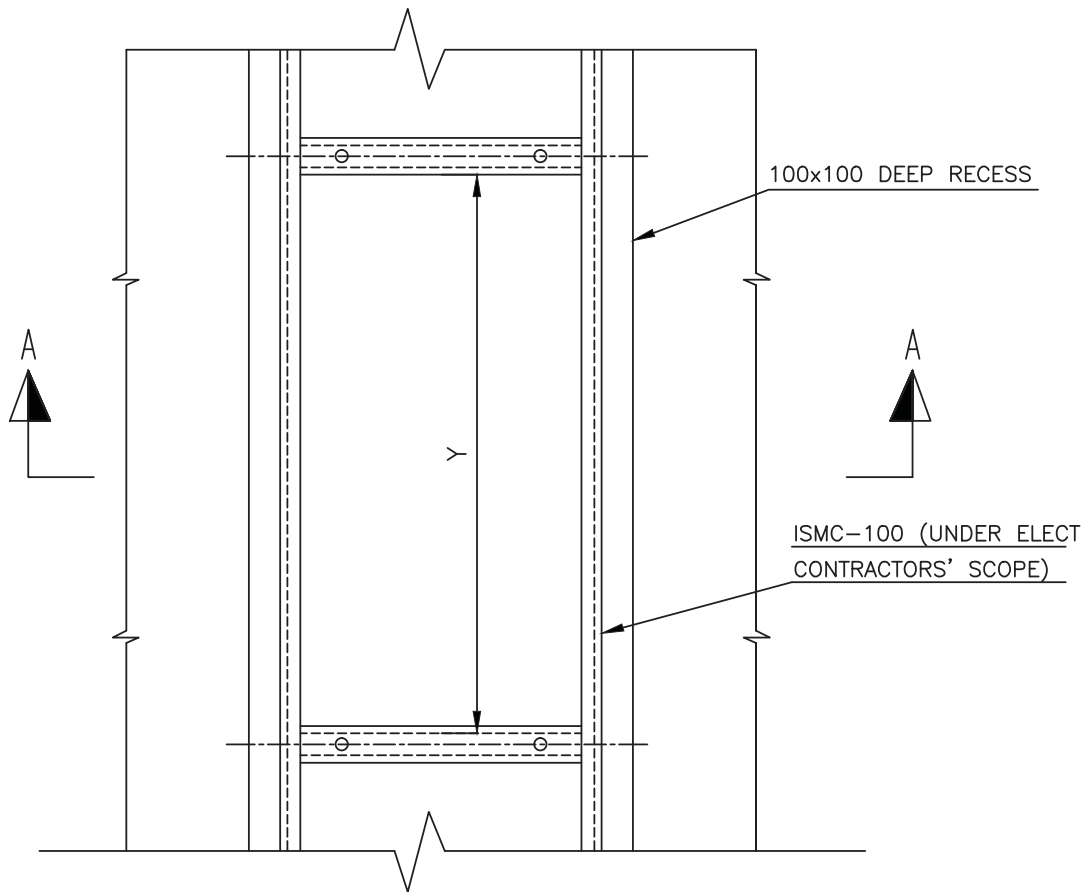
NOTES:-

- DIMENSION 'L' AND 'B' SHALL BE DECIDED BASED ON OIL VOLUME OF HIGHEST RATED TRANSFORMER.
- ALL DIMENSIONS ARE IN mm

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
SL. No.	OIL CAPACITY	L	B



SECTION-A A



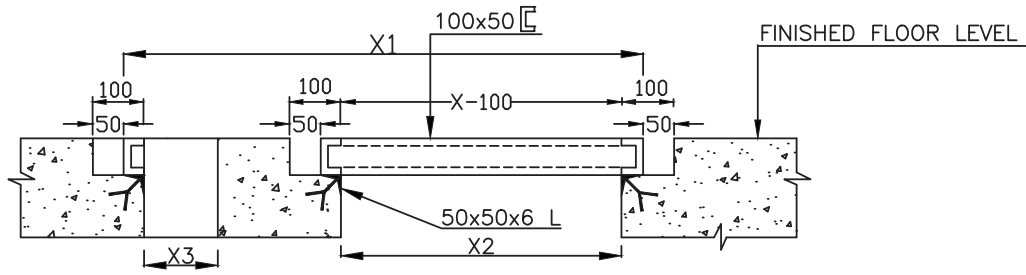
PLAN

X- DEPTH OF PANEL

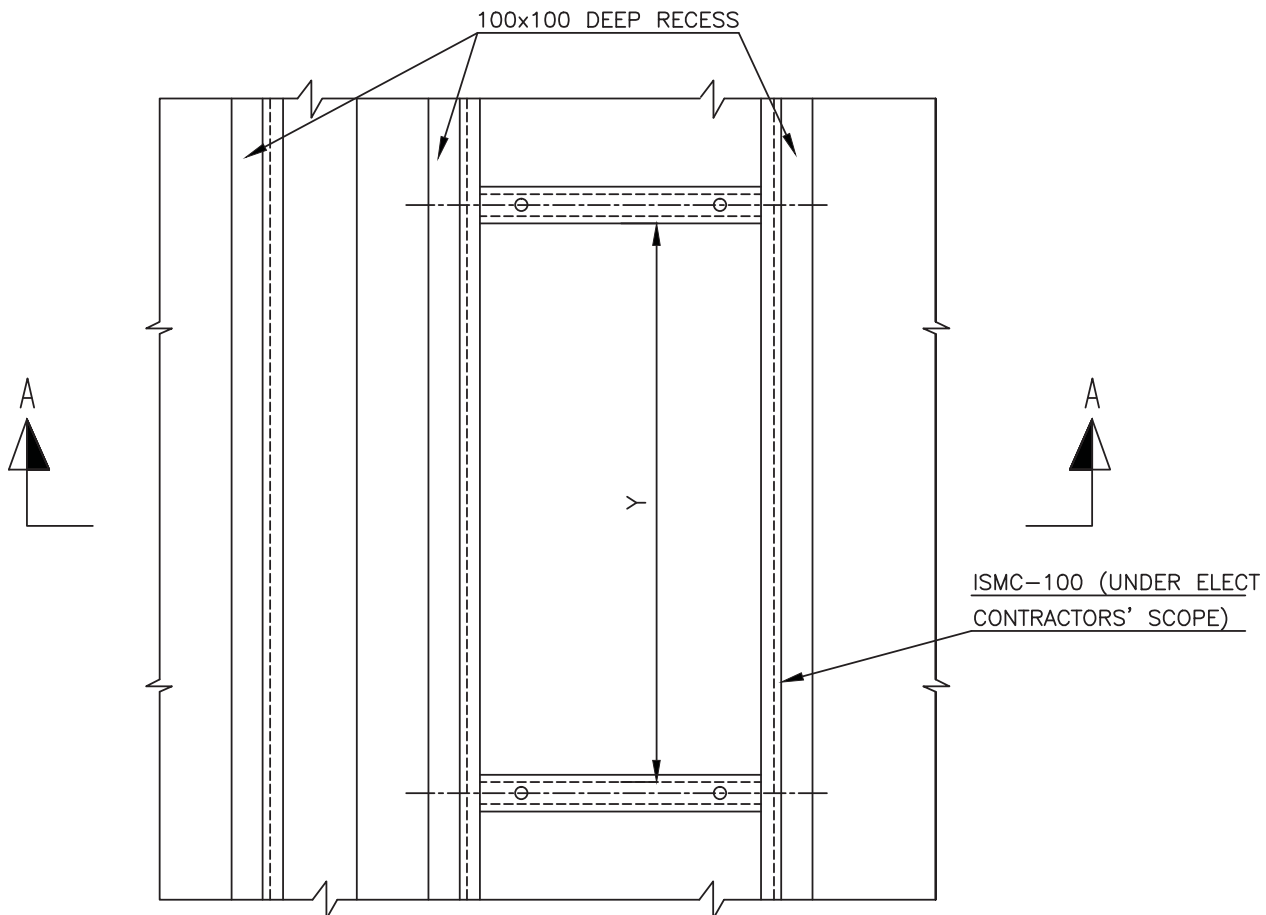
Y- LENGTH OF TWO PANELS

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



SECTION-A A

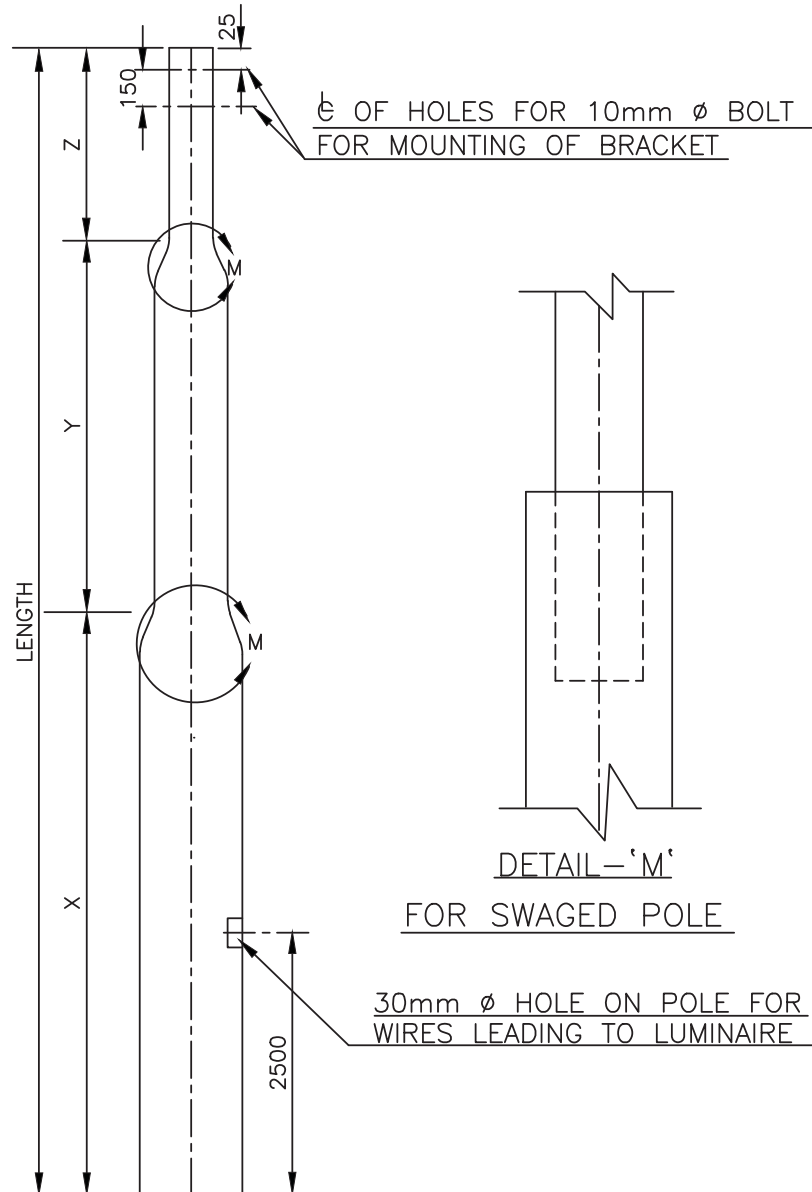


X1 = DEPTH OF PANEL
X2 = FOOR OPENING
X3 = FOOR OPENING
Y = LENGTH OF PANEL

PLAN

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.

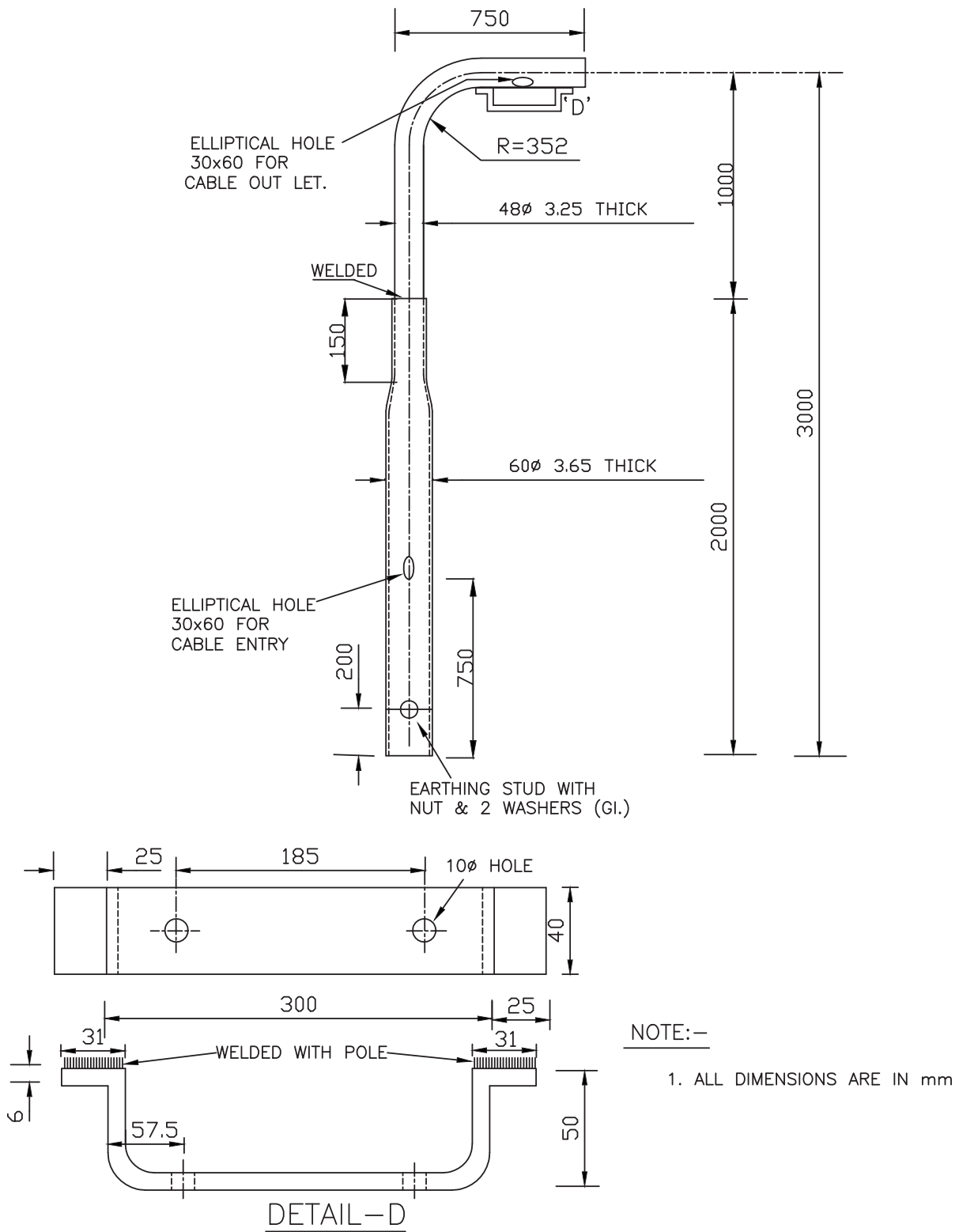


POLE DESIGNATION	LENGTH(M) $X+Y+Z=L$	PLANTING DEPTH(M)	DIAxTHICKNESS BOTTOM(mm)	DIA MIDDLE(mm)	DIA TOP(mm)	WEIGHT OF POLE (Kg)
410 TP3/SP3	$X+Y+Z=7$	1.25	114.3x4		78.1	87/85
410 TP12/SP12	$X+Y+Z=8$	1.5	114.3x4		78.1	101/97
410 TP13/SP13	$X+Y+Z=8$	1.5	139.7x4		88.9	125/119
410 TP27/SP27	$X+Y+Z=9$	1.5	114.3x4		76.1	113/108
410 TP30/SP30	$X+Y+Z=9$	1.5	139.7x4		88.9	140/133
410 TP33/SP33	$X+Y+Z=9$	1.5	165.1x4		114.3	170/184

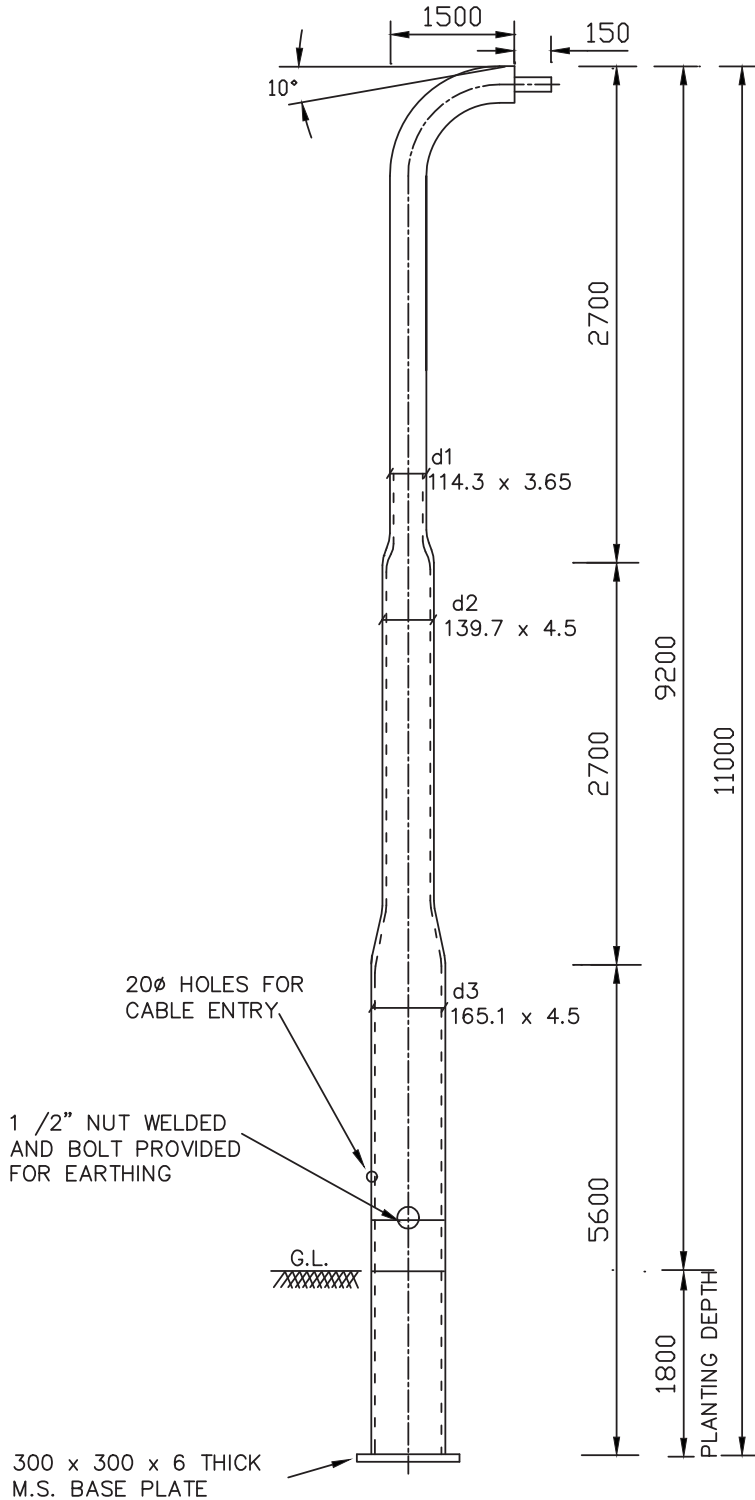
NOTE:-

1. TP REFER TO STEPPED POLE.
2. SP REFER TO SWAGED POLE.
3. POLE DESIGNATION IS AS PER IS: 1239

SWAGED POLE TYPE 'B'

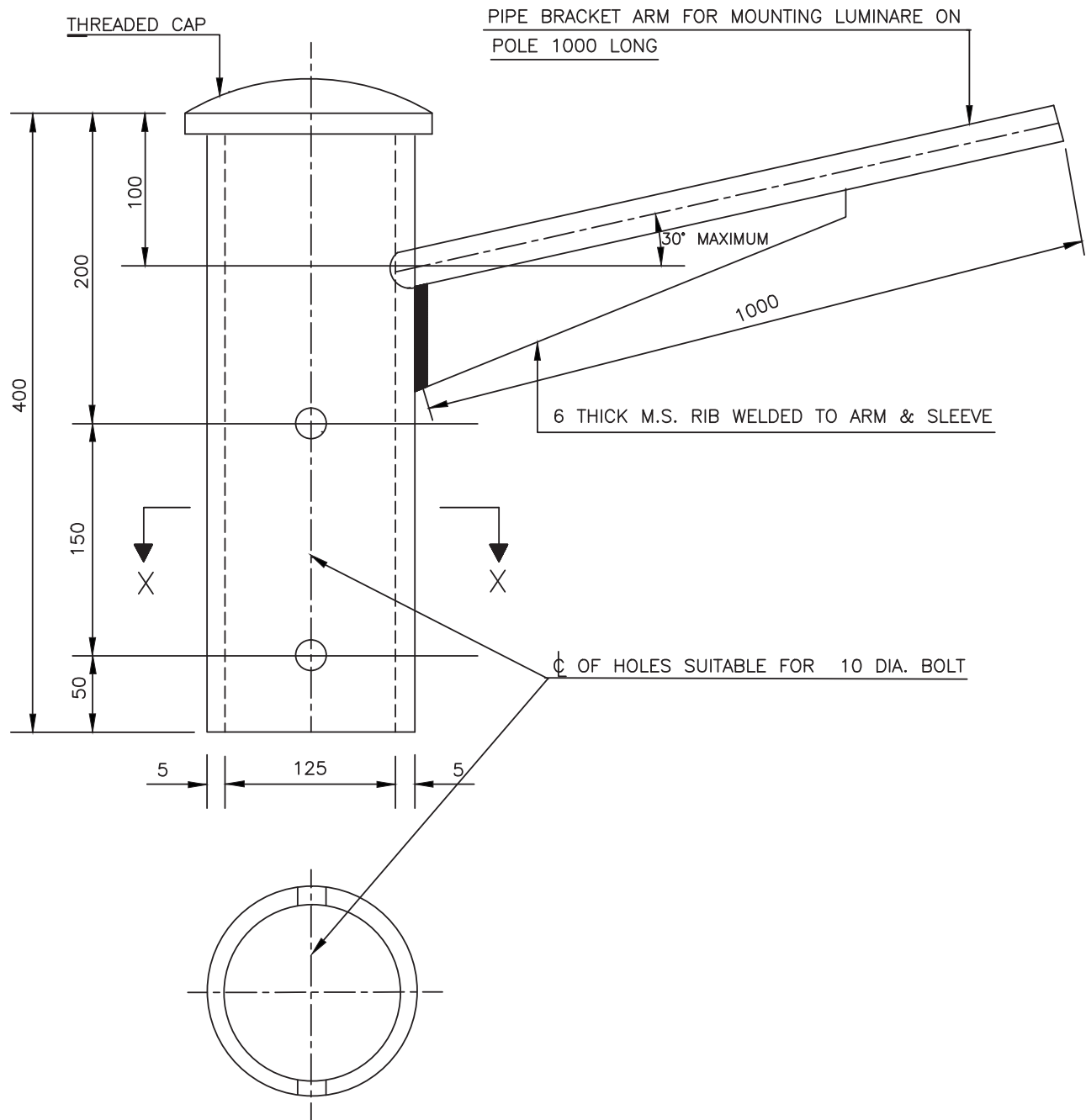


SWAGED POLE TYPE 'C'
(FOR PLANT GROUND MOUNTING)



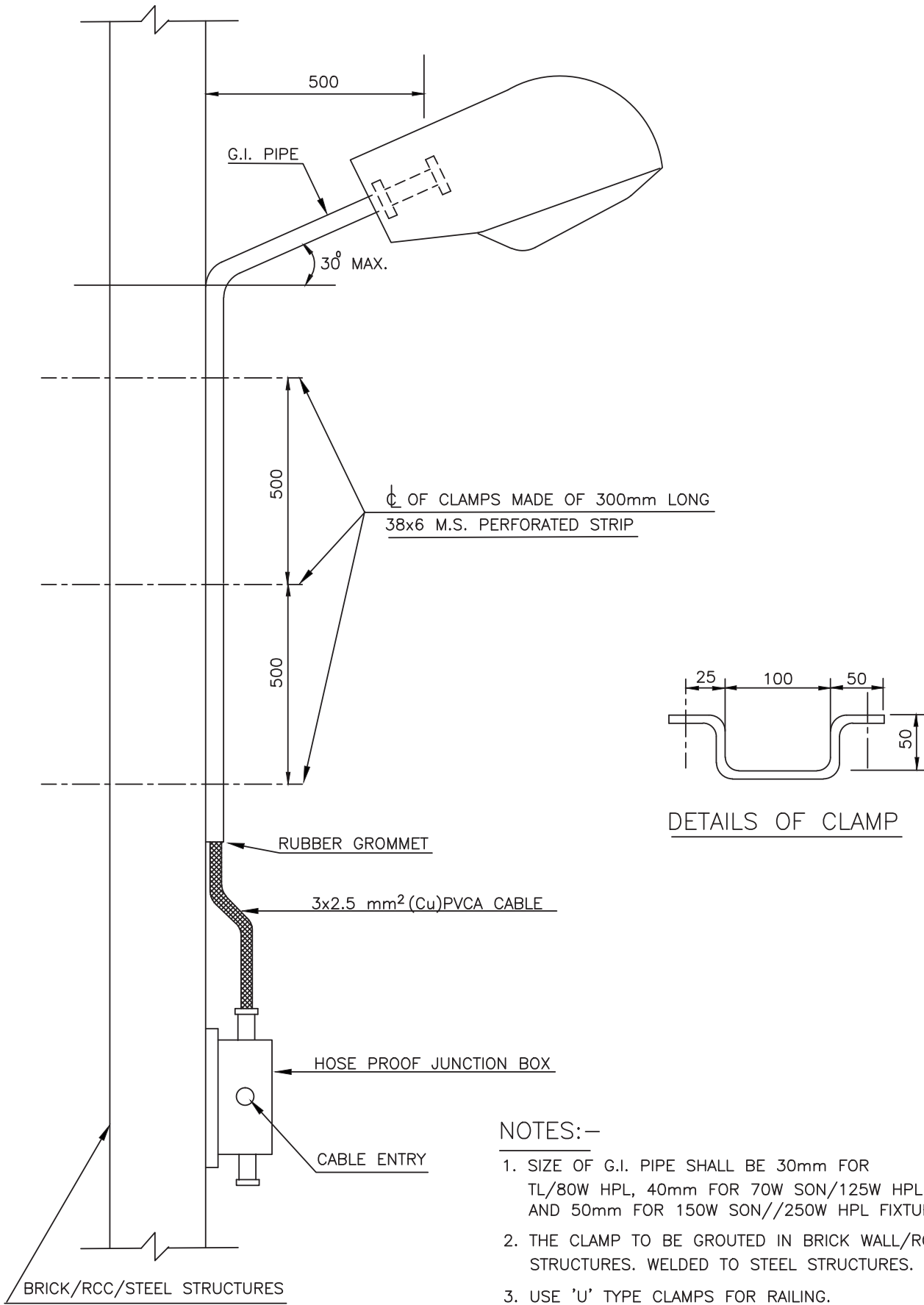
NOTES: -

1. NIPPLE OF DIA. 45 (NIPPLE TO BE PREPd. BY DIRECT REDUCTION OF DIA OF TOP PIPE WITHOUT USE OF ANY WASHER)
2. POLE MATERIAL MS AS PER IS 1239 ABOVE GROUND PORTION TO BE PAINTED 2 COATS OF RED OXIDE PRIMER, UNDER GROUND PORTION PAINTED BITUMINUS PAINT.
3. FOR FLOOD LIGHTING POLE THE TOP PORTION NOT TO BE TILTED BUT A 300 x 300 x 6mm THICK M.S. PLATE WELDED AT THE TOP SHALL BE PROVIDED TO MOUNT FLOOD LIGHT.
4. ALL DIMENSIONS ARE IN mm



NOTES:-

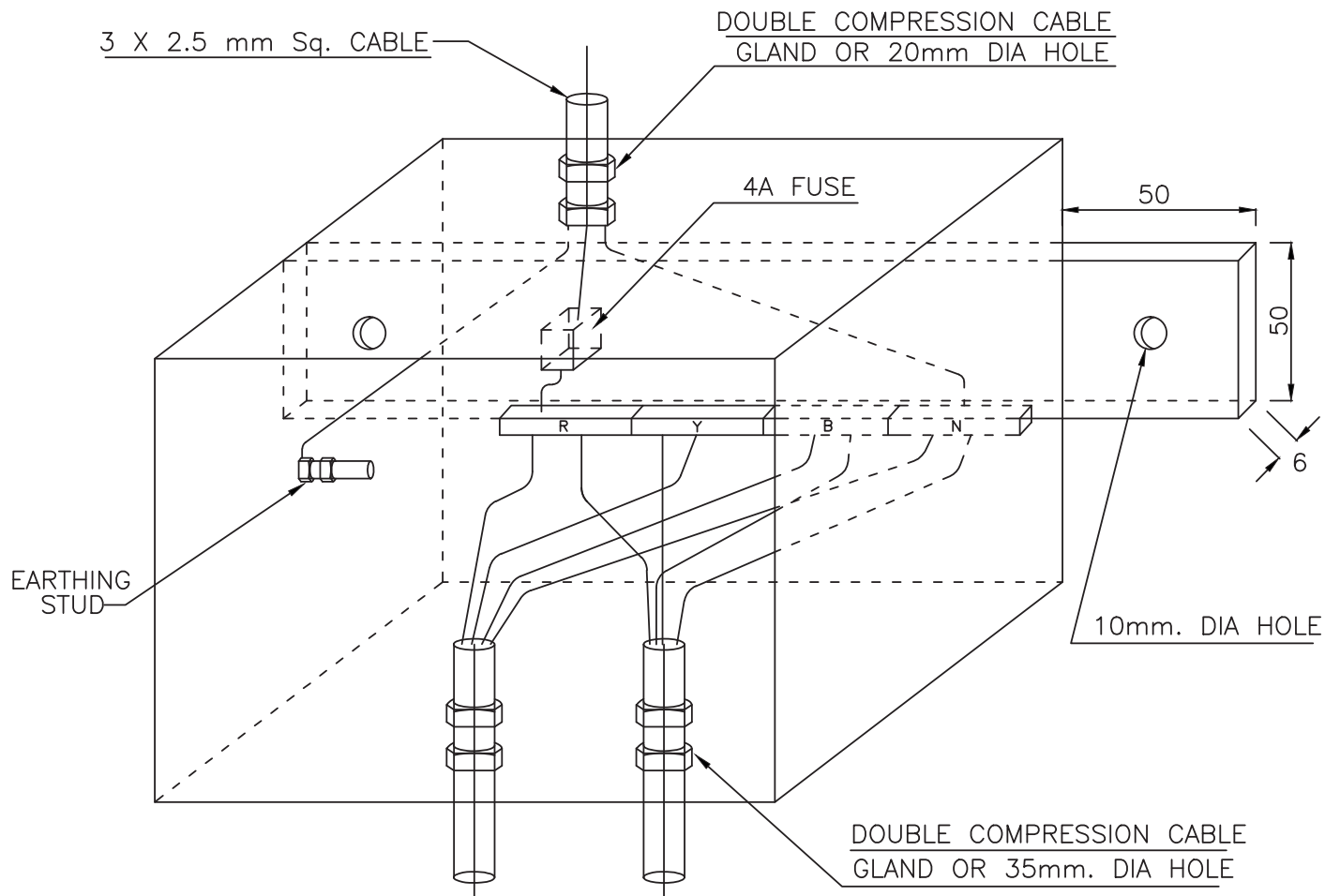
1. SIZE OF PIPE SHALL BE 30mm FOR TL/80W HPL FIXTURES,
40mm FOR 70W SON/125W HPL FIXTURES AND 50mm FOR
150W SON/250W HPL FIXTURES.
2. ALL DIMENSIONS ARE IN mm.



DETAILS OF CLAMP

NOTES:-

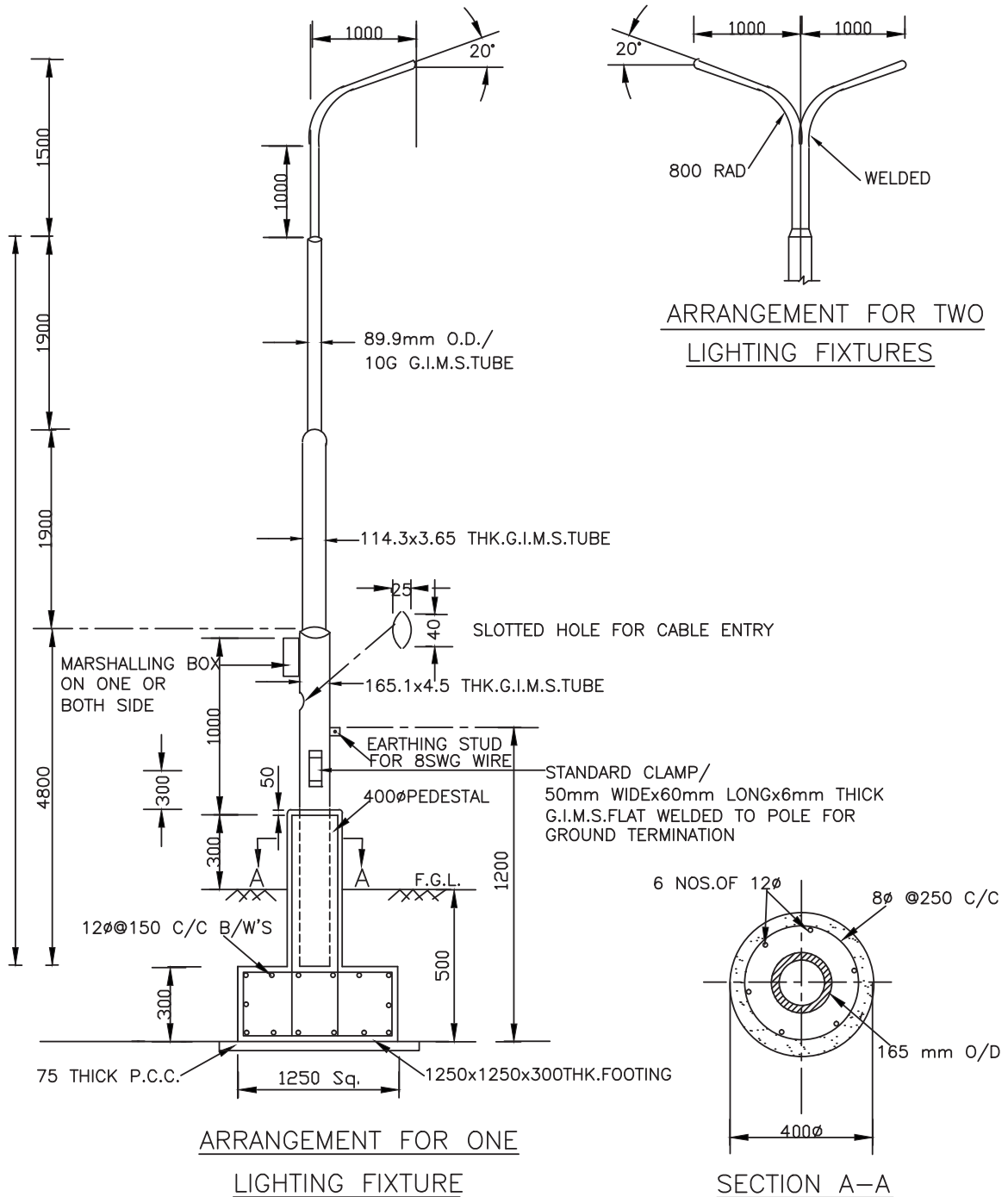
1. SIZE OF G.I. PIPE SHALL BE 30mm FOR TL/80W HPL, 40mm FOR 70W SON/125W HPL AND 50mm FOR 150W SON//250W HPL FIXTURES.
2. THE CLAMP TO BE GROUTED IN BRICK WALL/RCC STRUCTURES. WELDED TO STEEL STRUCTURES.
3. USE 'U' TYPE CLAMPS FOR RAILING.
4. ALL DIMENSIONS ARE IN mm.



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.

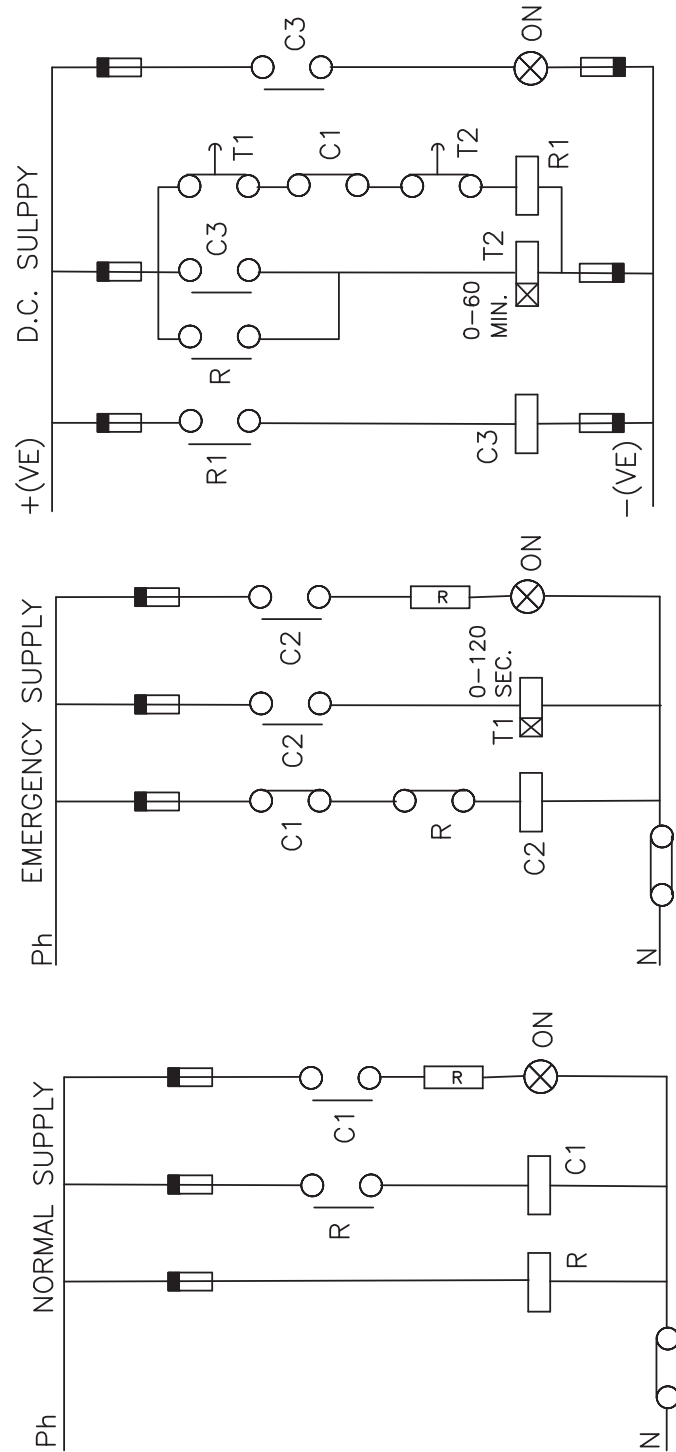
TYPICAL STREET LIGHTING POLE



NOTE :-

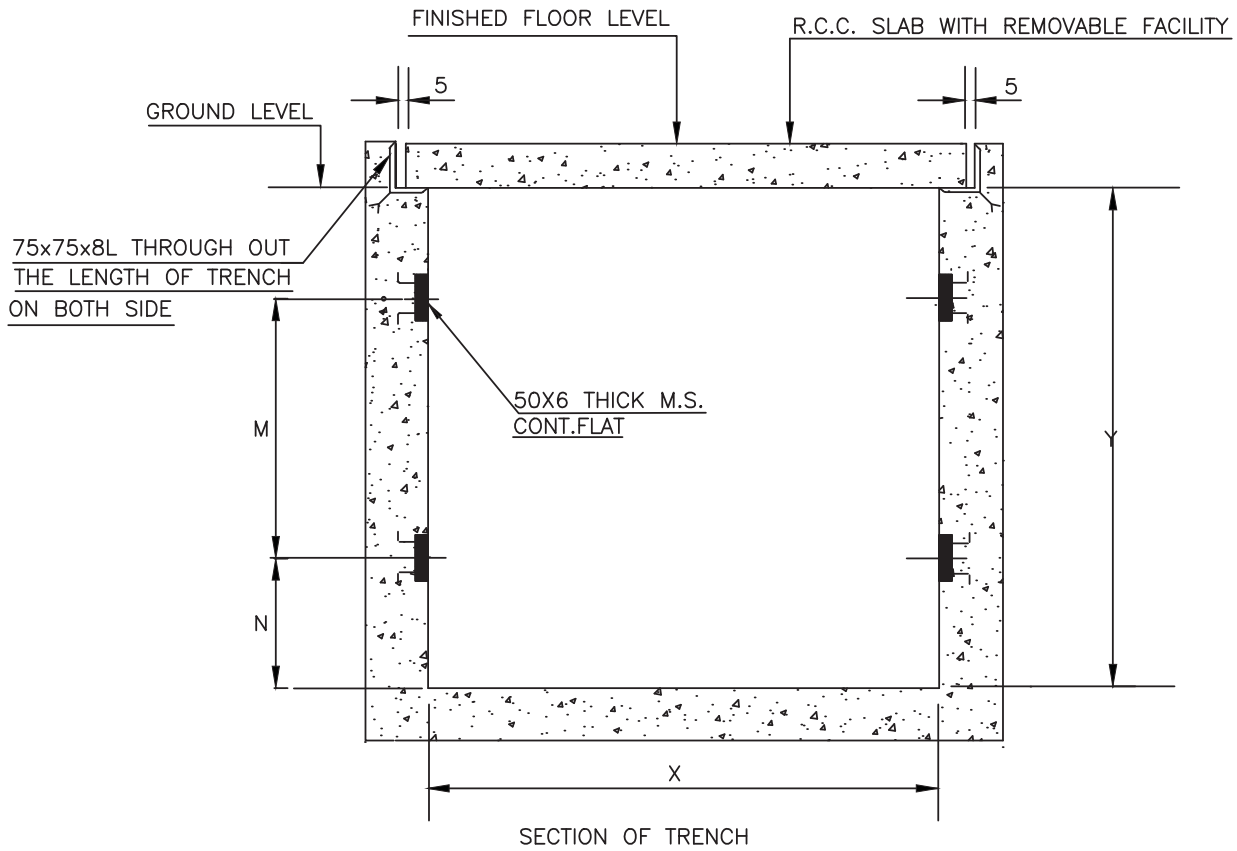
1. CONCRETING AND APPROVED MOUNTING HARDWARE FOR LIGHTING FIXTURES ARE INCLUDING IN SCOPE OF SUPPLY.
2. CONCRETE FOUNDATION OF GRADE M15 SHALL BE PROVIDED.

ALL DIMENSIONS ARE IN mm.



NOTE:-

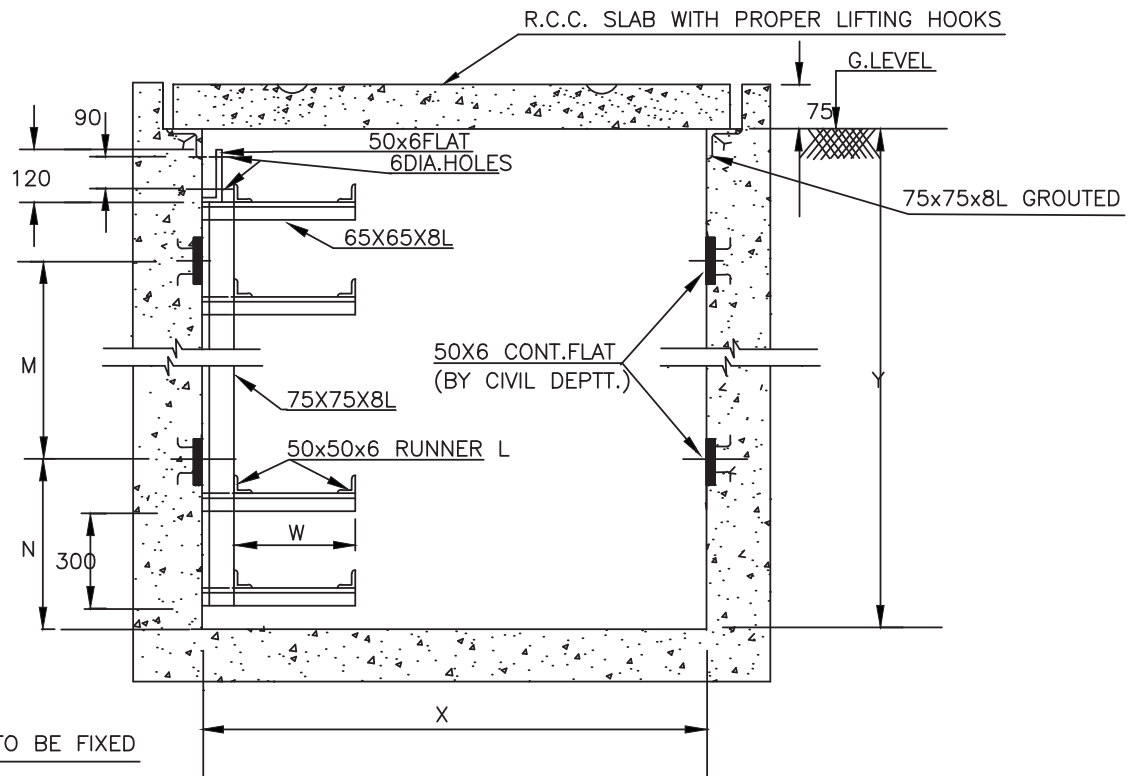
CONTACTORS C1,C2 AND C3 CONTROLS THE LIGHTING FEEDERS FOR NORMAL,EMERGENCY AND D.C. SUPPLY RESPECTIVELY.



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:—

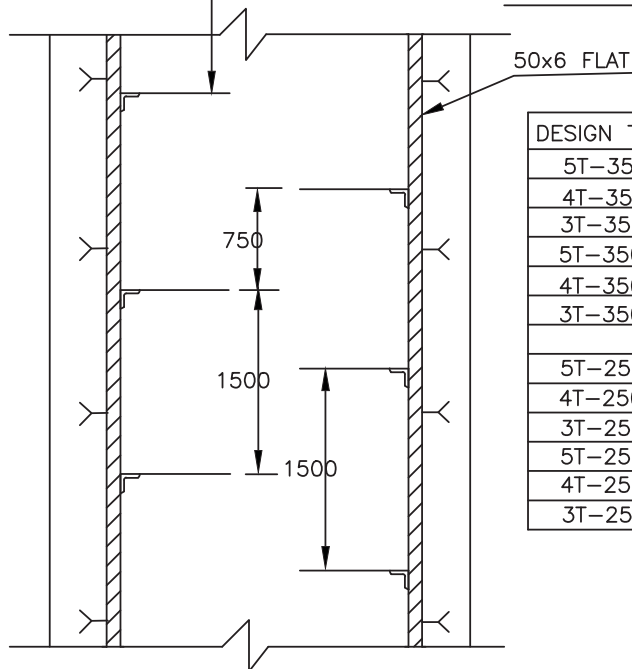
1. THE TOP OF TRENCH SHALL MATCH THE FLOOR LEVEL IN PLANT AREA.
2. IN INDOORS INSTEAD OF RCC SLAB, 20mm. THICK AL. EXTRUDED PLANK OR 10mm. THICK M.S. CHEQUERED PLATE SHALL BE USED AS PER PDS:E 507.
3. PROPER SLOPE TO BE GIVEN IN THE TRENCH FOR NATURAL DRAINAGE.
4. SS—SINGLE SIDE CABLE SUPPORTS.
5. DS—DOUBLE SIDE CABLE SUPPORTS.
6. ALL DIMENSIONS ARE IN mm.



CABLE SUPPORTS TO BE FIXED

© 1500 INTERVAL

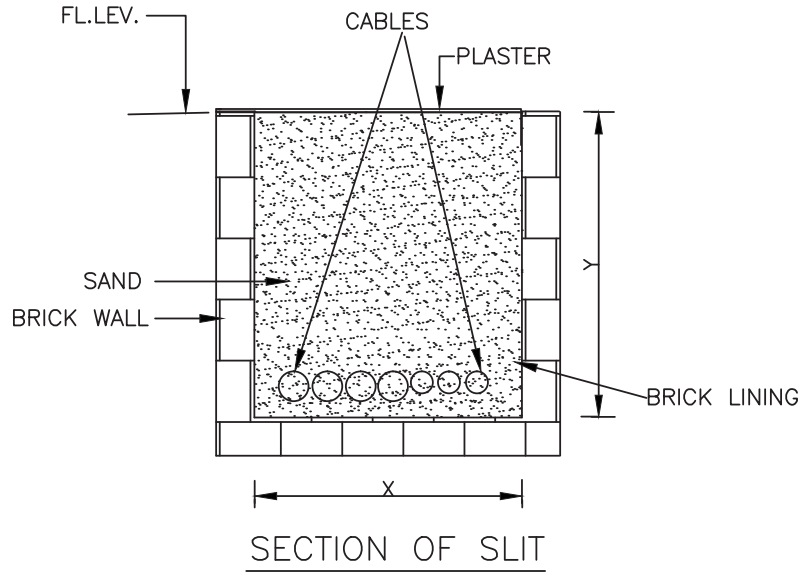
SECTION OF TRENCH



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

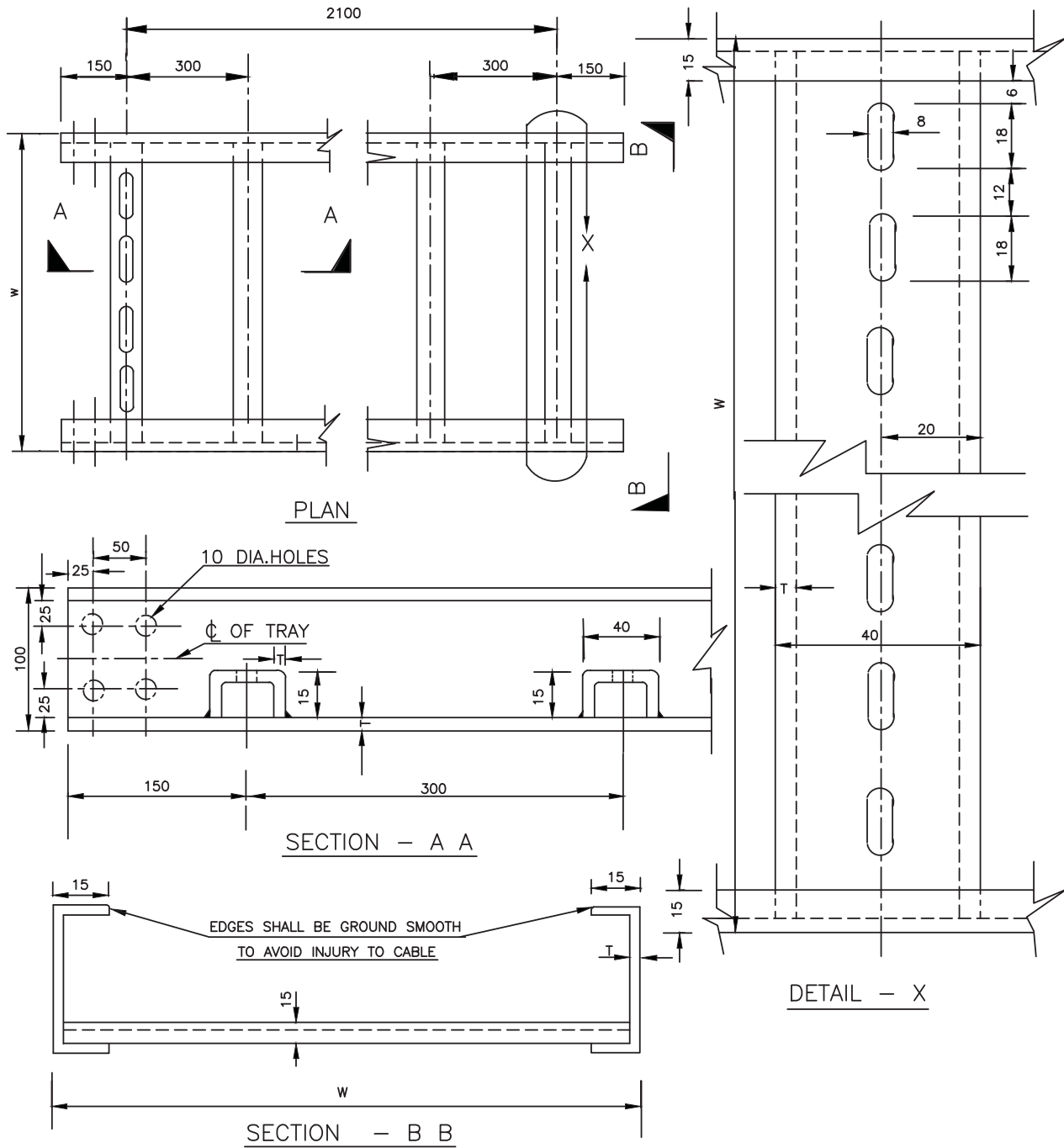
- NOTES:—1. SS—SINGLE SIDE CABLE SUPPORT.
2. DS—DOUBLE SIDE CABLE SUPPORT.
3. ALL DIMENSIONS ARE IN mm.



DESIGN TYPE	X	Y
S 300	300	300
S 200	200	200

NOTE:-

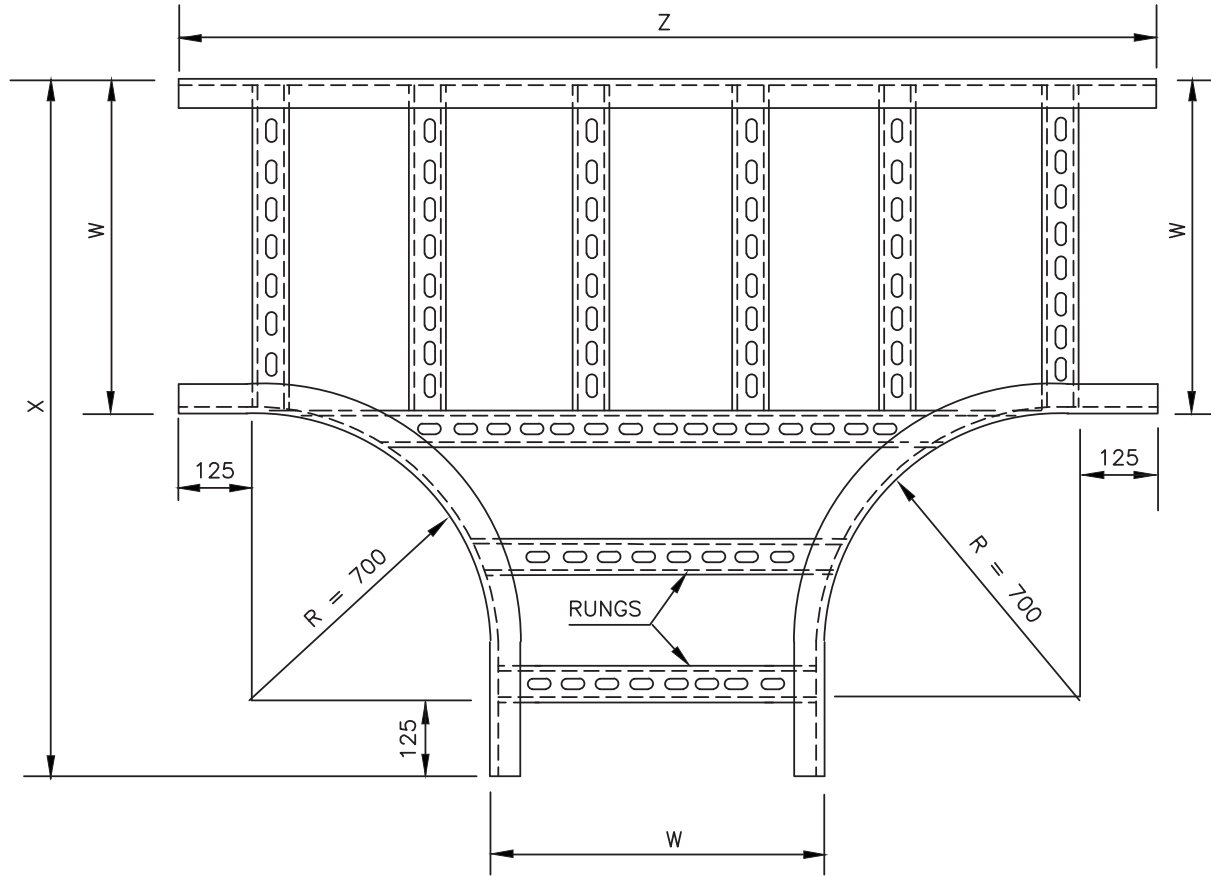
1. CABLE SLITS SHALL BE FILLED WITH SAND AND PROPERLY PLASTERED WITH LEAN CONCRETE AFTER LAYING OF CABLES.
2. WHEREVER CABLES ARE COMING OUT OF THE SLIT, SUITABLE MECH.PROTECTION TO BE PROVIDED.



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.

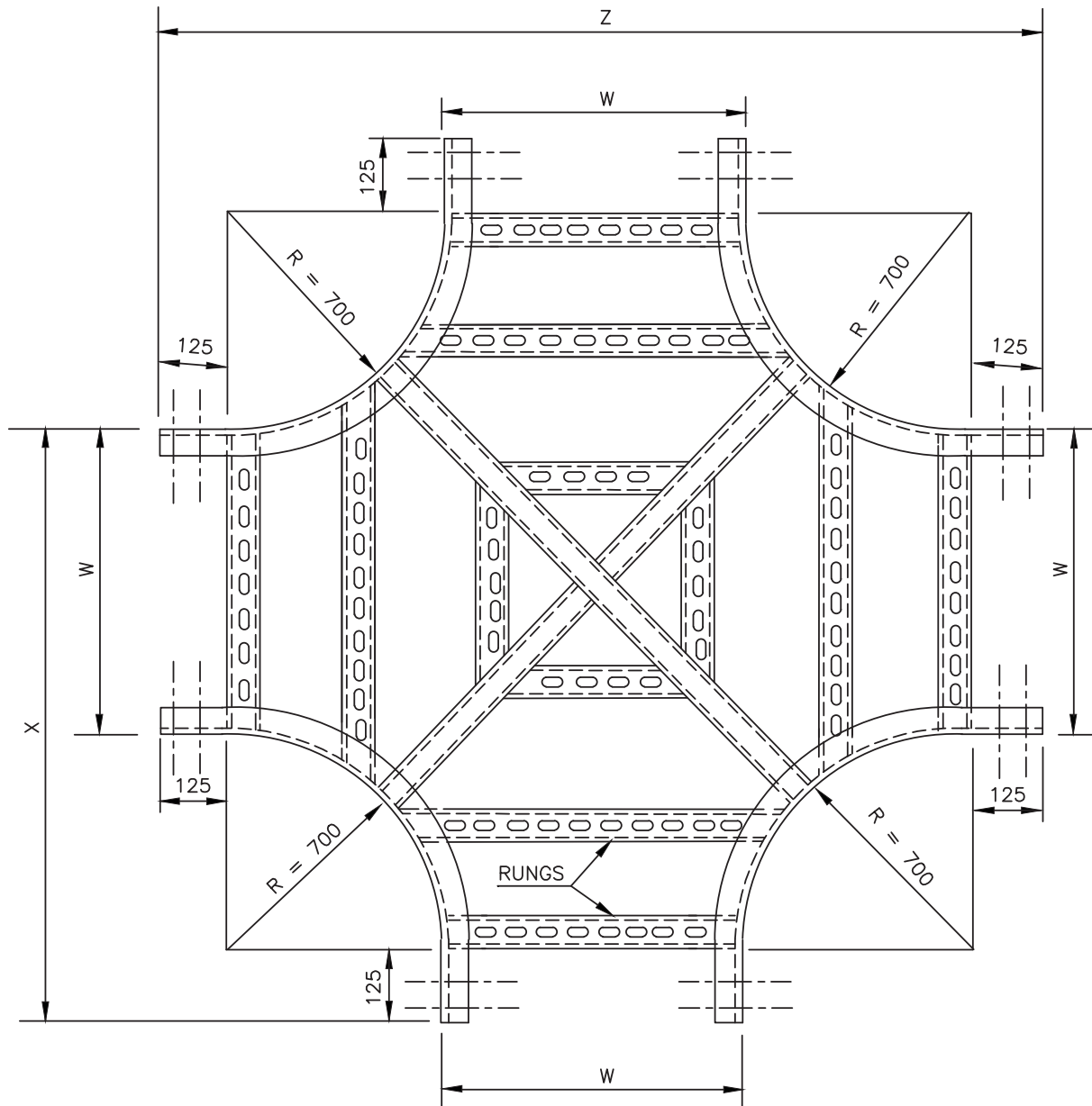


PLAN

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.

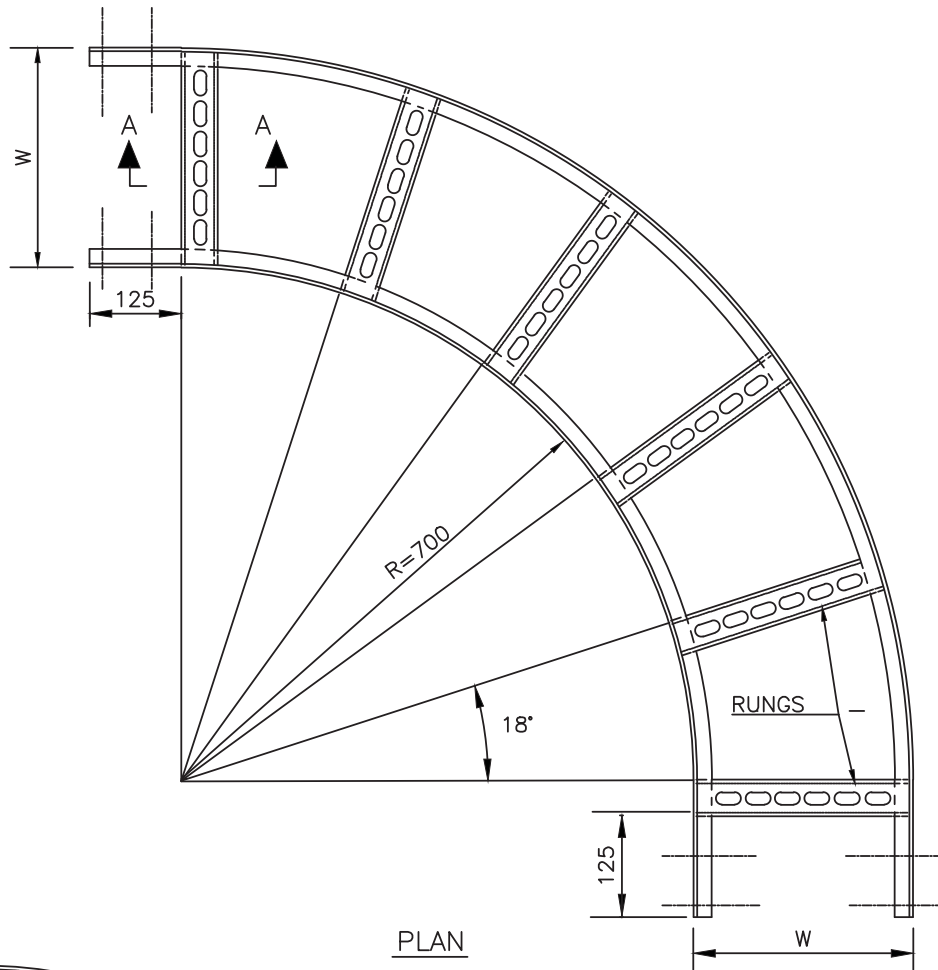


PLAN

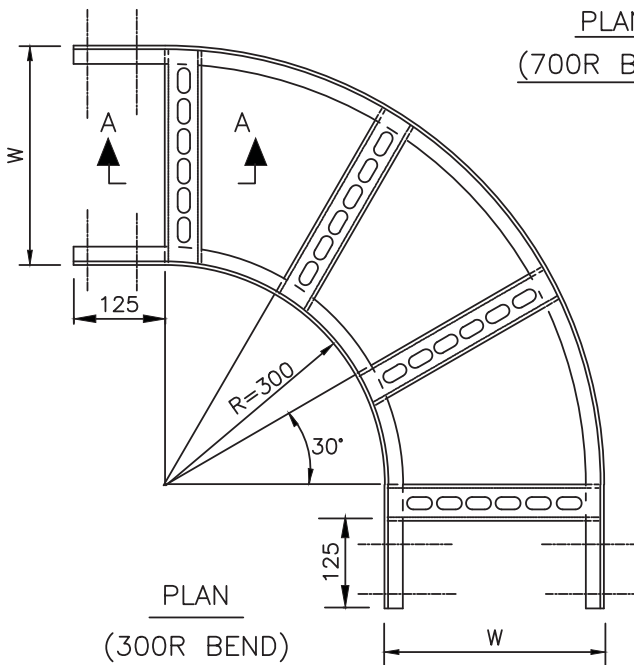
DESIGN TYPE	W	$X=R+W+125$	$Z=2R+W+250$
HC 900	900	1725	2550
HC 600	600	1425	2250
HC 450	450	1275	2100
HC 300	300	1125	1950

NOTES :-

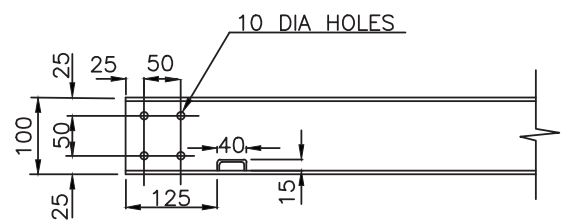
1. DISTANCE BETWEEN TWO RUNGS SHOULD BE APPROX. 300mm.
2. ALL DIMENSIONS ARE IN mm.



PLAN
(700R BEND)

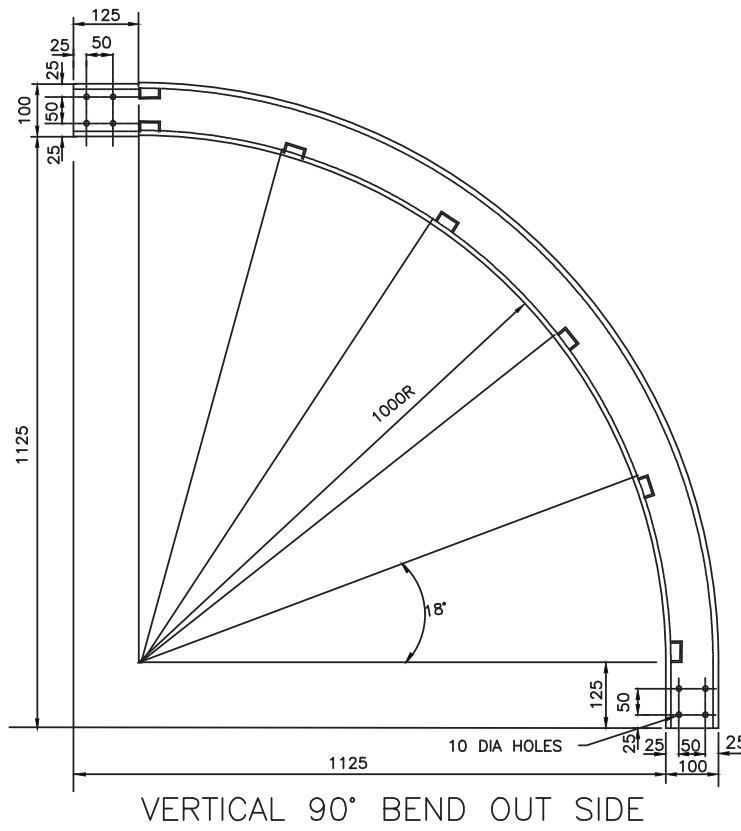
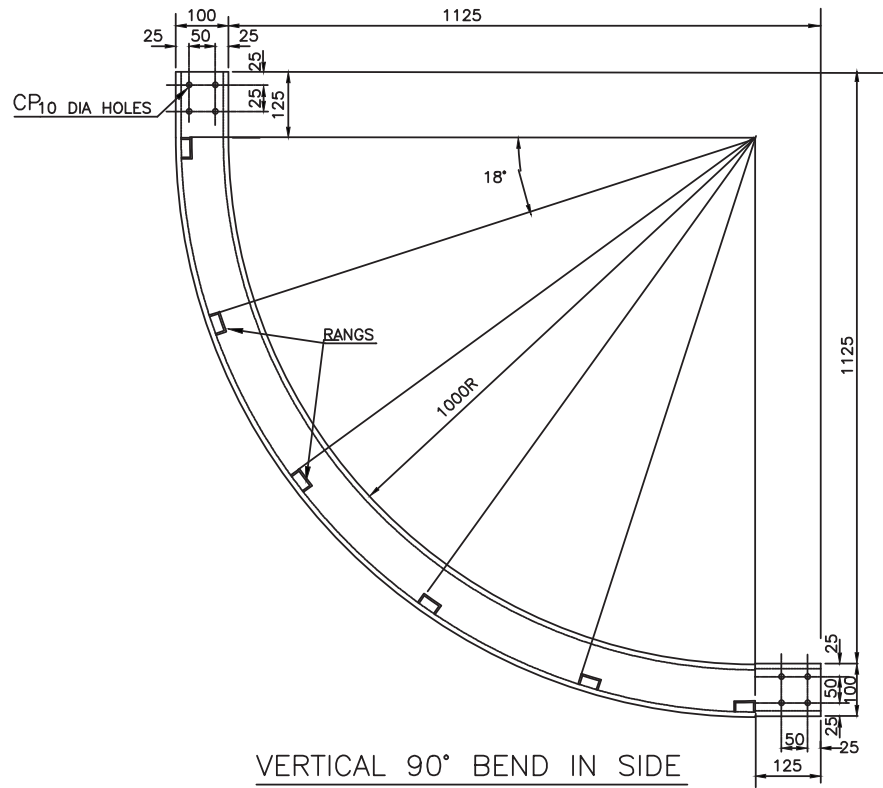


PLAN
(300R BEND)

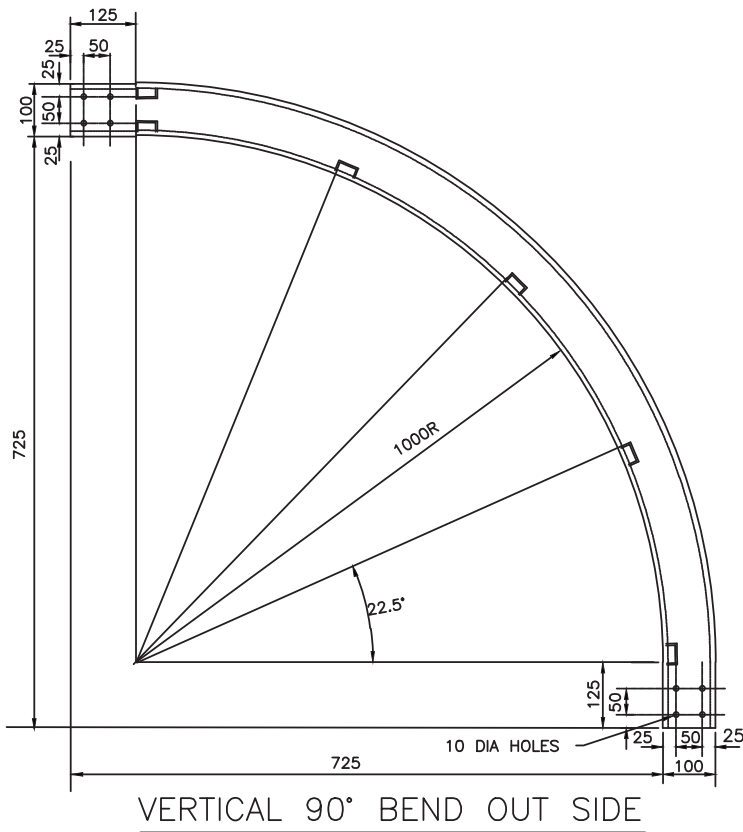
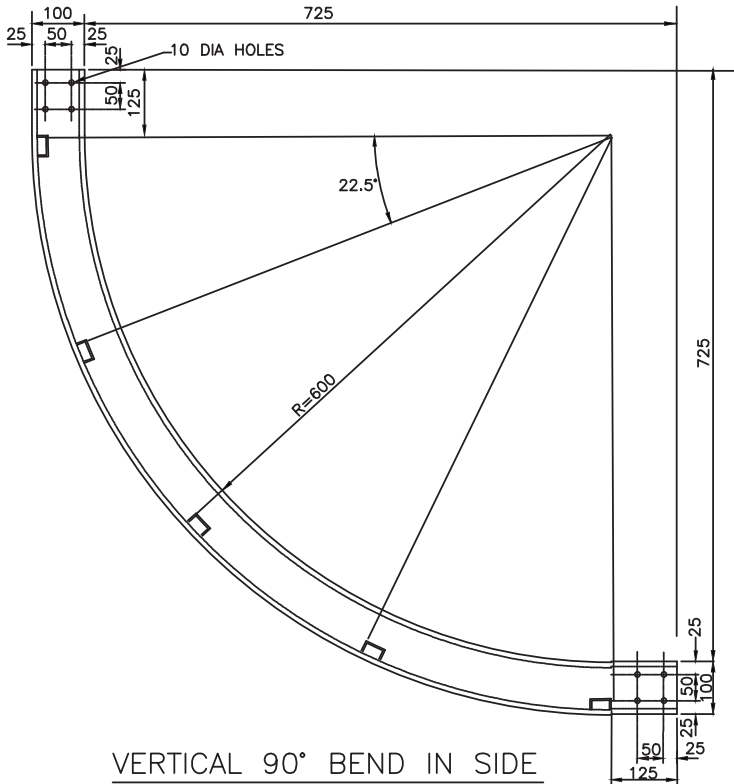


SECTION A-A

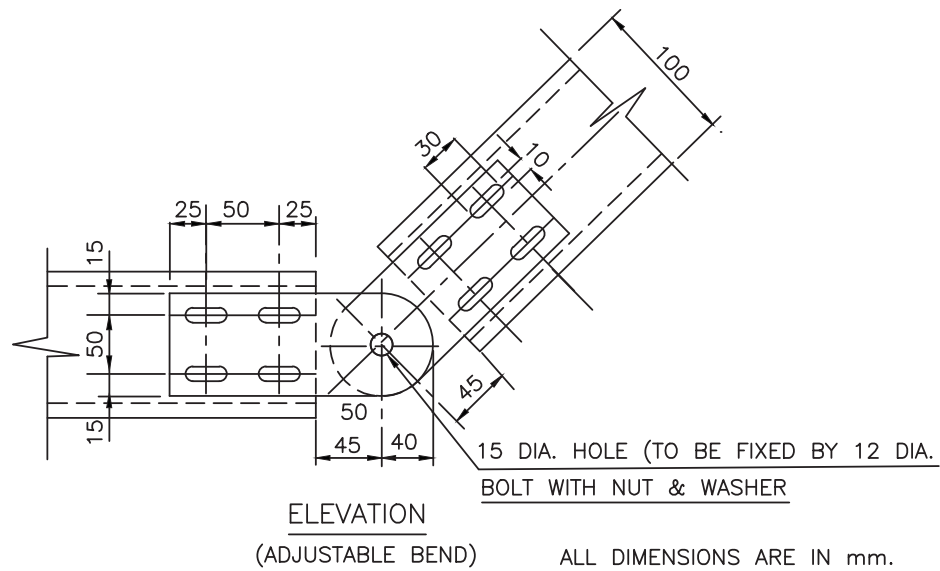
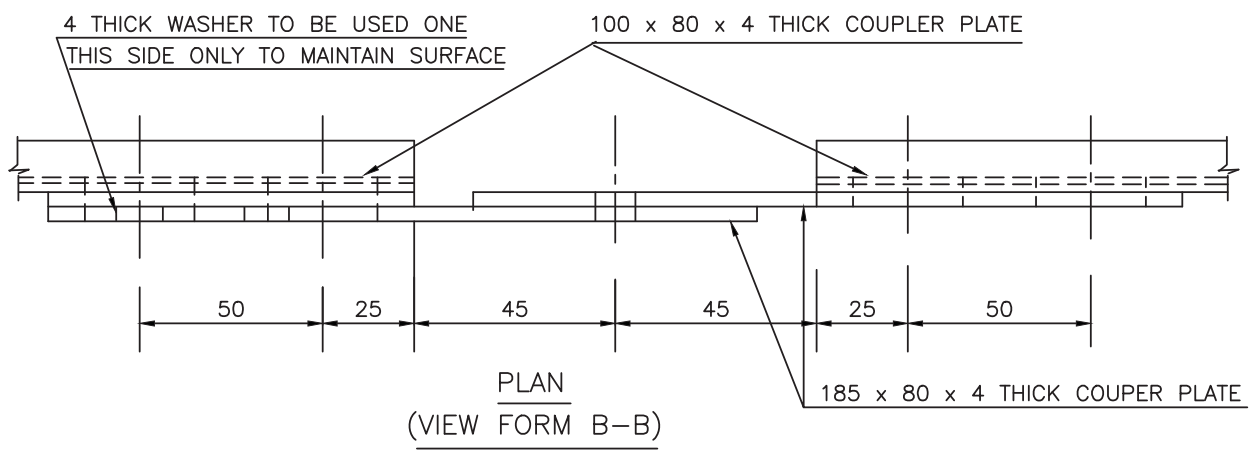
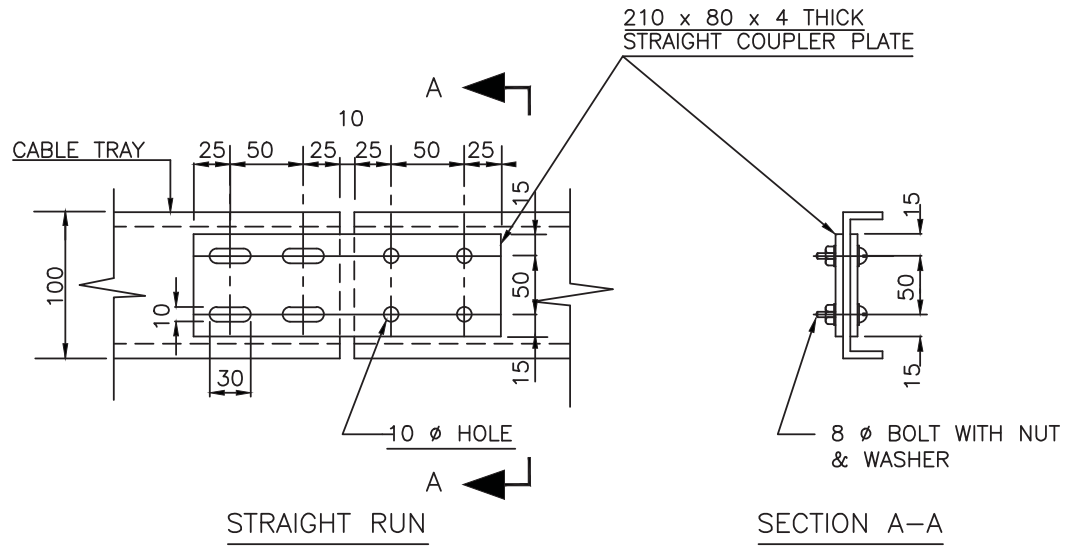
ALL DIMENSIONS ARE IN mm.

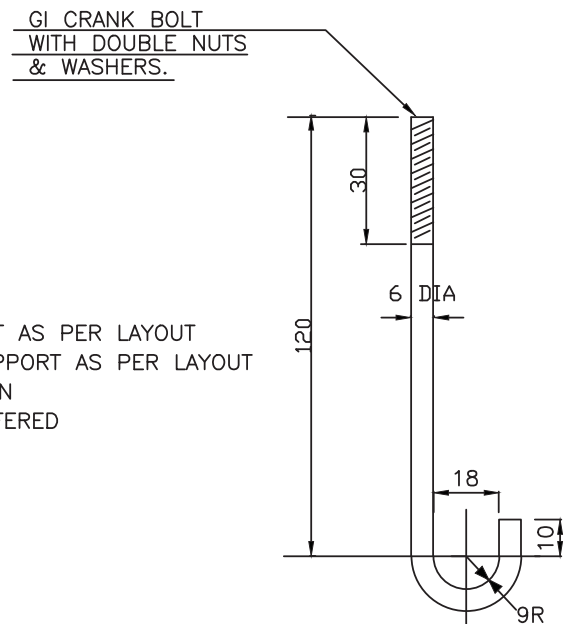
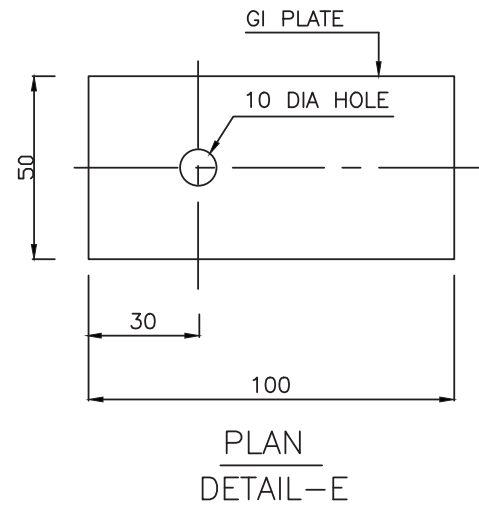
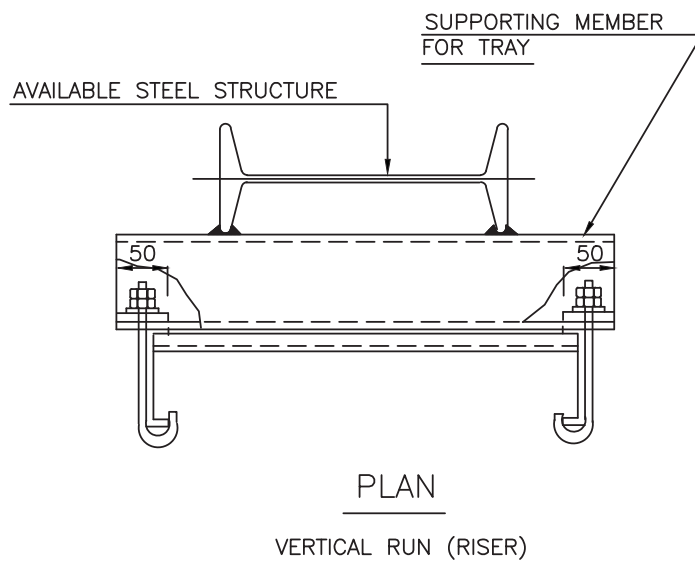
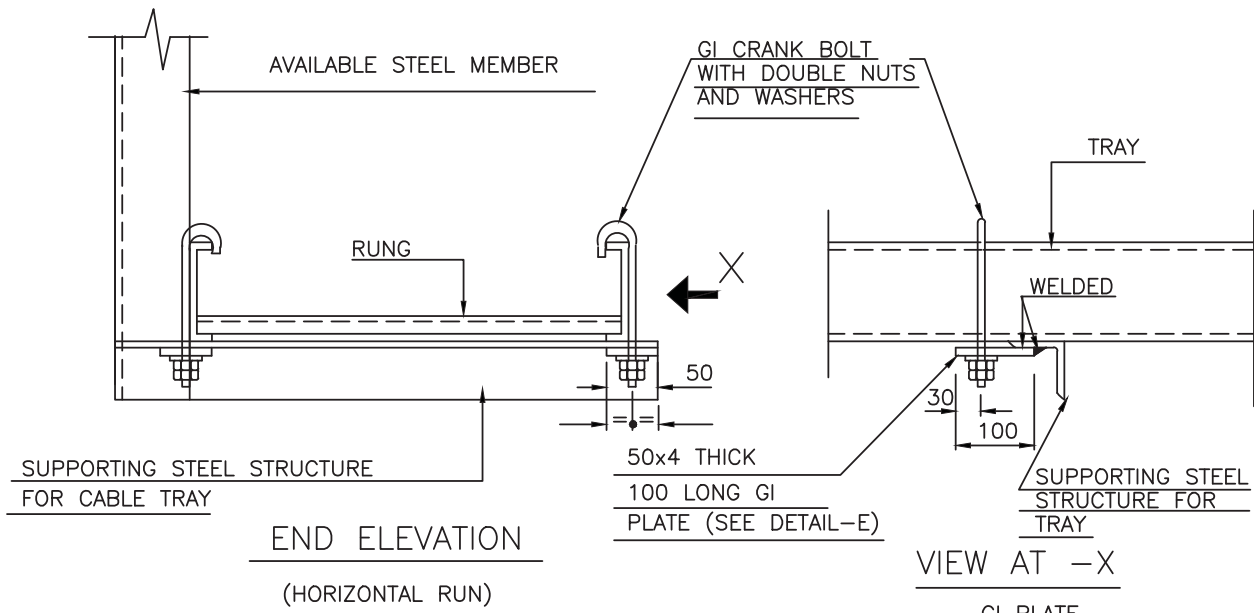


DIMENSIONS ARE IN mm.



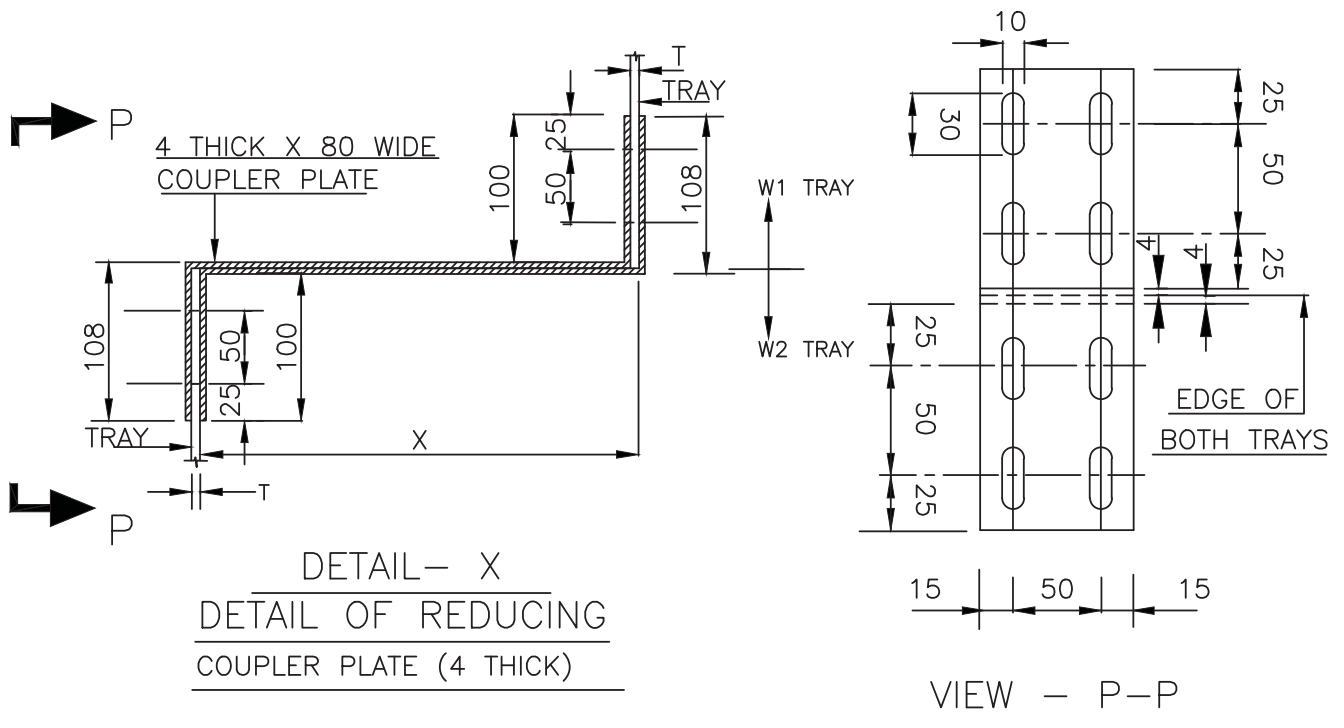
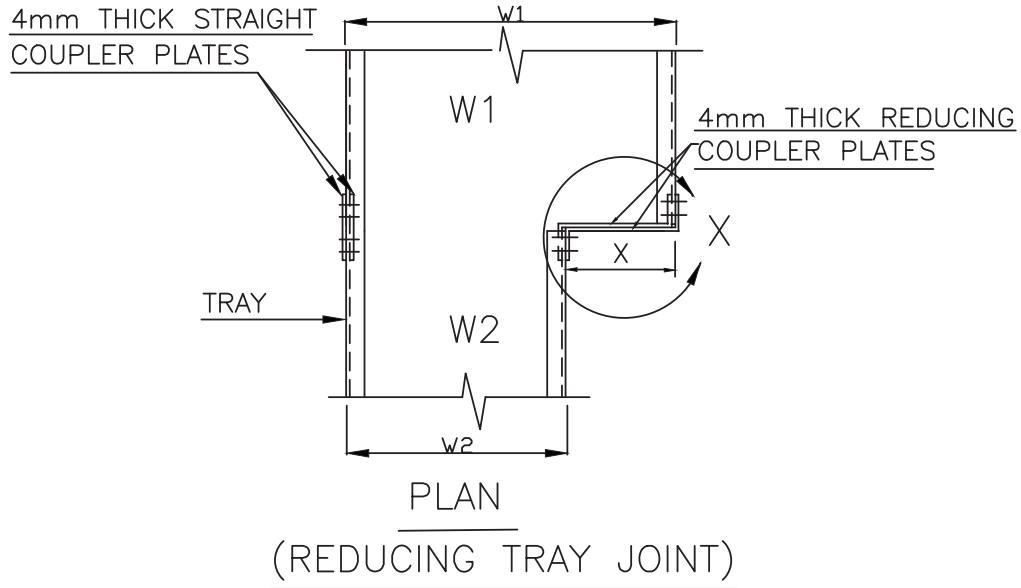
ALL DIMENSIONS ARE IN mm.





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 SHALL BE GALVANISED ITEMS.
4. ALL DIMENSIONS ARE IN mm.



ALL DIMENSIONS ARE IN mm.

SL. NO.	W1	W2	X
1	900	600	300
		450	450
		300	600
2	600	450	150
		300	300
3	450	300	150
		150	300



GENERAL NOTES ON EARTHING AND LIGHTNING PROTECTION

PDSE: 601	0
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 CONJUNCTION WITH EARTHING & LIGHTNING PROTECTION LAYOUT DRGS. AND RELEVANT 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.

0	03.01.07	15.01.07	ISSUED FOR IMPLEMENTATION		NKR		FAV		BB
REV	REV.DATE	EFF.DATE	PURPOSE	PREPD.		REVWD		APPD	



GENERAL NOTES ON EARTHING AND LIGHTNING PROTECTION

PDSE: 601	0
DOCUMENT NO.	REV
SHEET 2 OF 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.
- EARTHING ARRANGEMENT OF MOTOR AND ASSOCIATED LOCAL CONTROL STATION SHALL BE AS SHOWN IN PDSE: 608.
- EARTHING ARRANGEMENT OF RAILS SHALL BE AS SHOWN IN PDSE: 609 WITH BOTH ENDS EARTHED.
- 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.
- 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.
- IN SWITCH YARD AND GENERATING STATIONS SUITABLE EARTHING MAT SHALL BE PROVIDED TO REDUCE THE VALUE OF STEP/TOUCH POTENTIAL TO PERMISSIBLE VALUE.
- SWITCH YARD FENCE SHALL BE CONNECTED TO EARTH AT A REGULAR INTERVAL, NOT EXCEEDING 10 M.

D. STATIC EARTHING

- ALL PROCESS EQUIPMENT WHICH ARE LIKELY TO GET STATICALLY CHARGED, e.g. STORAGE TANKS, HIGH PRESSURE & MEDIUM PRESSURE VESSELS/PIPES, HIGH PRESSURE COMPRESSORS, HIGH PRESSURE STEAM EJECTORS ETC. SHALL BE EARTHED AGAINST STATIC CHARGE ACCUMULATION.
- EARTHING ARRANGEMENT ACROSS PIPE JOINTS/VALVES SHALL BE AS SHOWN IN PDSE: 612.
- DETAILS OF EARTHING OF VESSELS SHALL BE AS SHOWN IN PDSE: 613.
- MOBILE EQUIPMENT, REQUIRING EARTHING AGAINST STATIC CHARGE, SHALL BE TEMPORARILY EARTHED AS SHOWN IN PDSE: 608.
- PIPE TRESTLE CARRYING PIPES WITH HYDRO CARBONS SHALL BE CONNECTED TO EARTH GRID AT REGULAR INTERVALS, NOT EXCEEDING 25 M.
- 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

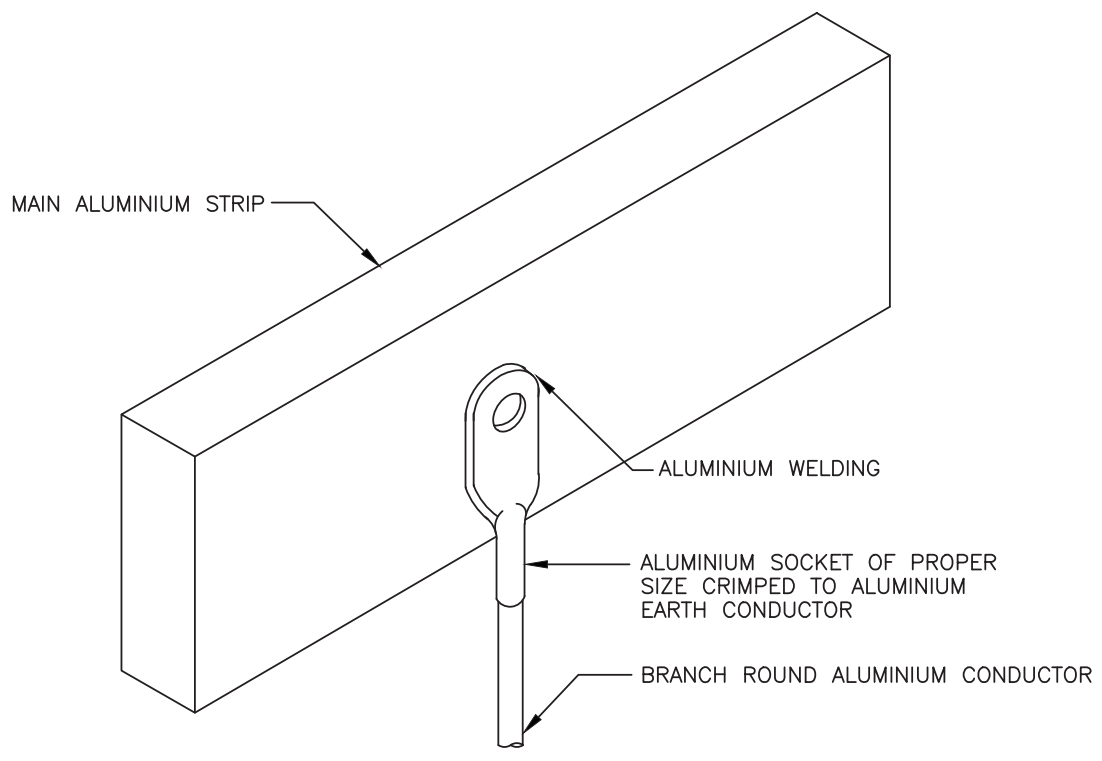
- FIXING ARRANGEMENT ON AIR TERMINATION AND ROOF/DOWN CONDUCTOR FOR LIGHTNING PROTECTION SYSTEM SHALL BE AS SHOWN IN PDSE: 614.
- FOR LIGHTNING PROTECTION OF TALL STEEL STRUCTURES/VESSELS/TANKS, DOWN CONDUCTOR SHALL BE TAKEN FROM THE BASE AND CONNECTED TO EARTH PITS. AIR TERMINATION ROD SHALL NOT BE REQUIRED.
- LIFT SHAFT SHALL NOT BE USED FOR FIXING THE DOWN CONDUCTOR.
- 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.
- FOR ALL HIGH RISE CONCRETE STRUCTURES, TEMPORARY LIGHTNING 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.

0	03.01.07	15.01.07	ISSUED FOR IMPLEMENTATION			
REV	REV.DATE	EFF.DATE	PURPOSE	PREPD	REVWD	APPD

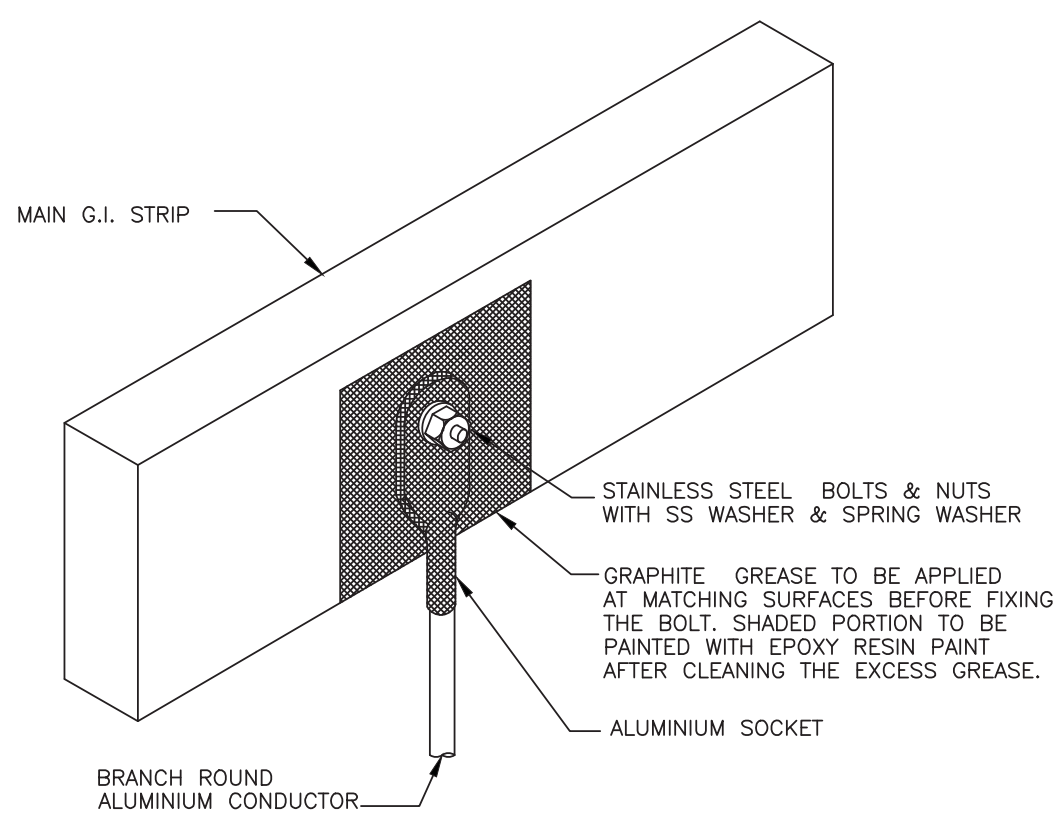
SL. No.	EQUIPMENT TO BE EARTHED	FAULT LEVEL (MVA)	G.I. STRIPS/WIRES		ALUMINIUM			REMARKS			
			MIN. SIZE (mm ²)	SIZE TO BE USED (mm ²)	SYMBOL	MIN. SIZE (mm ²)	STRIPS/WIRES SIZE TO BE USED (mm ²)		SYMBOL		
1A.	FOR PLANTS HAVING SWITCHYARDS/ GENERATING STATION										
I.	SWITCH YARD EQUIPMENT, GENERATORS, H.T. SWITCH BOARDS, TRANSFORMERS, MAIN EARTHING GRID, CONNECTION FROM EARTH BUS TO EARTHING GRID.	750 AT 11KV	706	2-50x8	2	491	2-38.1x6.35=484	2	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	TRANSFORMER 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-

SL. No.	EQUIPMENT TO BE EARTHED	FAULT LEVEL (MVA)	G.I. STRIPS/WIRES		ALUMINIUM STRIPS/WIRES			REMARKS			
			MIN. SIZE (mm ²)	SIZE TO BE USED (mm ²)	SYMBOL	MIN. SIZE (mm ²)	SIZE TO BE USED (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	-D0-
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

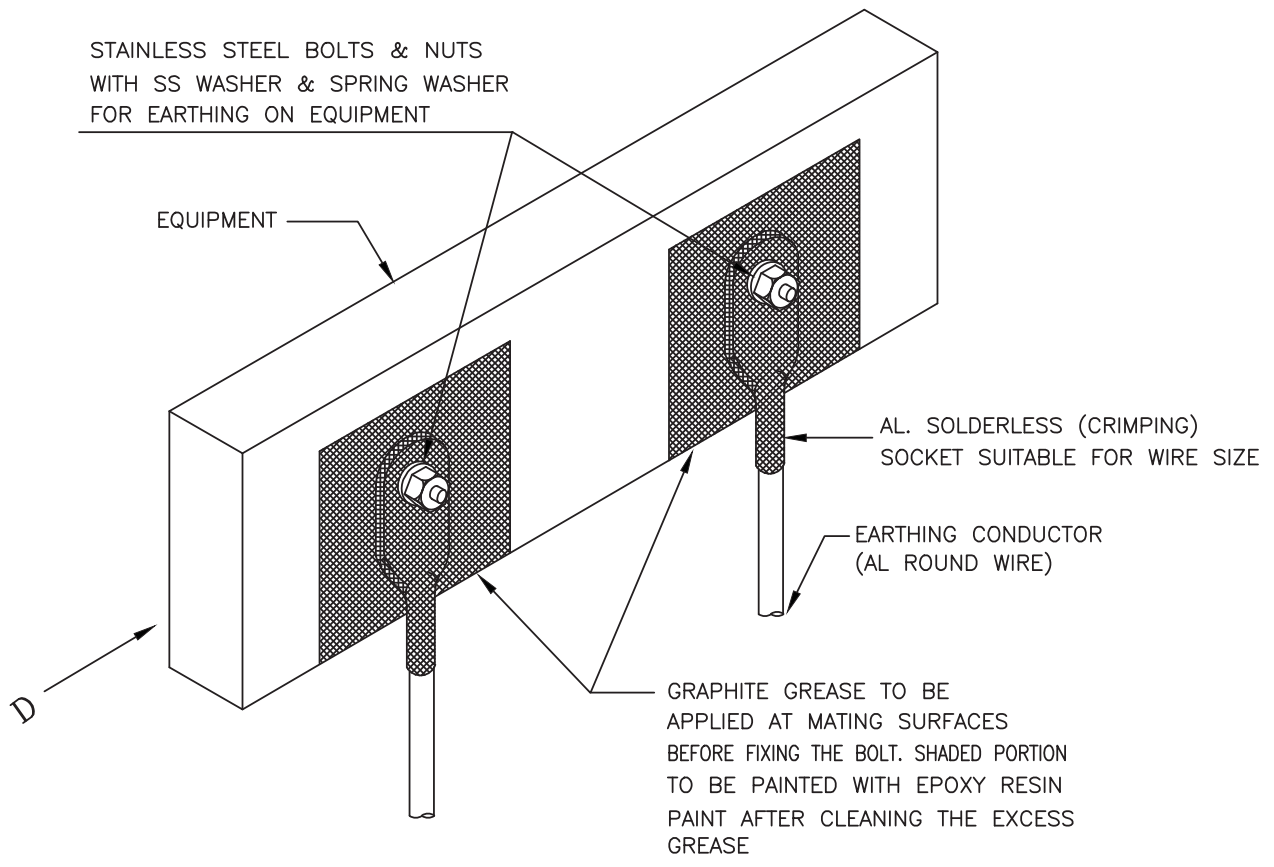
NOTE :--EARTHING CONDUCTOR SIZES FOR ITEMS AT SL.No.4,5,6 & 7 SHOULD BE CHOSEN AS HALF THE POWER CABLE SIZES ACTUALLY USED.



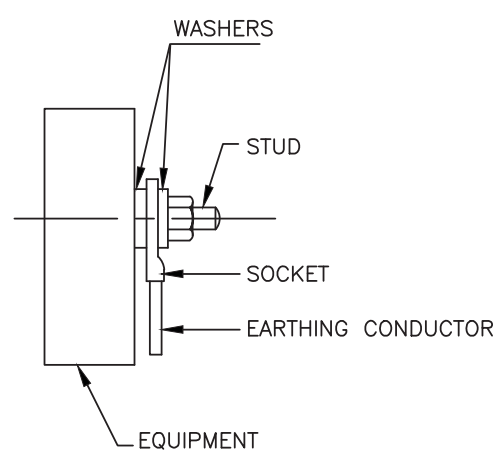
' T ' JOINT ALUMINIUM STRIP TO ROUND ALUMINIUM CONDUCTOR



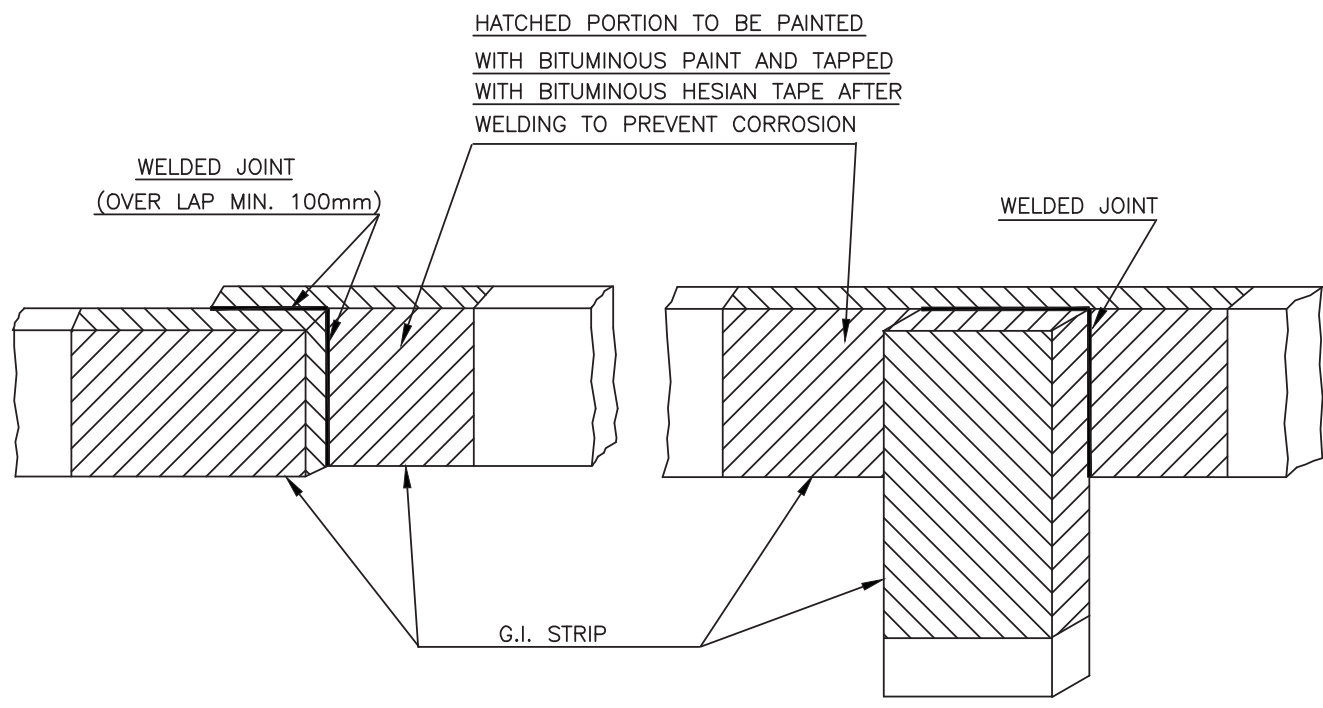
' T ' JOINT G.I. STRIP TO ROUND ALUMINIUM CONDUCTOR



ARRANGEMENT OF DOUBLE EARTH CONNECTIONS TO EQUIPMENT

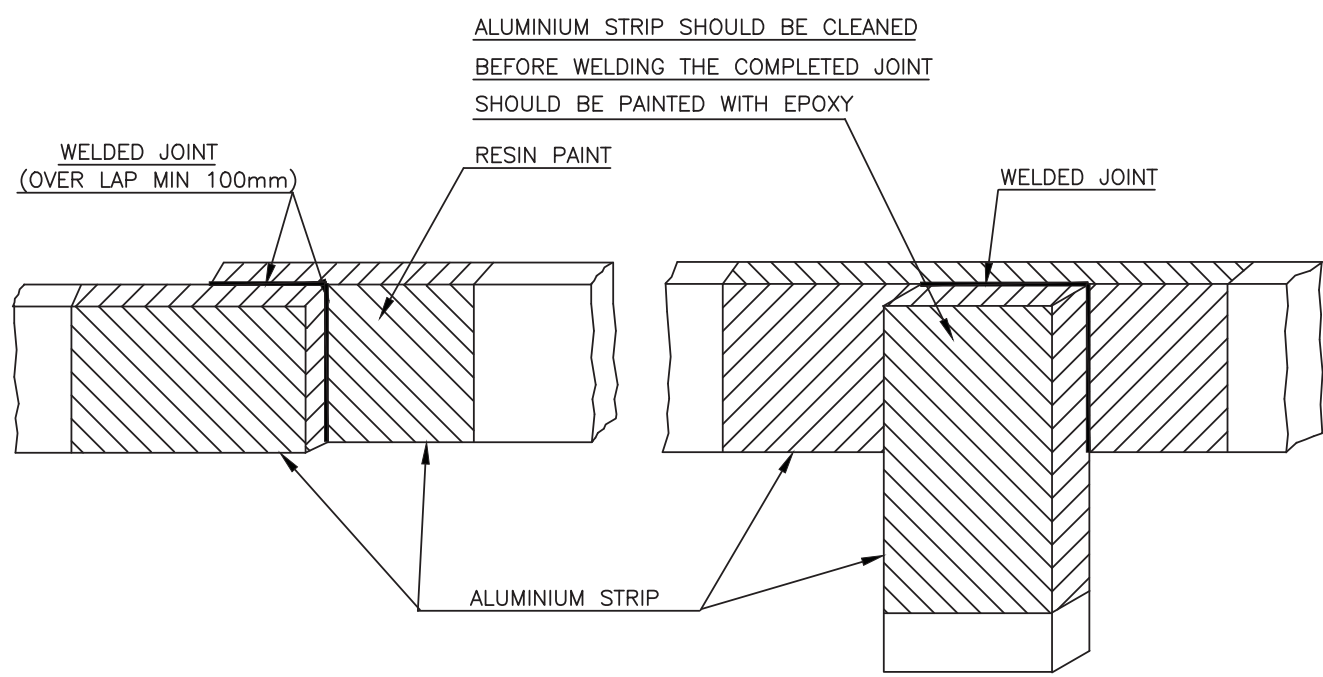


V I E W F R O M - D



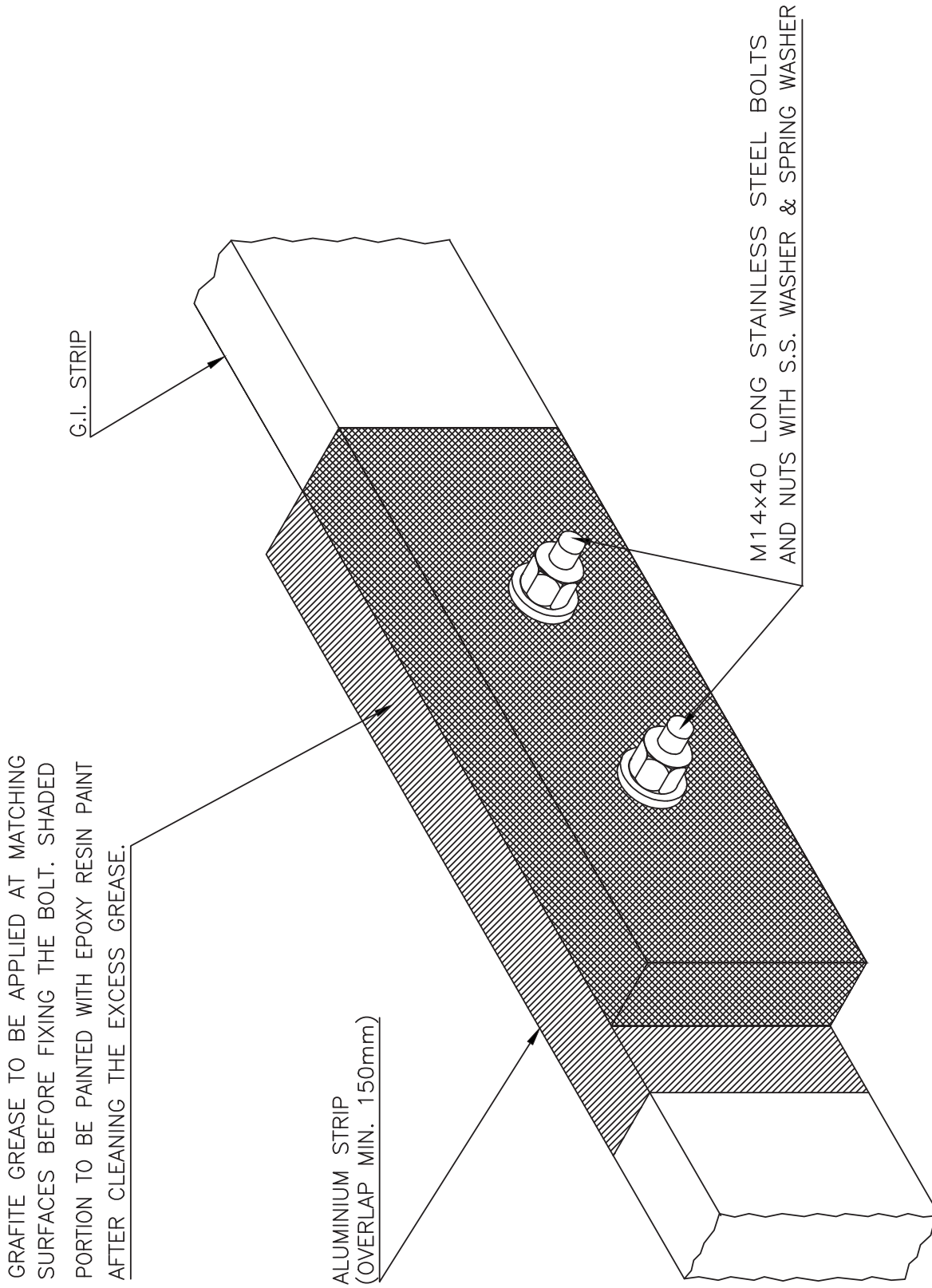
STRAIGHT JOINT G.I TO G.I. STRIP

" T " JOINT G.I. TO G.I. STRIP



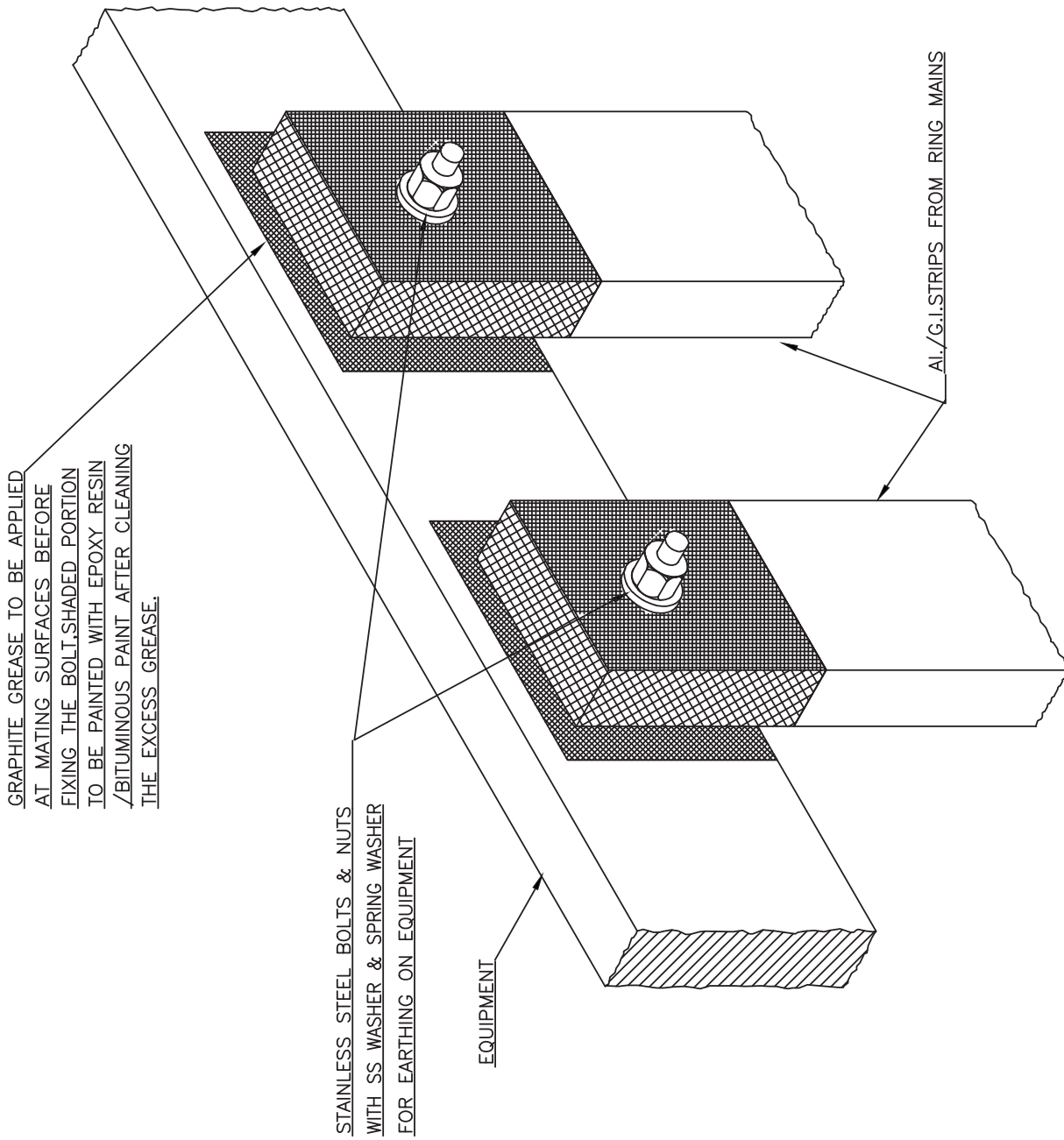
STRAIGHT JOINT AL. TO AL. STRIP

" T " JOINT AL TO AL STRIP



ARRANGEMENT OF LAP JOINT BETWEEN

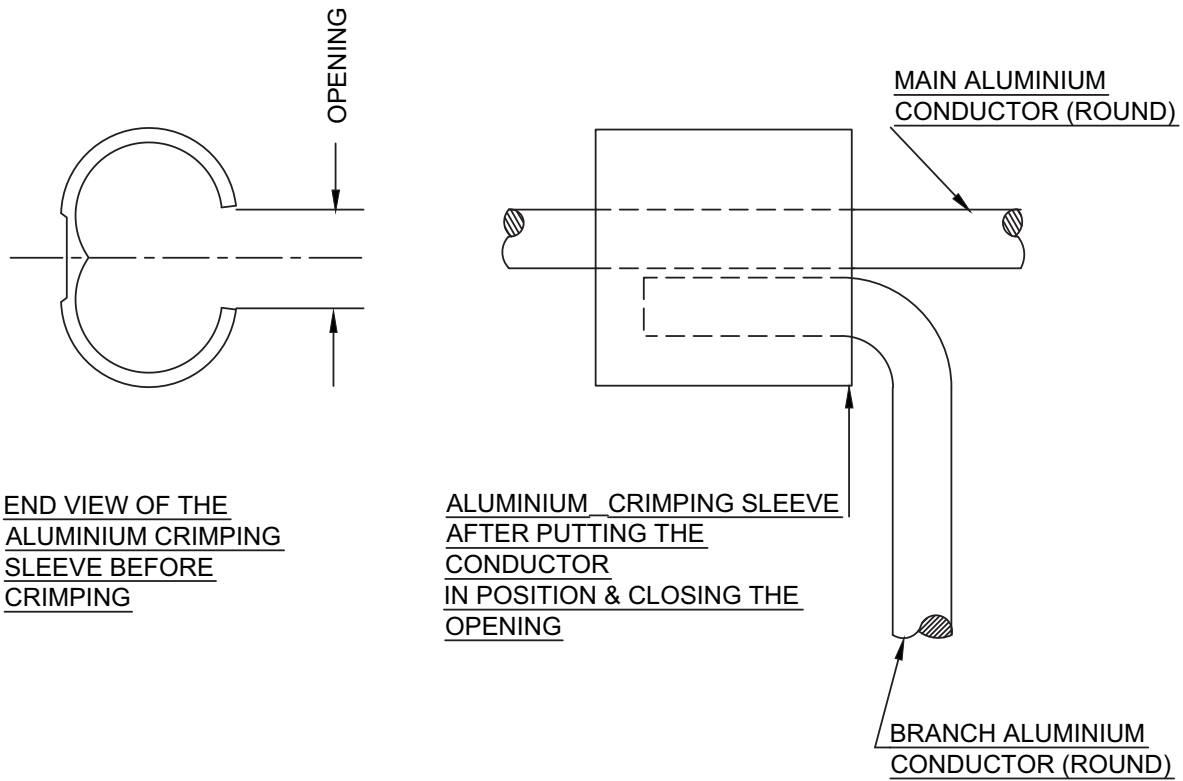
AL. EARTH STRIP TO G.I. EARTH STRIP



ARRANGEMENT OF DOUBLE EARTH CONNECTION ON EQUIPMENT

NOTE:-

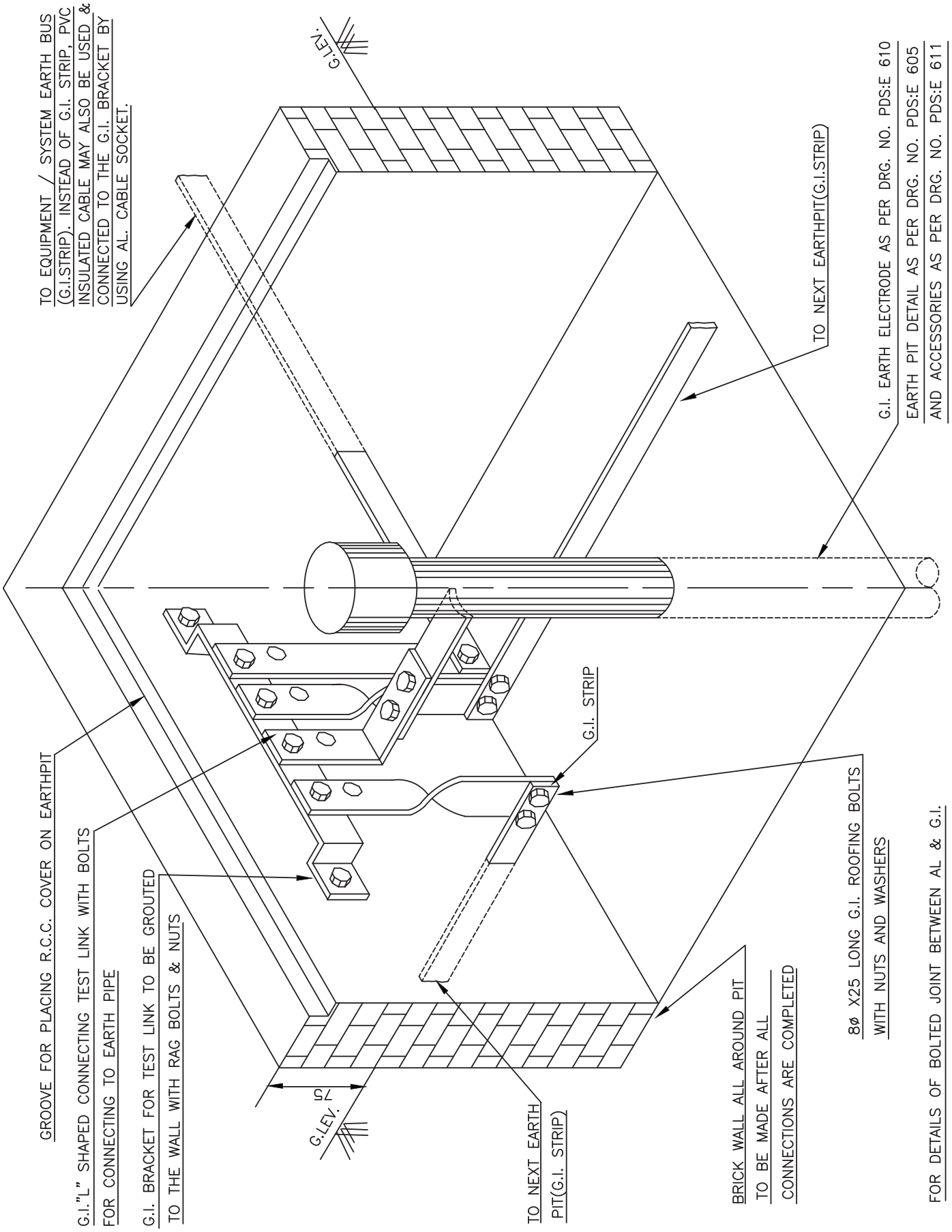
EPOXY RESIN PAINT SHALL BE USED FOR AL STRIP AND BITUMINOUS PAINT FOR G.I.STRIP.



"T" JOINT ROUND ALUMINIUM CONDUCTOR TO ROUND ALUMINIUM CONDUCTOR (CRIMPING TYPE)

NOTE :-

USE CORRECT SIZE OF COMPRESSION DIES.



GROOVE FOR PLACING R.C.C. COVER ON EARTH PIT

G.I. "L" SHAPED CONNECTING TEST LINK WITH BOLTS FOR CONNECTING TO EARTH PIPE

G.I. BRACKET FOR TEST LINK TO BE GROUTED TO THE WALL WITH RAG BOLTS & NUTS

TO NEXT EARTH PIT (G.I. STRIP)

BRICK WALL ALL AROUND PIT TO BE MADE AFTER ALL CONNECTIONS ARE COMPLETED

8φ X25 LONG G.I. ROOFING BOLTS WITH NUTS AND WASHERS

FOR DETAILS OF BOLTED JOINT BETWEEN AL & G.I.

REFER PDS:E 603 (SHEET 4 OF 6)

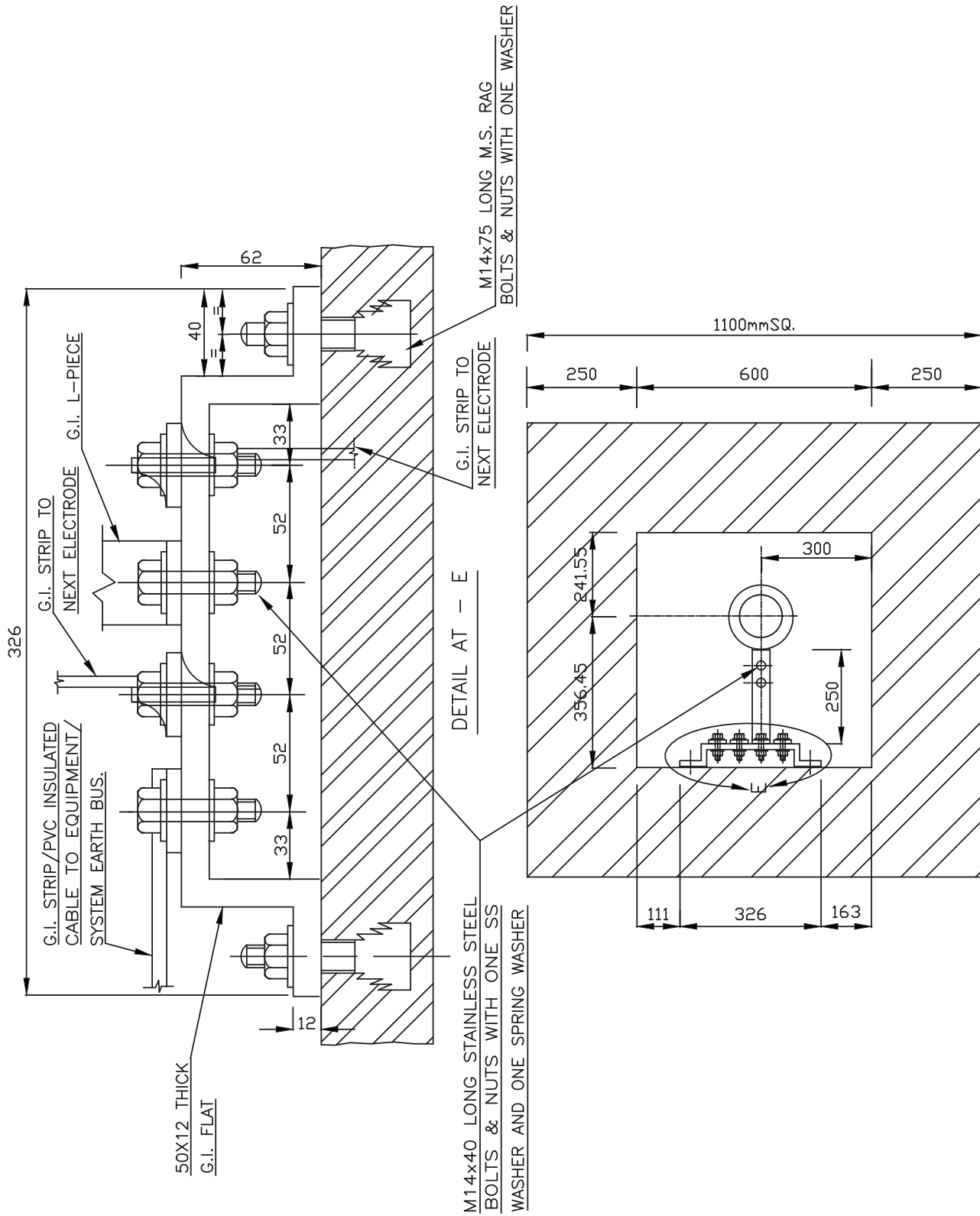
TO EQUIPMENT / SYSTEM EARTH BUS (G.I. STRIP). INSTEAD OF G.I. STRIP, PVC INSULATED CABLE MAY ALSO BE USED & CONNECTED TO THE G.I. BRACKET BY USING AL. CABLE SOCKET.

TO NEXT EARTH PIT (G.I. STRIP)

G.I. EARTH ELECTRODE AS PER DRG. NO. PDS:E 610
EARTH PIT DETAIL AS PER DRG. NO. PDS:E 605
AND ACCESSORIES AS PER DRG. NO. PDS:E 611

G.I. LEV.

G.I. LEV.



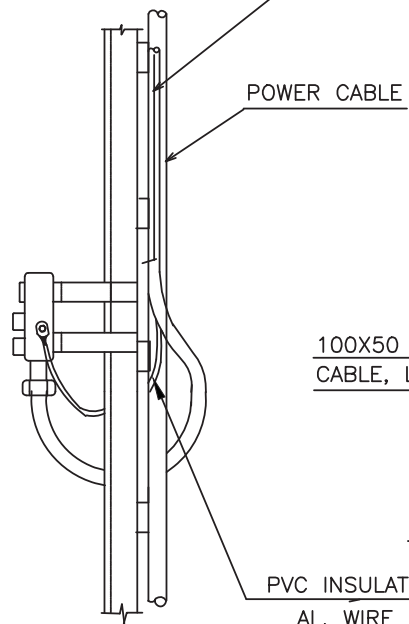
PVC INSULATED CONDUCTOR/ G.I.WIRE/
AL. WIRE FOR EARTHING OF MOTOR

2 NOS. EARTHING CONDUCTORS

POWER CABLE

CONTROL CABLE

CABLE CLAMPING
ARRANGEMENT



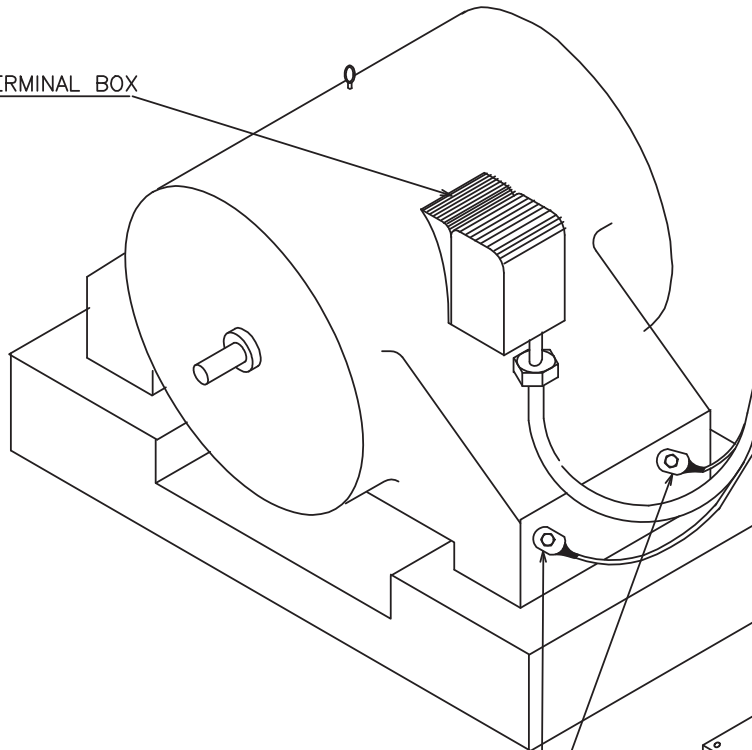
100X50 M.S CHANNEL FOR SUPPORTING
CABLE, LOCAL CONTROL STN.

HOSE PROOF/DUST PROOF
LOCAL CONTROL STN.

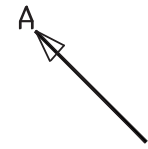
PVC INSULATED CONDUCTOR/G.I. WIRE/
AL. WIRE FOR EARTHING OF L.C.S.

VIEW AT-A

MOTOR TERMINAL BOX



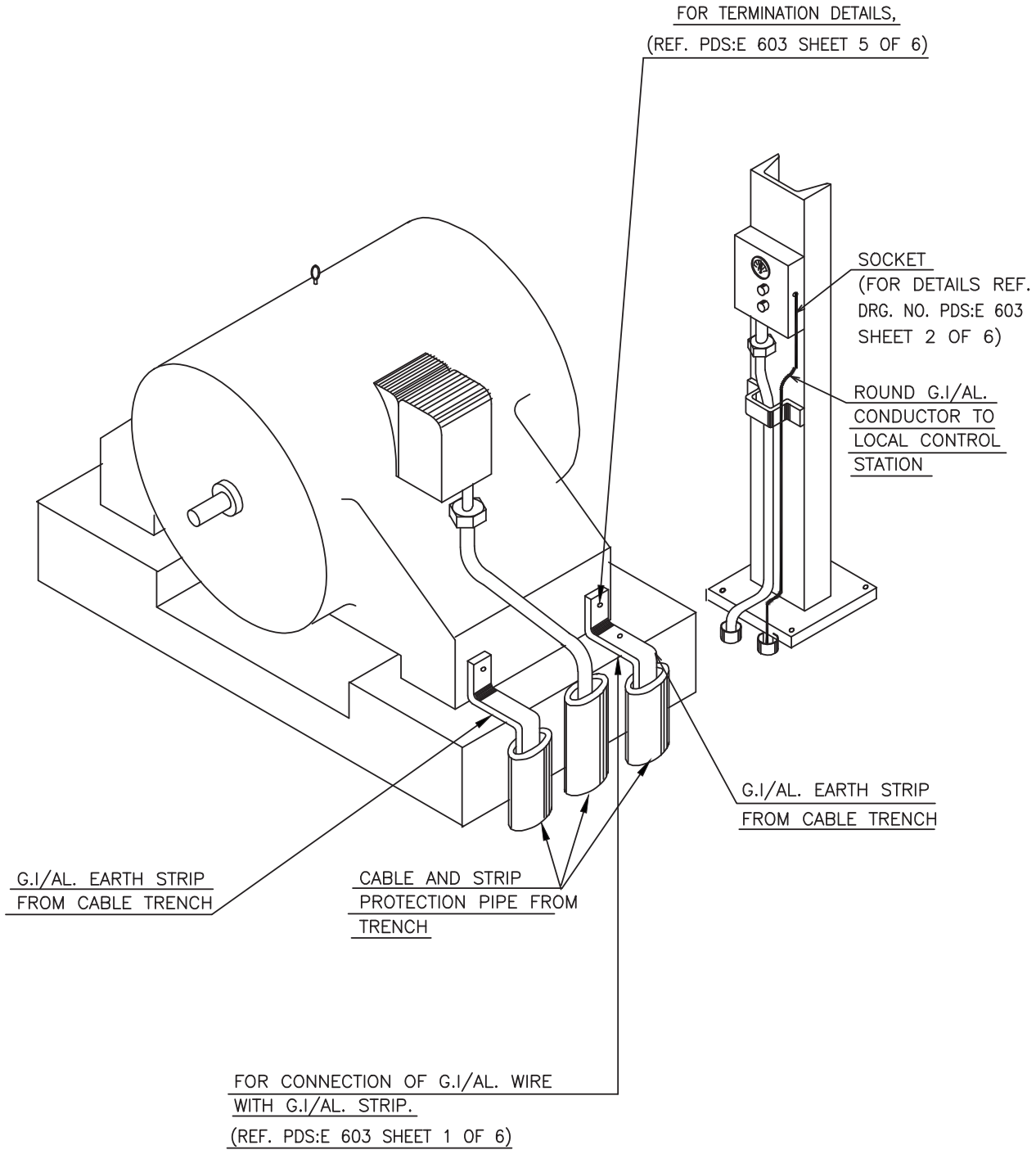
EARTH TERMINALS-TERMINATION
OF AL. CONDUCTOR THROUGH
AL. CABLE SOCKET
(FOR DETAILS REFER PDS:E 603 SH.2)

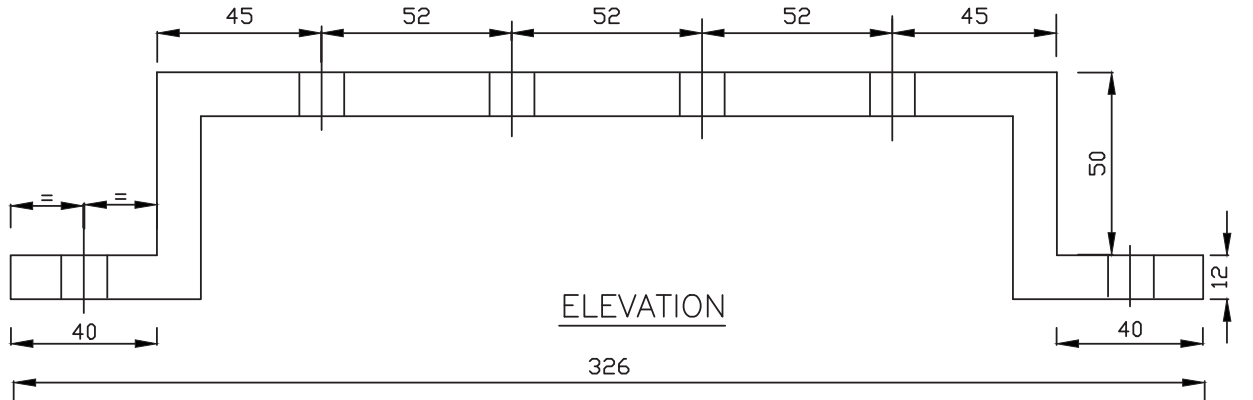


RUBBER BUSHING

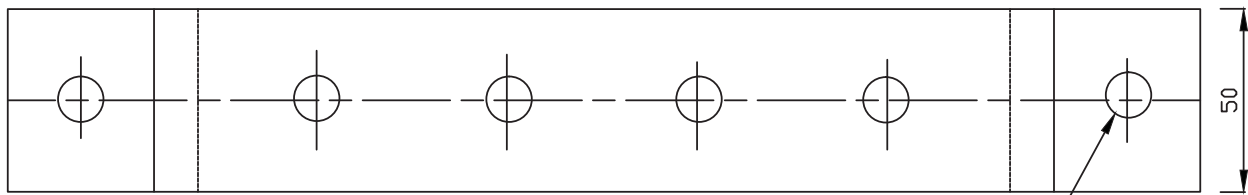
50X6 FLATS WELDED TO
THE CHANNEL @ 300
INTERVAL

200x200x10 THCK PLATE
GROUTED FLUSHING WITH
FINISH FLOOR LEVEL





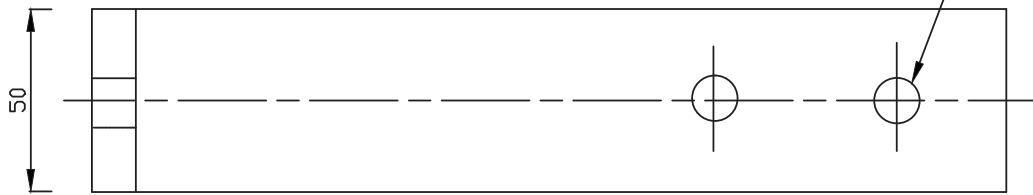
ELEVATION



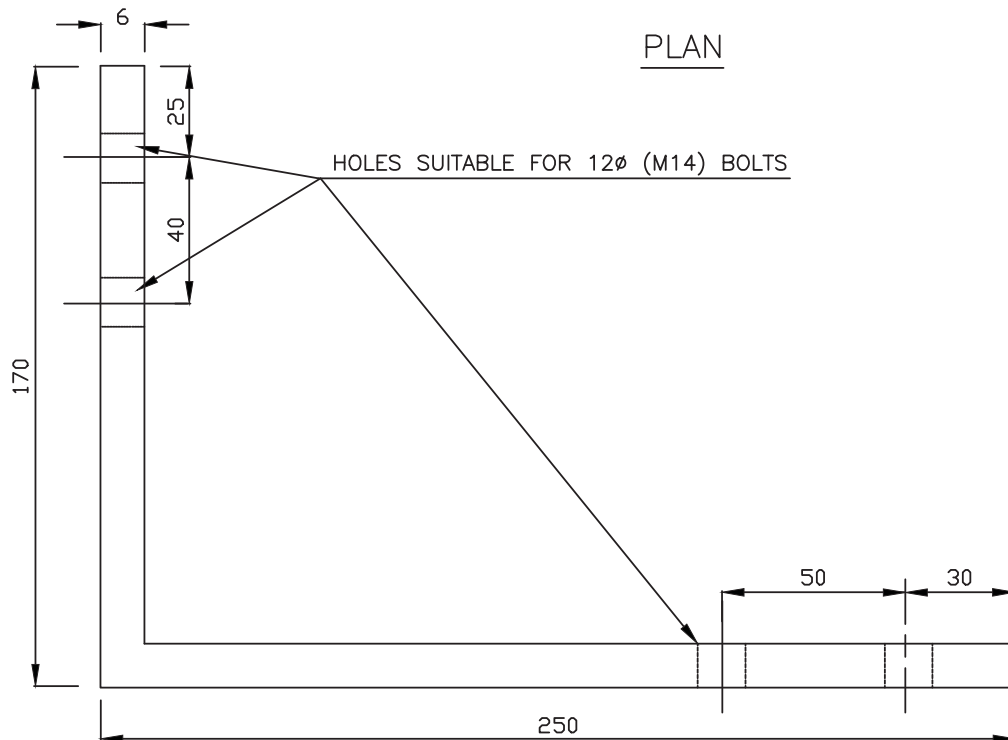
PLAN

G.I. TEST LINK

HOLES SUITABLE FOR 12 ϕ (M14) BOLTS

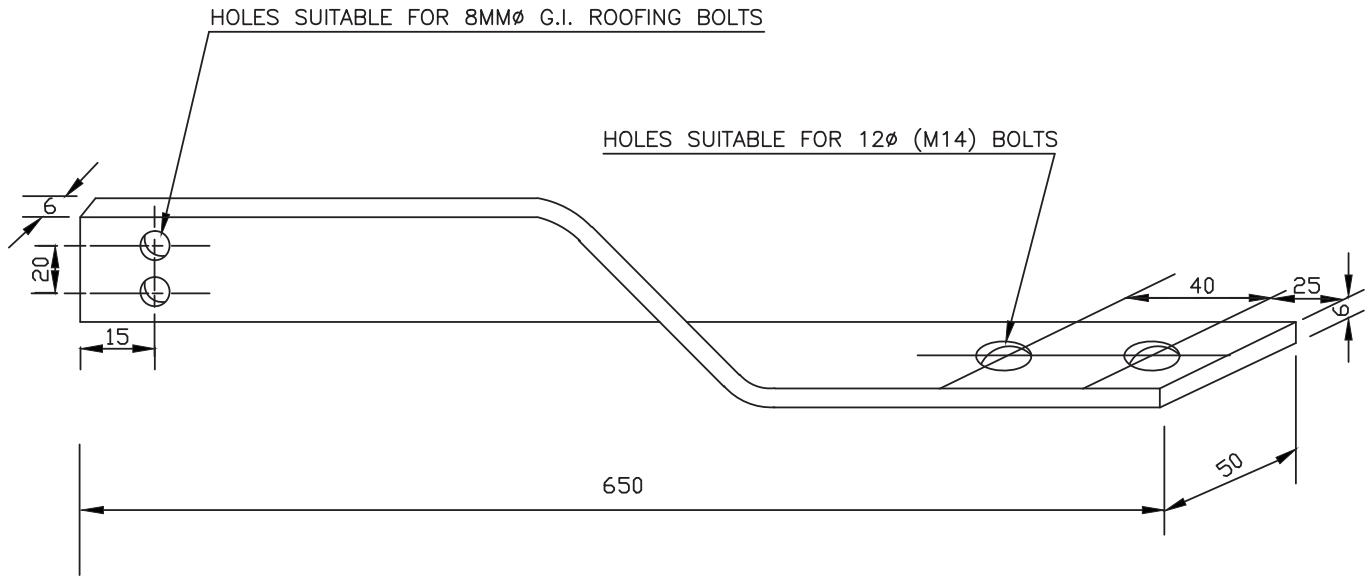


PLAN

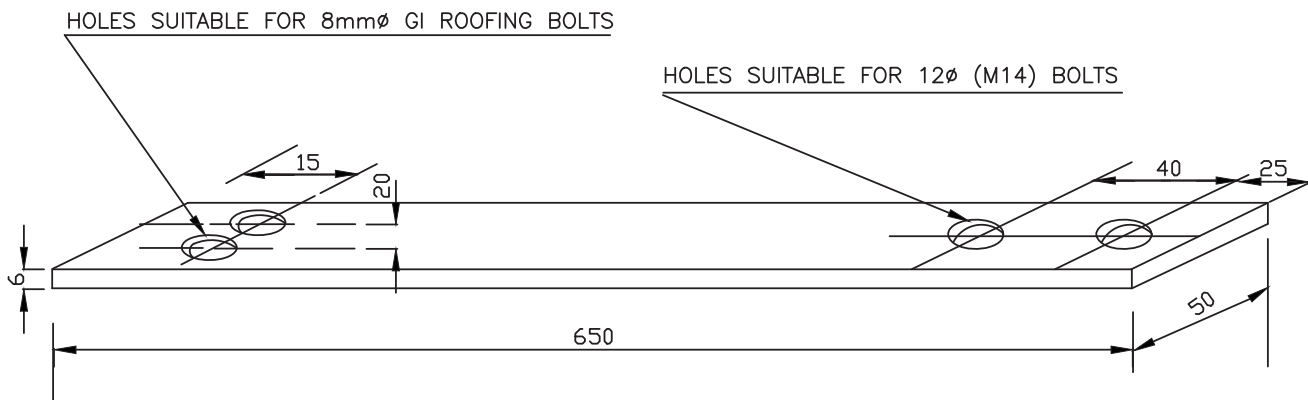


ELEVATION

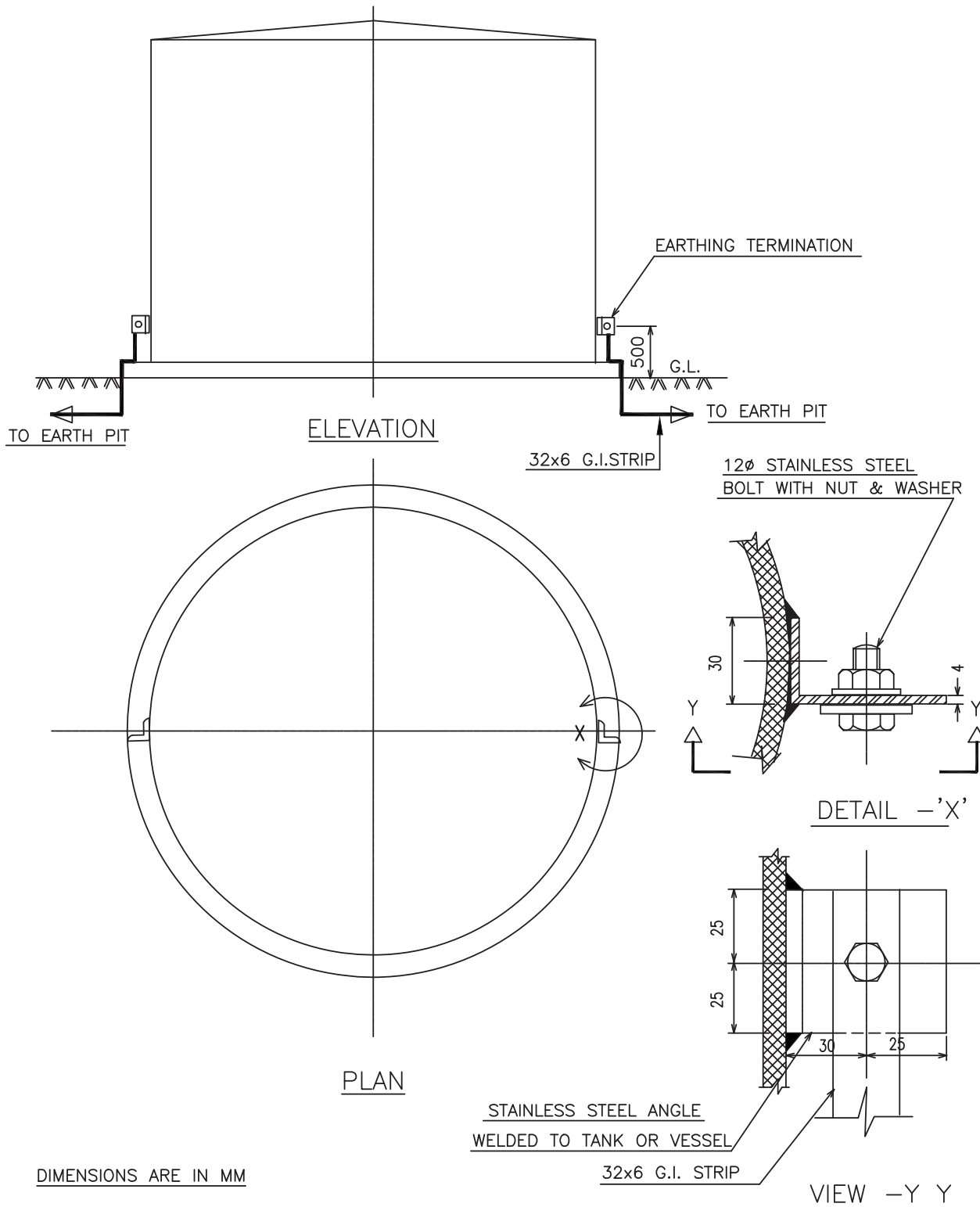
G.I. 'L' PIECE



CONNECTING TWISTED ALUMINIUM FLAT PIECE

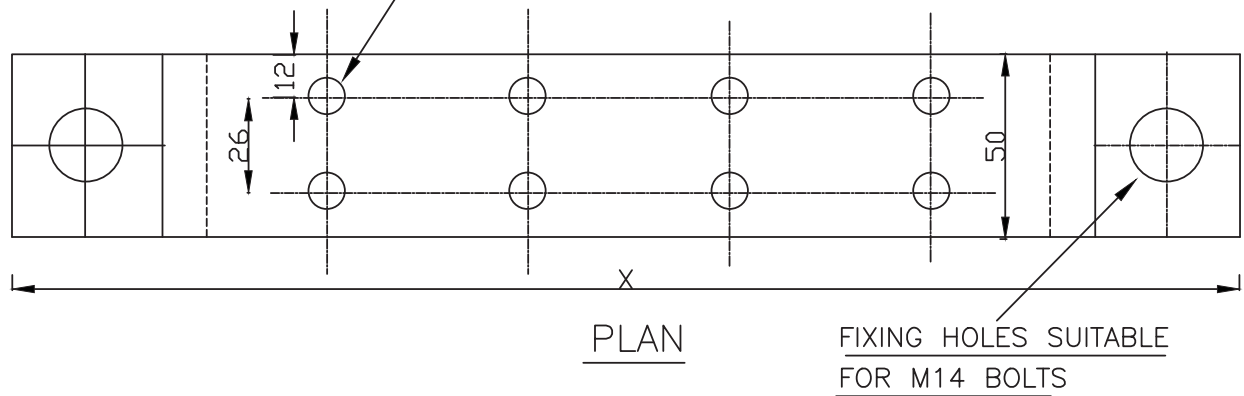
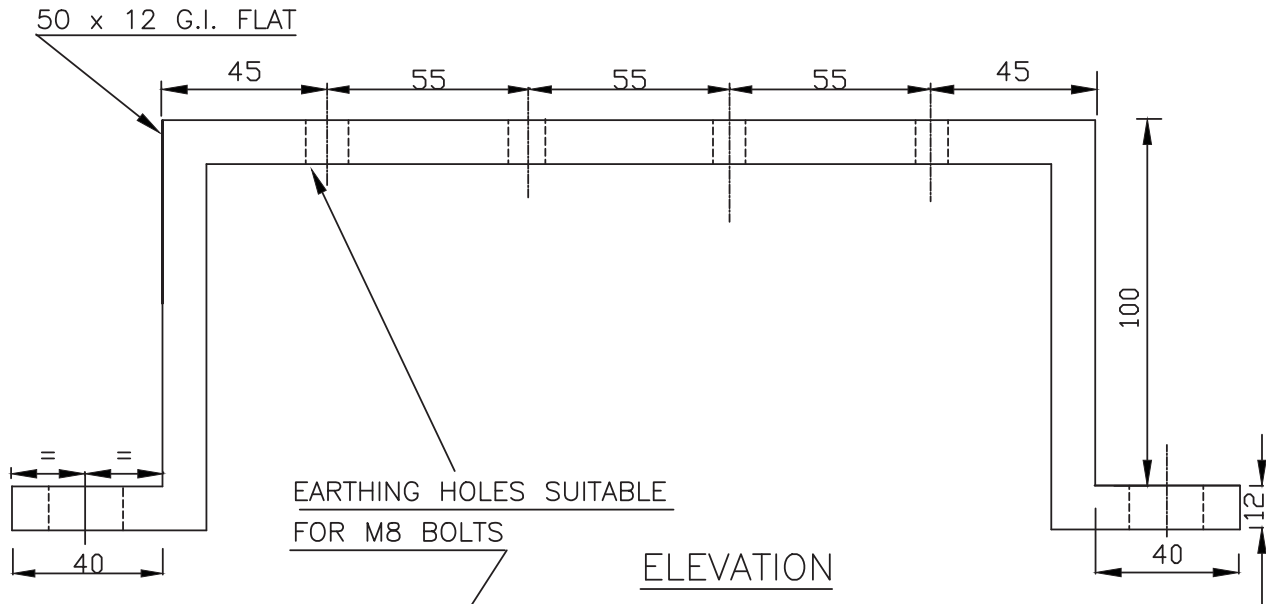


CONNECTING ALUMINIUM / G.I. FLAT PIECE



THE NO. OF EARTH CONDUCTOR SHALL BE AS FOLLOWS

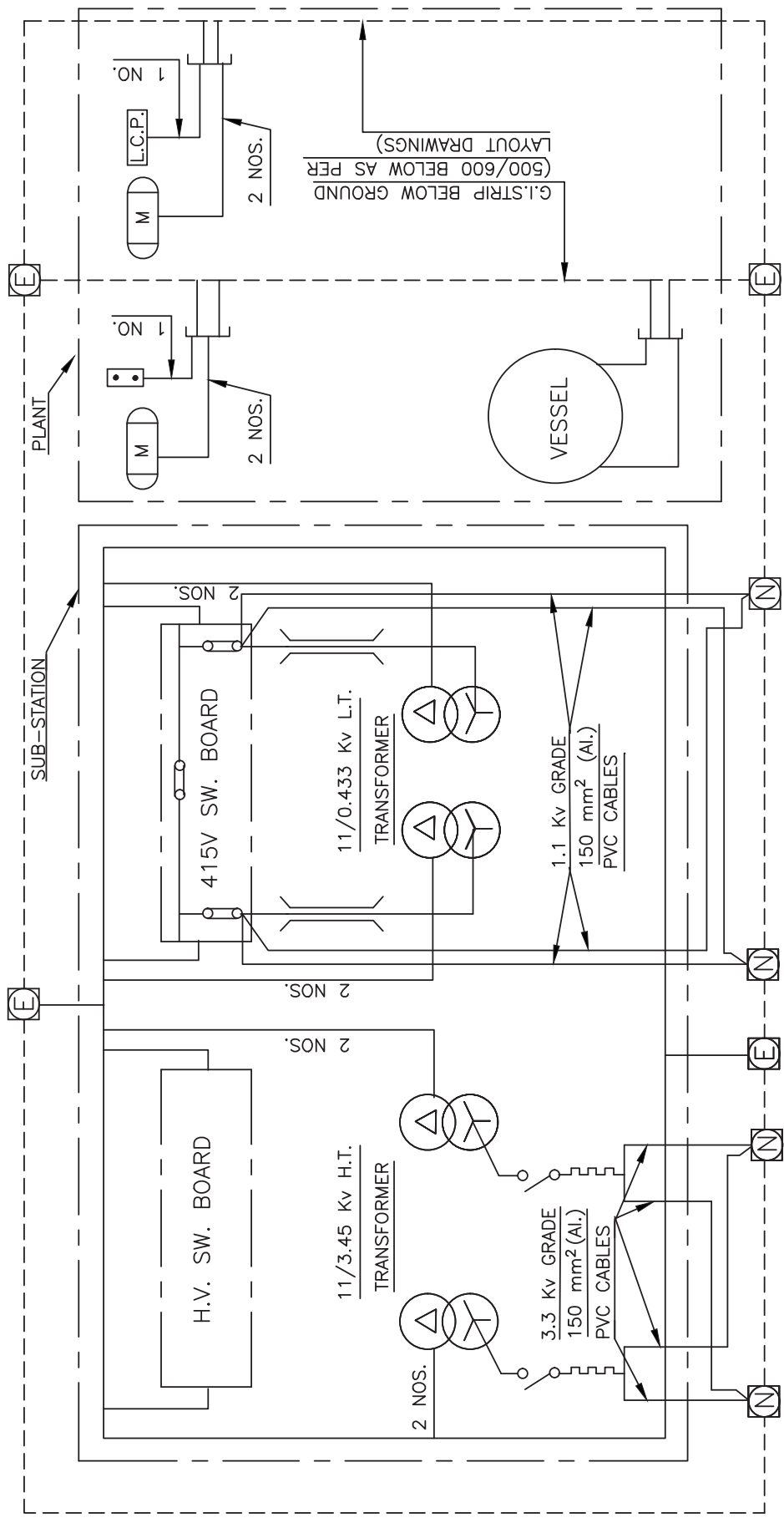
EQUIPMENT WITH ANY DIMENSION	HAZARDOUS AREA	NON-HAZARDOUS AREA
≤ 3 Mts.	1	1
> 3 Mts. ≤ 30 Mts.	2	1
> 30 Mts.	3	2



TYPE OF EARTH BUS	NO.OF EARTHING HOLES	OVERALL LENGTH x (mm)
1	8	335
2	10	390

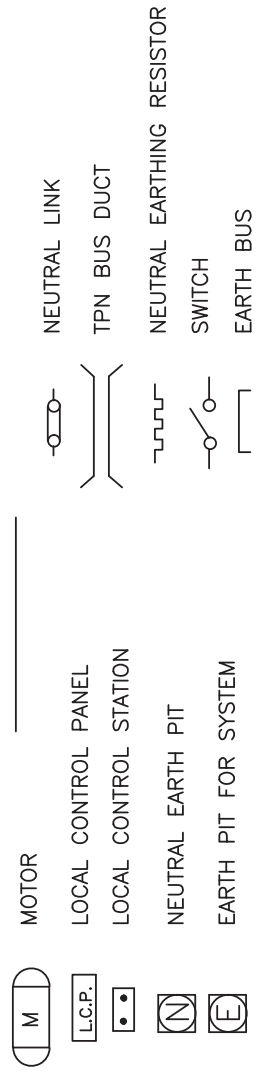
NOTES:-

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



- REF. DRGS.
1. EARTH PIT DETAILS - PDS:E 605
 2. EARTH CONDUCTOR SIZES - PDS:E 602 (2 SHEETS)
- NOTE :-
EARTH BUS SHALL BE 500 ABOVE FROM FLOOR LEVEL

L E G E N D



 पी डी आई एल PDIL	PROJECTS & DEVELOPMENT INDIA LIMITED	PC183/E/4006/SECVI-3.2.1	0	 Talcher Fertilizers
		Document No.	Rev	
		Sheet 1 of 8		

SECTION : VI – 3.2.1

FIRE FIGHTING SYSTEM

PLANT : ELECTRICAL DISTRIBUTION SYSTEM

**PROJECT: INTEGRATED COAL BASED FERTILISER COMPLEX,
AT TALCHER, ANGUL DISTRICT, ODISHA (INDIA)**



0	26.03.21	26.03.21	Issued for Enquiry	JKS	AMAR	AMAR
REV	REV DATE	EFF DATE	PURPOSE	PREPD	REVWD	APPD

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SECTION NUMBER	DESCRIPTION	SHEET NUMBER
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5.0	General Considerations	4
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7.0	Fire Water Distribution System	5
8.0	Gas Flooding system	6
9.0	Portable Fire Extinguisher	7
10.0	Fire Protection for Product Tank Farm Area	7
11.0	EMERGENCY SIRENS	7
12.0	Breathing Apparatus	7
13.0	Safety Items	7
14.0	Fire Alarm System, Detection System & Manual Call Points	7
15.0	Execution, Inspection & Testing	9
16.0	DOCUMENTATION	9

LIST OF ATTACHMENTS

ATTACHMENT NUMBER	DESCRIPTION	NUMBER OF SHEETS

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		Document No.	Rev	
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1.0 PURPOSE

The purpose of this document is to establish the design basis of the complete fire fighting system.

2.0 DEFINITIONS

PESO - Petroleum And Explosives Safety Organization

CCE - Chief Controller of Explosives

NFPA - National Fire Protection Association



IS - Indian Standards

NBC- National Building Code (India)

TAC – Tariff Advisory Committee

3.0 SCOPE

- 3.1 This specification covers design basis and execution requirements for fire protection system to be provided by CONTRACTOR as per statutory regulations and NFPA codes. The design and construction of the fire detection and protection equipment shall be of internationally accepted standards and in compliance with the regulations of the Tariff Advisory Committee (TAC), National Building Code (NBC) - 2016 and other relevant statutory requirements for Electrical Distribution System. Any other Standard which are not mentioned in the technical specification but are found necessary to meet the requirement of TAC and standard engineering practices for safe and sound operation of the System are to be included at no extra cost to the Owner.
- 3.2 The CONTRACTOR shall design, supply and erect complete fire fighting network / system inside and across the Electrical Distribution System.
- 3.3 The Bidder shall confirm that the fire fighting system is complete with all facilities whether specified in this specification or not.
- 3.4 A comprehensive fire protection system shall be designed for the whole of the proposed Electrical Distribution System to provide a high degree of protection for plant, tanks, equipment and buildings and employees. Interfacing with other systems (e.g. fuel and air handling plants, ventilation systems, etc.) will be required.
- 3.5 Taping/s with the fire water mains shall be provided at plant battery limit (adjacent to the proposed plant location) as per requirement. The same (tie-in location/s) shall be decided during the detail engineering. At tie in point fire water shall be provided at 9 kg/cm²g.
- 3.6 The CONTRACTOR'S design and engineering activities listed in this specification are the minimum requirements to be complied with preparation of detailed design basis, specifications, standards and list of codes for each system based on guidelines given in subsequent clauses of scope of work.
- 3.7 The term 'Fire Fighting System' referred here generally covers various equipments and facilities being provided for controlling fires. These include facilities such as fire water network accessories and fire water piping network together with hydrants, monitors, various kinds of portable fire extinguishers like Dry Chemical Powder type, etc., as well as sand and water buckets and sign boards.
- 3.8 The Fire Fighting System shall be designed to provide adequate facilities for extinguishing any fire in the entire area of Electrical Distribution System and associated facilities of the proposed Scope of work. The system shall be designed and installed as per TAC / NFPA/ API/ IS/PESO/NBC standards and also as per latest applicable standards/ codes. The

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system shall be complete in all respects essential for proper installation operation and maintenance, irrespective of whether such systems are specifically mentioned in this specification or not.

- 3.9 Hydraulic analysis of fire water ring main network including line size, flow and pressure at various section of the system shall be submitted for Owner/Consultant's approval.
- 3.10 The detail design shall take into consideration of all stipulations, practices followed by Statutory Regulations/Authorities for all types of jobs of this package.
- 3.11 Preparation of PFD/ P&ID's and equipment data sheets. Preparation of material take-off, material requisitions and purchase requisition of bought out items. Design calculations for the respective fire protection system. Installation, drawings and documents, Operating, maintenance and spare parts manuals wherever applicable.
- 3.12 Taking approval from statutory authorities.

4.0 FIRE PROTECTION PHILOSOPHY

The Fire Protection Philosophy is based on Loss Preventive and Control. The importance of adequate fire protection facilities need not be emphasized as no plant is absolutely safe because of the inherent hazard it carries. A fire in one part/section of the plant can endanger other sections of plant as well. If fire breaks out, it must be controlled / extinguished as quickly as possible to minimize the loss to life and property and to prevent further spread of fire.

5.0 GENERAL CONSIDERATIONS

The following fire protection facilities shall be provided depending upon the nature or the installation and risk involved.



- Fire Water System
- Gas Flooding (proven equivalent) System
- Carbon Dioxide Flooding System
- Dry Chemical Extinguishing System
- Portable fire fighting equipment

6.0 FIRE WATER SYSTEM

Fire Water System shall be designed as per NFPA Code and complied with Local Law/ Indian Standards/ Civil Defense requirements / National Building Code- 2016.

6.1 Fire Fighting System

- 1) Fire Hydrant shall be provided in a ring round the facilities of the plant and storage area in the contractor scope.
- 2) Fire Fighting System design and layout is subject to review and approval by Local Statutory Authorities. Documentation & obtaining approval of the fire fighting system from local fire service authority shall be in scope of contractor.
- 3) Contractor shall calculate the fire water requirement and tie-in for scope shall be taken from the OSBL fire water network. Offsite fire water network (OSBL scope) shall be available around the unit. Contractor shall take the required tappings from this Offsite header with an isolation valve for each tapings.
- 4) Valves on fire water mains shall be of Gate type with rising stem, only. Valves on fire water lines shall be located in RCC valve chamber provided with top cover to

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facilitate easy operation/ maintenance of valves. The top of chamber shall be 80 mm above ground level.

- 5) Fire Protection system's detailed location map to be displayed at Fire Station & Plant Control Rooms.

7.0 FIRE WATER DISTRIBUTION SYSTEM

7.1 General

- i) Fire hydrant ring from battery limit tapping point with isolation Gate valve, hydrants, monitors and deluge valve system and accessories to be provided.
- ii) Indoors hydrants for plant and non-plant buildings shall be provided as required.
- iii) Single headed hydrant for inside the buildings and double headed hydrants for outside building shall be used.
- iv) For process units, external ring header with hydrants and an internal distribution with monitors and hose reels shall be installed.
- v) Along the network, a number of block (gate type) valves shall be located in such a way that the various areas of the plant can be fed with fire water even during maintenance operations on part of the fire water network. Gate valve shall be provided at every 300m and at crossings (Junctions) to ensure easy maintenance and uninterrupted water supply in case of break down and shall be planned in such a way that outage of any section of fire water line should not affect other section.
- vi) Fire water shall not be used for any other purpose.
- vii) Extension of hydrants/monitors for spill fire (as required by TAC) shall also to be provided.
- viii) Diesel oil storage tank areas shall be surrounded by hydrants & water cum foam monitors (SS304 body & nozzle, fixed stand post type, manual operation, 500-750 USGPM variable type flow, self inducting foam induction mechanism) along with portable type foam cans (each 200 Litres capacity).
- ix) Cast Iron as MOC for piping items in the fire fighting system shall not be used.

7.2 Hydrant



The hydrants shall be wet barrel type, self-standing, 4" size with 2 separate hydrant valves (material of construction SS304) on each stand post & hose connection 2-1/2" with gate type isolation valves at vertical portion of hydrant.

7.3 Fire Box

Each Fire Box shall consist of two fire hoses having 2-1/2" diameter and 30 M length, one adjustable flow nozzle(material of construction SS304) and hose coupler (material of construction SS304). Fire boxes shall be installed so that each fire box can be reached from two hydrants. Hose boxes shall be made of M.S. material and painted red with dimensions 18 SWG thick M.S. sheet, size 750 mm x 600 mm x 250 mm.

7.4 Monitor

Monitor, fixed type, UL listed, material of construction SS304, shall be installed for the protection of high columns and process structures. Monitors capacity shall be 2580 LPM. Higher capacity may be achieved with higher pressure. Monitor shall be manually

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operated. The monitors shall be suitable for combination of straight and fog jet; the straight jet-to-fog change is obtained manually. Water Monitor shall be BIS marked IS: 8442. However to meet the jet-fog combination as specified UL listed monitor with 750 GPM shall be considered.

7.5 Fixed Water Spray System

Automatic fixed water spray system, designed in accordance with NFPA 15, with automatically pneumatically operated deluge valve having manual by-pass valve system & detectors, shall be installed to the following locations:

- Each Cable Cellar shall be fire protected by CO₂/DCP type fire extinguisher of suitable capacity.
- Both High Velocity Water Spray (HVWS) System and Nitrogen Injection Fire Prevention and Extinguishing System (NIFPES) shall be provided for transformers fire protection of capacity more than 60 MVA.
- Nitrogen Injection Fire Prevention and Extinguishing System (NIFPES) shall be provided for transformers fire protection of capacity more than 20MVA.
- Both High Velocity Water Spray (HVWS) System shall be provided for transformers fire protection having oil capacity more than 2000 Liters.

Other fire protection systems including Fire hydrants, monitors and Fire Extinguishers etc. shall be provided for transformer having oil capacity upto 2000 Liters.

7.6 Hose Reel

Hose reel, connected to fire water network, preferably shall be provided in sufficient numbers at various required locations. Each hose reel shall be equipped with a valve 1-1/2" size, 30 meters of fire hose and water branch pipe.

7.7 Hose Box (Indoor Hydrant)

Hose reel, connected to fire water network, preferably shall be located in the warehouses and process units. Each hose box shall be equipped with a hose cabinet, valve (1-1/2" size), 20 meters fire hose and water branch pipe.

7.8 Standpipe and Hose System

Standpipes with hose stations for Class III (NFPA 14) service are preferred, having one 2-1/2 inch valve hose connection and 1-1/2" valve hose connection with 30 m lengths of 1-1/2" fire hose and 1-1/2" water branch pipe, for the protection of selected buildings.



7.9 Sprinkler System

The sprinkler system, wet type, shall be designed according to NFPA 13. Sprinklers system shall be installed in the hall and rooms, as applicable.

8.0 GAS FLOODING SYSTEM

8.1 GAS / CLEAN AGENT FLOODING FIRE EXTINGUISHING SYSTEM

Clean Agent (Inergen or Argonite) System shall be provided to :
Rack Room, Panel room, Computer rack room and Control Room, as applicable.

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8.2 CARBON DIOXIDE GAS FLOODING FIRE EXTINGUISHING SYSTEM

Carbon dioxide gas flooding fire extinguishing system shall be provided for :

- Electrical panels at substations & other locations.

9.0 PORTABLE FIRE EXTINGUISHERS

Portable fire extinguisher shall be provided for all plant buildings. Wheeled type (40 kg charge) and portable type (6 kg charge) dry powder extinguishers, suitable for class ABC fire, shall be provided as per NFPA requirements. Portable type (6 kg charge) and wheeled (30kg charge) Carbon Dioxide extinguishers shall be provided for fire fighting in the electrical substation and control rooms and other agreed locations as per NFPA requirements. Contractor shall specify the numbers and location for Owner's review and approval.

DCP Units of 50 Kg and 75 Kg for areas like large oil consoles, substations, flammable gas etc., as applicable.

10.0 FIRE PROTECTION FOR DIESEL TANK

Adequate fire protection requirements shall be provided by bidder for Diesel tank as per NFPA and PESO.

11.0 BREATHING APPARATUS SET

Breathing apparatus set (UL listed) with shouldered type compressed air cylinders shall be provided, minimum 3 nos. in each control room & each substation, for emergency use.

Online air mask (UL listed) shall be provided along with each Breathing apparatus set.

12.0 SAFETY ITEMS

Bidder shall provide safety items as per hazard requirements, in accordance with NBC-2016/TAC/NFPA. Safety shower shall be provided, as applicable

13.0 EXECUTION, INSPECTION AND TESTING



If the system packager/manufacturer is collaborating with any foreign party for basic engineering, design, etc., he should provide certificate of collaboration and first submission of design and detailed drawing shall be approved by the Collaborator.

The Contractor shall supply recommended spares for first 24 months of operation and maintenance and subsequent requirements.

All execution, inspection and testing for completion of fire protection system shall be carried out based on Codes, standards and specifications. Contractor shall develop a detail inspection, and testing procedures based on codes, standards and specifications. Following minimum tests but not limited to, shall be carried out after completion of the system testing Fire water network piping

- Demonstration test for system capacity requirements.
- Demonstration test for water spray & sprinkler systems.
- Demonstration test for gas flooding system.

The Contractor shall meet all requirements for inspection and testing of the system.

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14.0 DOCUMENTATION

Drawings and documents shall be prepared as required by approval authorities in all respects and submitted by the Contractor. The Contractor shall make arrangement for inspection and testing for statutory authorities at various stages of the work.



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SECTION: VI – 3.2.2
DESIGN PHILOSOPHY – HVAC SYSTEM

PLANT : ELECTRICAL DISTRIBUTION SYSTEM



**PROJECT : INTEGRATED COAL BASED FERTILISER COMPLEX
AT TALCHER, ANGUL DISTRICT, ODISHA (INDIA)**

0	26.03.21	26.03.21	Issued for Enquiry	NY	ASR	RRK
REV	REV DATE	EFF DATE	PURPOSE	PRPD	REVD	APPD

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1.0 GENERAL

1.1 Intent:

1.1.1 This Philosophy states that LSTK Contractor's/ Bidder's scope of work shall include basic & detailed engineering, procurement, supply, manufacturing, fabrication, inspection & testing, transportation, loading, unloading, insurance, storage, construction, erection/ installation of all HVAC (Heating, Ventilation, Air Conditioning) System / package with auxiliaries viz. chillier units, chilled water pumps, condenser water pumps, cooling towers , air handling units, package /portable AC units, Ventilation system, piping, electrical, instrumentation and 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 complete HVAC System / package for **Electrical Distribution System** for **Talcher Fertilizer Limited at Talcher, Angul District Odisha (India)**.

1.2 Scope of work:



1.2.1 LSTK Contractor shall provide suitable HVAC system for all process / non-process buildings/ facilities mentioned in the NIT as well as for other buildings /structures also, which are not specifically mentioned in the NIT, however, required in view of plant's operational needs, shall be in the bidder's scope .

Indicative list wherein HVAC system are required :

1. Sub -station(s)
2. Field Maintenance office(s)
3. Operator cabins
4. Lift machine rooms, if any
5. Feeder panel rooms
6. Other miscellaneous building , if any.

1.2.2 Type of Air conditioning system and Ventilation system are preferably required as under for various above mentioned buildings / facilities :

1. Substation Buildings : Central AC system with complete auxiliaries with 100% stand-by chillers & AHUs are required with chemical filters.
2. Field maintenance offices : shall be air-conditioned through portable ACs with stand-by units.
3. Lift machine room: shall be air-conditioned through portable ACs with stand-by units.

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1.2.3 Ventilation system with adequate stand-by equipment to be provided not limited to the following buildings:

- Battery rooms (explosion proof fans with 100% stand-by)
- Maintenance rooms
- Pantry room
- All Toilets
- Plant room
- Clean agent room
- AHU (Air Handling Units) Rooms
- Locker rooms
- Electrical room
- Cable cellar (explosion proof fans with 100% stand-by)
- Store rooms
- Change rooms
- Chemical, oil and Bulk storage shed

Bidder to please refer ISHRAE/ASHRAE guidelines for Industrial Ventilation as prescribed in NIT.

However, minimum assumption shall be :

- i) 20 ACPH for toilet
- ii) 20 ACPH for Battery Room
- iii) 10 ACPH for Cable cellar area
- iv) 20 ACPH for plant room

1.2.4 Philosophy for Split AC /Cassette AC/ portable AC/ package units shall be opted as : Bidder to note that for centralized AC system 100% redundancy shall be there as per NIT requirement. Moreover, for package AC/ Split ACs dedicated for 'plant equipment' shall have 1W + 1Standby (100% standby) concept.

Split ACs / Portable ACs dedicated for human habitation / officer's cabins shall have no redundancy.

1.2.5 Noise level shall be limited to 70 DBA at 1 meter distance from the equipment complying national & state regulation.



1.2.6 Bidder to assure that HVAC system and auxiliaries shall be complete in all aspect complying to national / international / statutory requirement and bidder shall furnish their selection and design calculation of HVAC system w.r.t various buildings/ facilities during detail engg for owner's review and approval.

Bidder to also note that atleast 20% extra Design margin for HVAC to be considered above peak load requirement.



2.0 CODES AND STANDARDS:

2.1 The *Latest Edition* of codes and standards as listed below shall be followed for design and manufacturing of different machinery / package items.

- | | | |
|----------|---|--|
| IS: 659 | : | Safety code for Air-conditioning |
| IS: 660 | : | Safety code for Mechanical Refrigeration |
| IS: 655 | : | Metal Air ducts |
| IS: 2494 | : | V-Belts for Industrial Purposes. |
| IS: 3142 | : | V-Grooved Pulley |

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IS: 2379	:	Colour Code for Identification of Pipe Lines.
IS: 1239 (Part1)	:	Mild Steel Tubes
IS: 3589	:	Seamless or electrically welded steel pipes for water, gas and sewage.
IS:277	:	Galvanised Steel Sheets (Plain and Corrugated)
IS: 2062	:	Steel for General Structural Purposes.
IS: 3103	:	Code of Practice for Industrial Ventilation
IS: 4894	:	Test Code for Centrifugal Fans.
IS: 8148	:	Packaged Air Conditioners.
ISO/HIS	:	Centrifugal Water Pumps
ARI-450	:	Water cooled refrigerant condensers, Remote Type
ARI-460	:	Remote mechanical draft air cooled refrigerant Condensers.
ARI-480	:	Refrigerant cooled liquid coolers, Remote Type
ARI-520	:	Positive displacement refrigerant compressor and Condensing units
ARI-550/590	:	Water Chilling Packages using Vapour Compression Cycle.
ASME Section VIII Div.	:	Code for unfired pressure vessels
TEMA	:	Tubular Exchanger Manufacturers Association.
SMACNA	:	Sheet Metal and Air Conditioning Contractors' National Association.
AMCA-210	:	Laboratory Method of Testing Fans for rating purpose
ASHRAE/ISHRAE	:	Handbooks of : - Fundamentals - HVAC Systems and Equipments - HVAC Applications. - Refrigeration
BS-6540 Part-1:	:	Method of Test for atmospheric dust spot efficiency and synthetic dust weight arrestance.
BS EN 779	:	Particulate air filters for general ventilation – Requirements, testing marking.

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2.2 Other international standards may also be acceptable subject to their being equivalent or superior to those listed above, with prior approval of owner.

2.3 For provisions not covered by the above codes and standards, applicable good engineering practices and norms shall govern.

3.0 TECHNICAL REQUIREMENT:

3.1 Duty

3.1.1 HVAC system/ package to be designed considering continuous 24 hours operation for all concerned areas. The plant shall be suitable for maintaining inside design conditions all the year round. Notwithstanding the duty specified, all equipment shall be suitable for continuous operation for 8000 hrs. per year.



3.1.2 Heat load calculation of entire area of plant Building/Facilities shall be done by bidder and AC plant shall be selected on the basis of heat load calculation. Bidder has to submit heat load calculation of the various building including different area and bidder to furnish type of HVAC plant with technical details in his offer.

3.1.3 Outside atmospheric condition shall be referred as given elsewhere in process design philosophy of NIT.

Inside condition of various major areas under all weather condition i.e. summer, monsoon and winter shall prevail as under :



Area	Required Inside temperature	Required Relative Humidity
Sub Stations (Switchgear rooms)	25 ±1 °C	55 ± 5%
Rack rooms	25 ±1 °C	Rack room equipment OEM requirement to be followed.
PLC room	25 ±1 °C	PLC OEM requirement to be followed.
UPS room	25 ±1 °C	UPS OEM requirement to be followed.
Computer room	25 ±1 °C	OEM requirement to be followed.
Any other 'plant equipment' building / room	25 ±1 °C	OEM requirement to be followed.
Meeting rooms, conference rooms , executive separate Cabins/room , staff rooms, dining halls, Kitchens where human occupancy is predominant.	25 ±1 °C	55 ± 5%

Other plant building/ facilities shall also be equipped with adequate HVAC system by LSTK contractor.

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- 3.2** Refrigerant :
R-134a / equivalent and Eco-friendly refrigerant to be supplied & filled in the chiller units by LSTK Contractor.
- 3.3** Chilled units (with Centrifugal Refrigerant Compressor):
The compressor shall be of proven design based on national / international standards unless otherwise mentioned in specification.
Chiller units shall have proven track record of satisfactory operation for a minimum period of 8000 hours for process / power plant industry.
Casing hydraulic/pneumatic test pressure shall be at least 125% respectively of design pressures.
Refrigerant gas/water cooled oil cooler, thermostatically operated electric oil heater, oil pressure regulator, oil filter, shall form part of lubrication system.
Automatic capacity regulation feature is desired on compressor along with manually operated device.
Purge recovery unit, if required, shall be provided to efficiently separate out non-condensable gases and moisture from refrigerant as per Manufacturer's Standard.
- 3.4** Chiller units (with Screw Refrigerant Compressor- hermetic or semi hermit sealed units):
The compressor shall be of proven design based on national / international standards unless otherwise mentioned in specification and the offered model shall have proven track record of satisfactory operation for a minimum period of 8000 hours for process / power plant industry. The compressor shall be equipped with automatic unloaded starting arrangement. It shall have automatic sliding valve capacity control arrangement actuated through suction pressure sensor.
Compressor unit shall be complete with base frame, control desk with gauges, suction strainer, suction and discharge valves with check valves, drive motor, drive arrangement, motor driven oil pump / rotor shaft driven built-in oil pump.

Reciprocating Chiller Units shall not be acceptable.
- 3.5** Water cooled Condenser:
The tubes shall not be less than 12.5 mm diameter and shall be adequately supported to prevent tube vibration.
Condensers for rated AC plants shall have water boxes and covers to that each tube sheet can be exposed without disturbing the piping connections.
- 3.6** Evaporator / liquid cooler :
Tubes shall not be less than 12.5 mm diameter and Tubes shall be adequately supported to prevent tube vibration.
Condensers for rated AC plants shall have water boxes and covers to that each tube sheet can be exposed without disturbing the piping connections.
- 3.7** Refrigeration Packaging Assembly:
Skid shall be designed so as to provide maintenance accessibility and operation ease of valves and controls. Instruments shall be easily readable.
Lifting hook/eye shall be provided for handling of equipment during maintenance.
Steel structural members of the skid shall conform to IS-2062 / ASTM A 36.

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3.8

Air Handling Unit:

Air-handling unit shall be of double skin with insulation in sectionalized construction for convenient transportation and installation. The air handling unit shall comprise of filter section, damper section, heating section (if required), humidifier section (if required), cooling coil section, fan section and drain pan.

Cooling coil shall be minimum 4 rows deep .

Damper section shall have face and bypass damper. Bypass area shall not be less than 1/4th of the face area.

Filter section shall be provided with Chemical filters, as applicable.

Filters shall be selected for a pressure drop of maximum 4mm WG in clean condition.

Filters (prefilter + fine filter assembly) shall be capable of filtering up to 5-micron dust particles with an efficiency of more than 95%.

Inclined tube manometer with tubing shall be provided on AHU for indication of pressure drop across the filters.

Fan selection will have centrifugal type with electric motor. Fan rotating assembly shall be dynamically balanced. Flame resistant flexible bellow connection with metallic flanges shall be provided between fan outlet and duct.

Taper lock pulleys shall be provided with wedge type belts for drive. However, Direct coupled Fan with motor with flexible coupling shall be more preferred.

Grease cups shall be provided for fan bearings.

Drain pans for condensate shall be of stainless steel (18/8 grade) construction and thermally insulated. Water seal shall be provided in the drain outlet.

Ribbed neoprene rubber pads shall be provided as vibration isolators for the Air handling unit.

3.9

Chemical Filters :

Chemical filters shall be designed & selected by bidder for the indoor condition for Control room(s) and Sub-station(s) considering the worst surrounding atmosphere of plant.

Chemical filter shall be selected for the chemical media life of minimum 2 years. Outside gas concentration shall be considered while evaluating the life. Chemical filter's nomographs etc to be submitted by LSTK Contractor in support of the chemical media life.

Chemical air filter unit shall be skid mounted cubicle for horizontal installation.

Three stage chemical filter shall be provided.

Chemical filter shall have adequate provision for easy removal & servicing of filter packs. Bidder to provide differential pressure indication across filters and velocity across the filter shall be in range of 100-110 FPM.



3.10

Heating Unit :

Heating shall be preheating and / or Reheating as per psychometric Process requirement.

Heating shall be with electrical heaters.

Electric strip heaters, if provided, shall be complete with heating thermostats/humidistat, safety thermostats and contractors.

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3.11

Humidifier Unit:

Humidifier shall be stream pan type or water spray type.

Pan humidifier shall be complete with immersion type electric heaters actuated by humidistat, water float valve, stop valve in water make up line, level switch interlocked with heaters. Pan/ storage shall be fabricated with 18/8 grade stainless steel. The outer surface shall be thermally insulated.

Water spray type humidifier shall comprise of spray header, nozzles, arms , pump sets, humidistat, solenoid valve etc. Make up tank, water collecting trough complete with drain, quick fill, overflow, strainer make up connection with ball and float valve and isolating valves shall be provided.

Drain pan/water collecting trough of water spray humidifier shall be of stainless steel construction and thermally insulated.

The humidifier shall be sized to deliver 110% of capacity required.

3.12

Cooling Tower:

Cooling tower shall be natural or induced draft type in FRP construction. Cooling tower fan shall be of FRP blades directly mounted on the shaft of totally enclosed weather-proof (IP-55) motor with suitable weather proof canopy hood. The fan shall be protected by guard. The fan assembly shall be dynamically balanced.

Service ladder shall be provided for the cooling tower.

Water basin shall be made of F.R.P. and provided with suction strainer.

The cooling towers shall be provided with drift eliminator.

Supporting framework for the cooling tower shall be made of galvanized steel and further lined with FRP.

Cooling tower structure shall be designed to withstand wind load as specific, per IS-875.

Local lockable push button station in weather-proof enclosure with a canopy cover shall be provided.

3.13

Water Pumps:

Pumps shall preferably be back pullout type with mechanical seals.



Pumps shall be designed and selected by considering overall requirement of the AC plant , condenser water circuit and chilled water circuit, NPSH, pressure & temperature of the liquid etc and shall be provided with mechanical seal.

The pumps shall be complete with drive motor, coupling with non-sparking guard, common base plate, fixing and hold down bolts.

Bidder to note that nos. of chilled water pump & condenser water pump sets shall be selected as the numbers of chiller units plus one set of chilled water & condenser water pumps shall be operated as in standby mode. However, chilled water pumps and condenser water pumps shall have their respective common headers at inlet / outlet to ensure availability and inter-changeability of pumps in all condition.

3.14

If not specifically mentioned, all continuous operating machine shall have 100% stand-by.

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3.15 Refrigerant Piping:

All piping network shall be leak tested with nitrogen at 1.25 times of design pressure using soap water solution followed by electronic / halide torch leak detection. The piping network shall be further pressure tested with nitrogen at 1.25 times of design pressure for minimum 24 hours. After establishing the capability to withstand test pressure, the piping network shall be dried and vacuumized to 2.5mm Hg absolute. Vacuum shall be broken with dry nitrogen and the system shall be revacuumised to 2.5 mm Hg absolute. This vacuum shall be held for 12 hours before charging the refrigerant.

3.16 Water Piping:

All water piping shall be of Carbon steel and all chilled water and condenser water piping shall be complete with, flanges, fittings, valves , strainers, gasket & fasteners , hanger/ supports etc.

3.17 Fire Dampers:

Fire dampers shall be installed in supply air and return air path. These shall conform to UL555 for 1.5 hour fire rating.

The fire dampers shall be spring return, motorized & fail safe type with indication for open and Close position.

Fire damper operation shall be interlocked (through HVAC Panel) with the Signal from purchaser's fire and gas panel.

3.18 HVAC system interlocks with plant Fire and Gas system:

Unless otherwise specified, all the HVAC system of project will be interlocked with plant Fire and GAS system as follows complying to statutory requirement:

Fire alarm signal from fire and gas system to HVAC control Panel : Whole HVAC system shall shutdown.

3.19 Equipment Automatic Change over requirement :

Change –over from duty to stand-by equipment , in case of failure of the duty unit, shall be fully automatic.

Automatic Change over shall be provided to switch, on weekly basis, the duty and stand-by equipment , in order to ensure an even number of running hours for each units.

3.20 Expansion Tank (for Chilled Water System only):



Expansion tank shall be provided by vendor and installed at-least 1 m above the highest point of the system.

Tank shall be of minimum 500 liter capacity (unless otherwise required because of System design requirement) fabricated from 18/8 grade stainless steel min 3 mm thick with all requisite stiffeners.

The tank shall be complete with float valve assembly backed up with Gate valve for make up, quick fill gate valve, drain with valve and overflow.

Tank shall have rigid supporting arrangement. All piping and instrumentation shall be in scope of contractor only.

3.21 Portable AC/ Split AC/ Package AC shall be used wherever required with optimization of energy consumption. Minimum 3 star BEE-Star rating to be used for the same. Window AC shall be avoided. Adequate stand-by units are to be provided as per this specification.

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3.22 Plant Room Ventilation:

A.C. Plant room shall be forced ventilated by wall mounted exhaust fan(s) complete with electric motor, louver shutter and 18/8 grade stainless steel wire protection guard on intake side of exhaust fans.

The capacity shall be decided based on 20 air changes per hour.

Air intake weather protection louvers along-with bird protection screen shall be provided with suitable structural steel frame in wall.

3.23 Air Distribution, Ducting, Diffusers /Grilles:

Ducts shall be designed, fabricated and flanged as per IS-655 for static pressure up to 65 mmWG. In case, static pressure is more than 65 mmWG, SMACNA code shall be followed for design and fabrication of duct.

Duct hangers shall be supported with anchor fasteners in the roof. Anchor fasteners shall be provided by vendor.

All flange joints shall have minimum 6 mm thick Neoprene packing as gasket stuck to the flanges with adhesive (viz., resins like araldite or equivalent).

All the duct shall be made air tight with the help of sealant.

Ductwork shall be provided with following accessories.

- Turning Guide Vanes.
- Extractor with operating lever.
- Splitter Damper with control rod & locking device.
- Volume control Damper (opposed bladed type with 16 gauge with ~ 250 mm wide blades and 14 gauge casing of Galvanized Sheet Steel).
- Fire resistant flexible connection between duct chute and diffuser (if required).
- Access doors for heaters, fire dampers and filters.

Supply air diffusers or grilles, as required, shall be provided and shall be fitted with sponge foam tape. Volume control damper shall be provided with each supply air diffuser/grille. Volume control damper shall be key operated from the front of diffuser/grille. Supply air grilles shall be provided with vertical & horizontal adjustable louver

All return air diffusers/grilles, if required, shall be without volume control damper.

Diffusers/grilles shall be of powder coated steel construction with angle frame.

Diffusers/grilles shall not be supported from False Ceiling.

All ducting shall be designed and laid out as per requirement of various area of CCR Building so that an efficient layout may be done.

LSTK Contractor to submit a complete P&ID,GA of entire AC plant and duct layout proposed/ envisaged by LSTK Contractor for Owner's review and approval.

3.24 Insulation:



Surfaces to be insulated shall be thoroughly cleaned and allowed to dry.

Pneumatic/hydraulic test, if any, shall be carried out before insulation. Insulation material shall be high class fire resistant material and 'Non Combustible'.

a) **Hot Insulation:-**

Bare surfaces of pipe/equipment shall be provided with one coat of 20 micron min. (dry film thickness) heat resistant primer up to 125°C operating temperature.

Resin bonded mineral wool conforming to IS-8183 shall be used for hot insulation.

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Preformed pipe sections/mattresses of min. density 120 kg/m³ shall be used.
Hot insulation shall be clad with 24 SWG aluminium sheeting.

b) Cold Insulation:-

The pipes and duct shall be insulated and finished as per this specification.
Sound Attenuators shall be installed in ducts, as required.

For all inspection covers and hatches on equipment, pump casing, valve bodies & flanges more than 100 mm dia, the insulation shall be applied so as to facilitate removal without its damage. This shall be achieved by encasing the insulation in 24 gauge aluminium sheet metal sections, which are screwed together around the equipments to permit easy removal and replacement maintaining continuity of vapour seal.

The insulation materials shall be :

- i) Resin bonded fiber-glass of 24 kg/m³ density to IS: 8183.
- ii) Poly isocynurette of 32 kg/m³ density to IS: 12436.
- iii) Phenolic Foam of 32 kg/m³ density to IS: 13204.
- iv) Polyurethane Foam of 32 kg/m³ density to IS-12436.



The application, insulation material and recommended thickness are given in Appendix of this tech specification.

c) Underdeck insulation:-

Phenolic foam underdeck insulation shall be of rigid slab of 25 mm thickness and approx. 1000 mm x 500 mm size and shall conform to IS:13204. It shall have density of 32 kg/m³ and K value of 0.0034 w/mk at 53 deg. Mean temperature. The insulation shall be classified as 'Non Combustible' as per BS 476. It shall be pre-laminated on both sides with kraft paper.

Entire surface of slab and beams shall be thoroughly cleaned. Bituminous primer or zinc chromate primer shall be applied evenly @ 0.5 kg/m² over the entire surface. Hot bitumen or CPRX adhesive shall then be applied on the insulation panel @1.5 Kg/ m². The panels shall be pressed in position and further secured by dash fasteners.

Underdeck insulation shall be fixed only after all fixtures like hooks, clamps, cleats etc for light fixtures, ducts etc. have been fixed in the ceiling.

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3.25

Controls And Instrumentation:

Vendor shall include all controls & instruments as required for safety & operational requirements of the plant.

Automatic operation of all controls wherever feasible is required, with manual overdrive for maintenance etc.

All control shall be suitably interlocked for safe & sequential operation of plant generally in the following order:

- a) Start AHU blower.
- b) Start Cooling tower fan.
- c) Start Condenser water flow/condenser fan.
- d) Start Chilled water pump.
- e) Start Refrigeration unit/compressor.

While shutting down the plant, equipment will stop in the reverse order as listed above.



Humidifier heaters shall be actuated by humidistat.

Potential free contact shall be provided by vendor for closing motorised fire dampers and simultaneously tripping the AHU blower motor on receiving the fire signal from purchaser's Fire & Gas Panel. On expiry of fire signal, fire dampers shall open manually through reset button.

A) Requirements for Centrifugal compressor / chiller package:

The control panel shall be machine mounted In cubicle construction per manufacturer's standard design and shall have protection against following situation as a minimum.

- i) High condenser pressure.
- ii) Low oil pressure.
- iii) High bearing temperature switch for compressor.
- iv) Low evaporator pressure.
- v) Low chilled water flow.
- vi) Low condenser cooling water flow
- vii) Overload protection for all motors.
- viii) Low chilled water temperature.
- ix) Excessive vibration switch.
- x) Purge pump high discharge pressure.
- xi) High lube oil temperature to cut off heater supply.
- xii) Anti freeze.
- xiii) High Compressor discharge temperature.
- xiv) Oil Filter differential pressure.
- xv) To ensure opening of inlet guide vanes after compressor motor has stabilized.
- xvi) Motor current limiter.
- xvii) To ensure close guide vanes at start-up.
- xviii) Low water level in humidifier tank.
- xix) Air heater change over switch.
- xx) Air flow switch.

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B) Requirements for Screw compressor/ chiller package:

Local Control desk with gauges shall be machine .mounted in cubicle construction provided with:



- i) Suction & discharge pressure gauges.
- ii) Suction & discharge pressure switches.

The control panel shall be either machine mounted or floor mounted in cubicle construction as per manufacturer's standard design and shall have protection against following situations as a minimum:-

- i) Low oil pressure.
- ii) High bearing temperature switch for compressor motor.
- iii) Low oil temperature.
- iv) Low chilled water flow.
- v) Low condenser cooling water flow.
- vi) Overload protection for all motors.
- vii) Low chilled water temperature.
- viii) High lube oil temperature to cut off heater supply.
- ix) Anti freeze.
- x) High Compressor discharge temperature.
- xi) Oil Filter differential pressure.
- xii) Motor current limiter.
- xiii) To ensure minimum position of slide valve at start-up.
- xii) Low water level in humidifier tank.
- xiv) Air heater change over switch

The control panel shall be fully wired and factory tested before dispatch. The Control panel shall contain at-least the following control for the automatic operation of chilling unit.

- i) Compressor capacity control device.

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- ii) Start/stop push button station for the machine.
- iii) Automatic temperature controller for oil temperature and Chilled water temperature controller shall be of PID type.
- iv) Start/stop push button station for chilled water pump set.
- v) Operation indicating pilot lamps.
- vi) Vane opening indicator calibrated in percent (for centrifugal package).
- vii) Pressure Gauges for purge unit (for centrifugal package).

The entire control panel shall be factory wired and factory tested before despatch.



All controls such as fire damper motors, face and bypass damper motors, modulating type thermostat; high/low pressure switches, oil pressure switches, controls for actuating capacity control solenoid. valves, thermostatic expansion valves, pilot solenoid valves" flow/pressure switches, heater, heating thermostats, humidistat, and all necessary instruments for automatic, ,regulated and safe operation of the plant shall be included in the scope of supply and installation. All controls shall be suitably interlocked to operate the equipment' in their proper sequence.

Flow meters in chilled water and, condenser' water lines signal to control panel, temperature and Pressure Gauges in inlet and outlet of cooling water and chilled water shall be provided locally.

All electric motor driven equipments shall be provided with local Start/Stop Pushbutton stations for operational and statutory requirements. Stop push button shall be lockable type.

Vendor shall provide thermowells in- refrigerant circuit so as to enable to take readings for temperature of refrigerant at' various places of the circuit during performance testing.. Exact locations shall however, be finalised by Owner and vendor mutually during drawing approval stage.

Calibration of all instruments shall be done by Vendor.
Pressure gauges shall be provided with bleed and block valves.

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3.26 Audio-visual Annunciation Section:

It shall consist of facia type Annunciators having translucent plastic window of 35 mm x 50 mm (min.) size engraved with appropriate function in block letters for each 'alarm trip point. Annunciators shall be suitable for operation on 24V D.C. and shall have a single alarm buzzer common to all points. Three push buttons 'for audible alarm acknowledge, reset and test with appropriate name plates shall be provided common to all alarm points. Annunciators shall be solid state type of, reputed make. Annunciators shall operate satisfactorily between 80 .and 110% of rated supply voltage.

Annunciators shall be provided for all faults covering at least the followings:-

- a) Low oil pressure.
- b) Low chilled water flow.
- c) Low condenser cooling water flow.
- d) Low chilled water temperature
- e) Low evaporator pressure.
- f) High condenser pressure.
- g) Compressor motor overload.
- h) Low water level in humidifier tank.
- i) Chilled water pump motor over load.
- j) Condenser cooling water pump, motor over load,
- k) Air handling unit motors overload.
- l) Cooling tower fan motors overload.
- m) Treated water plump motors overload (in case ~water softening plant is furnished).
- n) Crankcase heater / heaters.
- o) Open/close position of fire/smoke dampers.
- p) Fresh Air fan status.
- q) Any other as necessary.



In the event of a fault, the particular window shall glow and the window will remain lighted till the fault is rectified. Minimum 20% spare windows shall be provided on annunciator.

3.27 **Motor / Driver rating :**

Electrical drivers (Motors) shall have power ratings at least equal to following percentage of rated absorbed power for all equipments :

Absorbed power (in kW)	Motor rating percentage of
< 22	125
22 - 55	115
> 55	110

4.0 **INSPECTION AND TESTING**

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Equipment shall be subjected to expediting, inspection and testing at vendor's/sub-vendor's Works by Third Party Inspection agency (TPI) as per NIT COMMERCIAL PART. Vendor shall submit Quality Assurance (QA) plan before commencement of fabrication. Approved QA plan by owner shall form the basis for equipment inspection. **TPI Cost shall be in vendor' scope.**



For Inspection and Testing at Site, vendor shall comply with the following procedures:

- I. All electrical items will be subjected to inspection at any stage. Routine electrical test as per relevant codes. Inspection of Manufacturer's test certificates.
- II. Inspection of raw materials to be used for fabrication and. assembly and inspection of manufacturer's test certificates.
- III. Inspection of welding including welder's qualification as desired by inspection engineer. Inspection of fabricated items.
- IV. Pressure testing of pipe fit ups for refrigerant and water services.
- V. Pressure testing, leak testing of complete piping network for chilled water/brine, condenser water & refrigerant services.
- VI. Vacuumising & gas/oil charging for refrigeration system.
- VII. Checking of electrical circuits (Power and control) and checking functioning of controls of refrigerant system and other circuits of air conditioning plant.
- VIII. Checking of assemblies for MCC, control panel, local panel (dimensional & functional), annunciation panel etc.
- IX. Checking of calibration of controls and instrumentation.
- X. Inspection of complete electrical installation at site and clearance from local authorities.
- XI. Installation of main equipments like compressor, condenser, chiller, evaporator, AHU etc.
- XII. Mechanical run test of AHU .

NOTE:

Inspection & testing procedure mentioned above is for general guidance & information of vendor and inspection by purchaser/consultant is not limited to these. Inspection engineer of Purchaser/consultant will have full right to have detailed inspection of vendor shop/ works. Co-ordination of inspection agency / purchaser/consultant with his factory/erection site will be sole responsibility of successful LSTK Contractor after placement of order for complete air conditioning plant covered under these specifications.

However, such inspection by Ownerside, shall in no way absolve the vendor of his responsibility.

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5.0 PERFORMANCE TESTING AND GUARANTEES:

Performance Testing

Vendor shall give two seasonal tests for (i) summer or monsoon (More stringent of the two) & (ii) winter to determine the equipment capacity and performance of the system in accordance with applicable Standards and as agreed with owner. For chilling package, performance test at site shall be as per ARI Standard based on the available load and cooling water temperature/ambient conditions. Period of each test shall be at least 48 hours or as agreed by Owner and time for each test will be fixed up mutually with the purchaser and/or his authorised representative.

The vendor shall operate, test and adjust all equipment and balance the system.

Following test readings shall be recorded during the performance testing:

Test Readings

1.Compressor

Refrigerant gas suction pressure	(kg/cm ² g)
Refrigerant gas suction Temperature	(^o C)
Refrigerant gas discharge Pressure	(kg/cm ² g)
Refrigerant gas discharge Temperature	(^o C)
Operating speed	(rpm)

Power consumption at 100% load and at each step of capacity regulation.

2.Chiller (for chilled water system only)



Refrigerant liquid temperature at inlet	(^o C)
Refrigerant Gas suction pressure	(kg/Cm ² g)
Refrigerant Gas suction temperature	(^o C)
Water flow rate	(m ³ / hr.)
Water temperature – entering	(^o C)
Water temperature – leaving	(^o C)
Water pressure – entering	(kg / cm ² g)
Water pressure –leaving	(kg / cm ² g)

3.Condenser

Refrigerant gas temperature at inlet	(^o C)
Refrigerant condensing pressure	(kg/cm ² g)
Refrigerant liquid temperature at outlet	(^o C)
Air / Water flow rate	(m ³ / hr.)
Air / Water temperature – entering	(^o C)
Air/ Water temperature –leaving	(^o C)
Water pressure – entering	(kg / cm ² g)
Water pressure – leaving	(kg / cm ² g)

4.Water Pump

Flow rate	(m ³ / hr.)
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Discharge pressure	(kg / cm ² g)
Suction pressure	(kg / cm ² g)
Operating speed	(rpm)

5. Air handling unit

Refrigerant liquid temperature at inlet to coil	
Air temperature - entering (D.B)	(⁰ C)
Air temperature - entering. (W.B)	(⁰ C)
Air temperature -leaving (D.B)	(⁰ C)
Air temperature -leaving (W.B)	(⁰ C)
In case of chilled water coils:	
Water pressure - entering coil	(kg / cm ² g)
Water pressure - leaving coil	(kg / cm ² g)
Water Temperature - entering coil	(⁰ C)
Water Temperature -leaving coil	(⁰ C)
Velocity of air in various sections of air handling unit.	

6. Electric motor

Starting current/ No load current	(A)
Motor terminal current	(A)
Power factor	
Supply voltage	(volts)
Kwh for Compressor motors	

7. Supply Air Grilles / Diffusers

Air flow rate	(m ³ / hr.)
Air temperature (D.B)	(⁰ C)
Air temperature (W .B)	(⁰ C)



8. Room conditions

D.B. & W.B., temperature, RH at different points

9. Air handling unit blower

Speed, static/total pressure, outlet velocity and air flow.

Vendor shall bring all required testing instruments at site duly calibrated. Plant shall be formally taken over by owner after witnessing the seasonal performance tests successfully as per terms & condition prescribed in NIT.

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Guarantee for Supply and Workmanship (Defect Liability) :

LSTK Contractor shall provide guarantee against workmanship, standard performance parameters and materials of their supply as per provision available in NIT. Guarantee shall be provided by LSTK Contractor for their supplied materials/ equipments and workmanship. In this period, if contractor's supplied item(s) fails during operation or not meeting standard performance parameters, then LSTK Contractor shall have to replace with new parts/ equipments without any additional cost to owner.

6.0 PROTECTION AND PAINTING:

All exposed carbon steel parts to be painted. Non-ferrous materials, austenitic stainless steels, plastic or plastic coated materials, insulated surfaces of equipment and pre-painted items need no painting.

Stainless steel surfaces, both inside and outside, shall be pickled and passivated.

Machined and bearing surfaces shall be protected with varnish.

Painting Specification shall be as per manufacturer standards..

The color of finish coat may be intimated to vendor, after placement of order.

7.0 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 and shall be properly packed. To provide adequate protection during 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 water-proof envelope shall be inserted in the package together with equipment.

Each equipment shall have an identification plate (made of SS material) giving salient equipment data, make, year of manufacture, equipment number, name of manufacturer etc

8.0 SPARE PARTS REQUIREMENT:



All erection, pre-commissioning & commissioning spares including spares consumed during testing / PGTR till handing over the plant to owner shall be supplied by LSTK Contractor free of cost. Any unused commissioning spares shall be owner's property.

Mandatory spares shall be supplied by the LSTK contractor as per NIT.

LSTK Contractor to also furnish separate recommended list of 2 years operation & maintenance spare part list along with budgetary offers, valid for 2 years from the date of submission of offer for owner's consideration .

Recommended spares and their quantities should 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.

Detail List of special tools & tackles shall be furnished by the LSTK bidder along with

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the bid and shall be in scope of supply of the LSTK contractor.

9.0 SPECIAL TOOLS & TACKLES:

Vendor shall provide one set of special tools & tackles as a minimum for operation & maintenance along-with HVAC plant.

10.0 TECHNICAL DOCUMENT REQUIREMENTS

Bidder shall furnish design calculations, Heat Load Calculations for all three seasons (Summer, Monsoon & Winter) with Psychrometric plots specifying the design TR capacity, dehumidified air quantity and Monsoon & Winter heating capacity.



Any other data over & above that furnished by Owner shall be referred from Handbook of ASHRAE and Climatological Data Book.

Bidder has to submit all Equipment list with power consumption , GA, Plant layout, Cross sectional drg, technical Drawings of all equipment , Data Sheets, specifications, catalogues, O&M Manual, QAP/ITP, pamphlets and other documents of all equipments in AC plant with their installation and operation & trouble shooting manuals. Bidder has to provide training to purchaser’s engineers / operation team for the operation and maintenance of the entire plant as mutually agreed with Owner.

11.0 ENGINEERING RESPONSIBILITY OF THE SYSTEM:

The responsibility of complete system design, manufacturing, erection, working and safety will solely be responsibility of the LSTK Contractor for the parameters as mentioned in the tender document and this philosophy.

The system after commissioning shall be offered to owner for PGTR with mutually agreed period/ duration. Thereafter, Owner will monitor the performance for standard designed parameters for the period agreed with owner. In case, during this period, performance is not found satisfactory and rectification / replacement, design improvement or any other change as felt necessary, will be made by the LSTK Contractor at no extra cost. Though, these improvements can only be done after getting the approval from the owner. Contractor shall provide supervision services from OEM (original equipment manufacturer) during erection, commissioning and PGTR of the system.

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APPENDIX-1

INSULATION MATERIAL AND THICKNESS

S. No.	Application	Insulation Material	From	Thickness (mm)
1	Supply / Return air duct	Resin bonded Fiber glass / equivalent	Slab / Roll	50
2	Outdoor Exposed supply / return duct	Resin bonded Fiber glass / equivalent	Slab / Roll	50
3	Refrigeration Piping	Polyurethane or Phenolic Foam or, Polysiocynurette	Pipe Section	50
4	Chiller	-Do-	Slab	60
5	Chilled water pumps	-Do-	Slab	40
6	Expansion tank & associated piping	-Do-	Slab	30
7	Chilled eater piping, valve, specialties	-Do-	Pipe Section	40
8	AHU Drain pipe	-Do-	Pipe Section	15
9	AHU Drain pan, coil & blower section	-Do-	Slab	15
10	Acoustic treatment	Resin bonded Fiber glass / equivalent	Slab/ Roll	40
11	Pan Humidifier	Resin bonded Fiberglass	Slab	75
12	Hot Water / Steam piping	Resin bonded Fiberglass	Pipe Section / Roll	75

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SECTION:VI – 3.2.3

DESIGN PHILOSOPHY – EOT CRANE & HOIST

PLANT : ELECTRICAL DISTRIBUTION SYSTEM

**PROJECT : INTEGRATED COAL BASED FERTILISER COMPLEX
AT TALCHER, ANGUL DISTRICT, ODISHA (INDIA)**

0	26.03.21	26.03.21	Issued for Enquiry	NY	ASR	RRK
REV	REV DATE	EFF DATE	PURPOSE	PRPD	REVD	APPD





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1.0 INTENT

- 1.1 Design, detailed engineering, manufacturing, shop testing & inspection, painting, supply, transportation to site, unloading and storage at site, load testing at site, final painting and Erection & commissioning, requisite statutory approval of Electric Over head Travelling Crane along with runway rails and supply of spare parts for crane as per the technical specifications, terms and conditions mentioned in this Technical Specification.
- LSTK Contractor to provide EOT Cranes of adequate capacity in various Maintenance Bay, Transformer House and other location wherever required for ease in operation and maintenance activities . Cranes to be provided in nearest multiple of 5 Metric Tonnes considering maximum weight to be lifted. Relevant Indian/ ISO Standards to be applicable for EOT Crane . The main hook capacity of each crane shall be minimum 25% over and above the heaviest component/ equipment to be handled. 15 T and above EOT cranes shall have 5T auxiliary hoist. All statutory guidelines to be complied by the contractor/ sub-contractor.



2.0 SCOPE OF SUPPLY & ERECTION

- 2.1 The scope of supply & erection shall be, but not limited to, the following:

Sl. No.	<u>Description</u>	<u>Qty & Scope (Location wise)</u>
1.1	Design, Engineering, Manufacturing, Testing, Inspection, Supply, Erection & Commissioning of suitable capacity EOT Cranes including its drives and all other relevant electricals	Bidder to furnish
1.2	Runway Rails for crane along-with necessary fixtures for fixing the rails on structural steel girder, along-with electrical interconnection for the earthing of rails.	Bidder to furnish
1.3	Mechanical stoppers on both the ends of runway rails for LT motion and for CT motion.	Bidder to furnish
1.4	Festoon flexible cable type down-shop leads system along with necessary insulators, brackets, lighting etc.	Bidder to furnish
1.5	Access ladder, Platform and safety handrail for EOT cranes	Bidder to furnish

2.2 CODES AND STANDARDS

The Design, manufacture, performance and testing of the EOT crane as specified herein after shall comply with the requirements of the applicable latest standards and codes of practice. The latest standards with all amendments shall be followed in particulars.

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IS:3177 code of practice for overhead traveling Crane and Gantry crane other than steel work crane.

IS:2365 steel wire suspension ropes for lifts elevators and hoists.

IS:807 code of practice for design, manufacture, erection & testing of crane and hoists.

IS:3443 crane rail section.

IS:3815 point hook with shanks for general Engineering purpose.

IS:800 code of practice for use of structural steel in general building structure.

IS:2062 weldable structural steel.

IS:3681 spur and helical gears.

IS:3734 dimensions for worm gearing.

IS:1364 precision and semi-precision, hexagonal bolts, screws, nuts and locknuts.

IS:816 code of practice for use of metal arc welding for general construction in mild steels.

IS:1181 qualifying test for metal arc welders.

IS:1323 code of practice for oxy-acetylene welding for structural work.

IS:3961 recommended current rating of cables.

IS:282 hard drawn copper conductors for overhead power transmission.

IS:2147 degree of protection provided by enclosures for L.V. switchgear and control gear.



IS:2959 contactors for voltage not exceeding 1000V AC or 1200V DC.

IS:2208 HRC cartridge fuse links for voltage above 650V.

IS:4047 heavy duty air break switches not exceeding 1000V.

IS: 5749 forged rams horn hooks.

The material of various components shall be in accordance with relevant IS or equivalent international standard.

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3.0 GENERAL DESIGN REQUIREMENTS:

Whole supply & erection shall conform to the following standards and specifications except as modified herein:

The Vendor shall be responsible for complying with any other statutory requirements governing the work.

DESIGN OF MECHANISM

For the hoist mechanism of cranes electric motor shall be connected to the reducer through floating shaft and half geared couplings. Coupling of the output shaft of the reducer to single or double drum shall be by means of geared coupling.

BEARINGS

All running shafts and wheels running on fixed axle shall be fitted with sealed antifriction ball or roller bearings.

COUPLINGS

1. All couplings shall be gear couplings, except that rigid coupling may be used on long transmission shafts.
2. All couplings shall be of steel. Cast Iron shall not be used.

GEARINGS

All gear boxes shall be in totally enclosed construction and gears shall be spur or helical type with machine cut teeth suitably hardened and tempered and shall conform to AGMA standard. The surface hardness of pinion shall be between 255 to 300 BHN and for gear 217 to 255 BHN. Difference in hardness of pinion and gear must not be less than 20 BHN.

For Accurate fixing of unit mechanism (reducer, brakes, motor etc.) and as well as to exclude the possibility of misalignment while working, support surfaces shall be machined level.



TRACK WHEELS

In case where crane and trolley have more than four wheels, balancers shall be used.

The body of the balancer may be fabricated from steel plates or from cast steel.

BRAKES

Hoisting Motion: - The brake shall be automatic electro-mechanical or thrusters release brake applied directly to the hoist motor shaft.

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Traversing Motion: - The traversing motion (CT) of every electric overhead travelling crane shall be fitted with an automatic electro-mechanical brake irrespective of traversing speed.

Capacity of hoist brakes shall be determined as follows:

$M_t = K \cdot M_{ct}$ Kg-m where,

M_{ct} = Static Moment on the braking shaft, due to action of the load, considering the maximum efficiency of the mechanism.

K= Co-efficient of reserve of braking, taking from following figures, corresponding to the class of duty of the mechanism.

For light duty (Class I)	K = 1.5
Medium duty (Class II)	K = 1.75
Heavy duty (Class III)	K = 2.0

Manufacturer to consider Heavy duty co-efficient (K=2.0) of reserve of braking and shall be compliant to IS: 3177.

In case of hoist mechanism with two drives, each drive must have at least one brake. Co-efficient of reserve of braking of each brake is taken not less than 1.25, considering that the full load can be held by one brake.

In case where two brakes are used for each of the two drives co-efficient of reserve of braking must not be less than 1.1 for each brake.

Required capacity of braking in case of traverse and travel motions shall be 0.8 – 1.0 times the static moment on the respective braking shafts due to action of inertial forces, considering maximum efficiency of the mechanism.

Brake drums shall preferably be made of steel castings or steel forging.

HOOKS

Hooks shall conform to the relevant Standards.

The crane hooks shall be provided with spring loaded safety locking arrangement.



No repair work on hook made to shall be allowed without prior approval from purchaser.

MEANS OF ACCESS

Platforms: - An adequately guarded platform minimum 750 mm wide shall be provided on both sides for the full length of the bridge. All platforms and ladders shall have non-skid chequered plate treads and shall be provided with handrails and toe guards. Opening on guard railings for access from outside shall be provided with safety chains.

The access ladder to EOT assembly from G.L. shall be suitably located avoiding any hindrance to EOT travel

LUBRICATION

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All the grease points shall be brought to a safe and easily accessible place which shall be prominently displayed.

All gear boxes shall be fully enclosed type prohibiting ingestion of outside dust, oil and moisture. Gear shall be compliant to AGMA/ IS:4460. There will be no centralised lubrication system.

BUFFERS

Bridge of crane and trolley shall be provided with buffers for soft dashing with end Stop. Buffers ends should be made of rubber or iron & wood.

Welding: Welding shall be in accordance with relevant Standards.



ELECTRICAL DESIGN

All electrical including electro-magnetic brakes, limit switches, cables, wirings, lightings etc. shall be in accordance with the Electrical Specifications enclosed.

4.0 SPECIFIC DESIGN REQUIREMENTS:

The Cranes shall be suitable for the duty conditions as given in the specifications sheets.

- 4.01 Material of construction must be well proven for the required services.
- 4.02 Cranes shall be suitable for outdoor installation but placed under the roof.
- 4.03 All gear boxes shall be fully enclosed type.
- 4.04 The rail and roller support for the flexible cable shall be designed for maximum reliability and minimum maintenance requirements. The roller supports shall be interconnected by flexible steel wire in order to protect the flexible cables against mechanical stress. DSL trolleys shall be provided with four wheels. Rollers should not require greasing.
- 4.05 Mechanical safety lowering brake shall be supplied by the Vendor which shall be capable of holding the test load in addition to electro hydraulic thrusters brake for all the hoisting motions.
- 4.06 The Vendor shall provide non-sparking type aluminium guards for couplings.
- 4.07 The Vendor shall, if required, provide a clearance certificate from a Competent Authority regarding following the safety rules and regulations.
- 4.08 All the Bearings shall be antifriction type. Bush Bearings are not acceptable.
- 4.09 1 No. rotary type and 1 No. gravity type limit switches will be provided for each crane/ hoist.

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- 4.10 2 Nos. one way lever type limit switch will be provided for trolley and 1 No. anti-collision device and 1 No. one way type limit switch will be provided for LT.

Anti collision device will consist of 1 No. one way lever type limit switch and striker arm.

- 4.11 Micro speed arrangement on main hoist, CT *and* LT will be achieved through separate sq. cage motors, 1 No. thruster brake and planetary gear box arrangement.

4.12 Installation

The cranes shall be placed on rails at an suitable elevation of equipment/ train building and shall be operated from pendant push-button boxes.

The flexible supply cables shall allow operation of the cranes in the full length of the equipment/ train building.

5.0 BATTERY LIMITS

The following items are excluded from the supply from EOT Crane Manufacturer :

Building structure including beams supporting crane rails.
Gangways and ladders along building walls.
Earth connection to gantry rails.

- 5.1 It is the obligation of the vendor / OEM to ensure supply of complete package of EOT Crane.
- 5.2 However, all requisite regarding supply, erection, commissioning covering wide spectrum of project shall be LSTK Contractor's responsibility.

6.0 EXTENT OF SUPPLY & ERECTION

6.1 General



Supply includes Design, calculations and all materials and services needed for satisfactory and safe operation of the cranes including :

erection on site
pre-commissioning and start-up
load testing which will be performed after erection.

- 6.2 The supply shall include but not be limited to:-

6.2.1 Design, engineering and fabrication.

6.2.2 The electrical equipment including isolator, flexible feeder cables/internal connection

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and the control system as per electrical specifications.

- 6.2.3 The roller supports, fixing material and rails for flexible supply cables.
- 6.2.4 Crane rails including support plates, cleats, etc. and electrical inter-connections for earthing of rails.
- 6.2.5 Mechanical stops and buffers for LT & CT motions.
- 6.2.6 Gangways and steps on the cranes but not on the building.
- 6.2.7 Workshop tests according to Clause No. 7.0
- 6.2.8 Painting according to brief specification as described in Article 9.0
- 6.2.9 The documentation in accordance with NIT/ITB.
- 6.2.10 The spare parts for 2 years operation as per NIT/ITB.
- 6.2.11 Inspection programme as per Clause No. 7.0
- 6.2.12 The name plate in the English Language with indication of max. Permissible load.
- 6.2.13 Alignment of sole plates, erection and alignment of rails, and down shop leads including supporting arrangement for DSL, wherever required.

7.0 INSPECTION, TESTING & REPAIRS



- 7.1 Inspection & Testing programme shall be furnished by the Vendor after placement of order for OWNER'S approval.
- 7.2 Inspection and testing shall conform to relevant standards.

Parts found defective or not conforming to the Standards as to workmanship or materials shall be rejected and replaced by the Vendor free of cost.

Waiving of inspection or acceptance of material or equivalent by the purchaser shall not relieve the manufacturer from the responsibility of furnishing material or workmanship in accordance with the relevant Standards.

All welding shall be carried out by qualified welders. Manufacturer shall furnish evidence acceptable to Third party Inspector of qualification tests of welders as required by relevant Indian Standards. All welding shall be subject to inspection by TPI, who will have the option to call for radiography or other non-destructive examination of welds to check soundness.

The main bridge girder shall be completely radiographed and radiographs produced. However, butt welds of bridge girder will be 100% radiographically tested on tension zone and 25% at random on compression zone.

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7.3 TESTS AT MANUFACTURER'S WORKS

All electrical and mechanical equipment shall be tested in accordance with the appropriate Standards at either the crane maker's or the equipment manufacturer's works and test certifications shall be furnished.

The cranes shall be tested at manufacturer's works under no-load. Travelling gear may be run light to check shaft and gear alignments.

TESTS AT SITE

For testing of electrical installation, refer Electrical Specification.

Test for Operation:

After the supply has been connected, and before the complete crane installation is put into commercial service, tests shall be carried out to prove the following :

Satisfactory operation of all motors under no-load conditions.

The satisfactory operation of each controller, switches contractor, relay and other control devices and in particular the correct operation of all limit switches under the most unfavourable conditions:

The correctness of all circuits and interlocks and sequence of operation.

The satisfactory operation of all protective devices:

The satisfactory operation of each motion of the cranes.

The compliance of the crane with the specified performance requirements: and

Tolerance on specified speeds at full load shall be with $\pm 10\%$.



7.4 DEFLECTION TESTS:

The deflection test shall be carried out *at site* with the safe working load at rest and with the crab in a central position. The measurement shall not be taken on the first application of the load. The datum line for measuring the deflection shall be obtained by placing the crab on the extreme end of the crane span with smaller hook approach.

7.5 OVERLOAD TESTS:

After tests but before the crane is put into service, it shall, with overload relays approximately set, be tested to lift and sustain a minimum test load of as per codes & standards requirement.

During the overload test each motion in turn shall be manoeuvred in both directions and the crane shall sustain the load under full control. The specified speeds need not be attained but the crane shall show itself capable of dealing with the overload without difficulty.

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8.0 PREPARATION FOR SHIPMENT

- 8.1 Each transport unit shall be suitably prepared for shipment, properly braced and loose parts secured to prevent damage during shipment. All material shipped shall be properly marked with the item number for which it is intended by means of a metal tag.
- 8.2 The vendor shall give all information concerning the protection needed for preservation of the equipment.

9.0 PAINTING

Painting shall be as per manufacturer standard and appropriately chosen for owner's site condition.

10.0 SPARES

- 10.1 All erection, pre-commissioning & commissioning spares including spares consumed during testing / PGTR till handing over the plant to owner shall be supplied by LSTK Contractor free of cost. Any unused commissioning spares shall be owner's property.
- 10.2 Mandatory spares shall be supplied by the LSTK contractor as per NIT.
- 10.3 LSTK Contractor to also furnish separate recommended list of 2 years operation & maintenance spare part list along with budgetary offers, valid for 2 years from the date of submission of offer for owner's consideration .
Recommended spares and their quantities should 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.
- 10.4 Detail List of special tools & tackles shall be furnished by the LSTK bidder along with the bid and shall be in scope of supply of the LSTK contractor.



11.0 DRAWINGS AND DOCUMENTS:

The drawings, documents and data to be supplied after placement of the order shall be as per NIT.

12.0 GUARANTEE:

The crane shall be guaranteed by the supplier to be of accepted design, free from inherent defects in either workmanship or materials and to safely handle its rated capacity load without any undue deflections on its structure or mechanism. Any part proving defective within the warranty period shall be replaced free of charge by the Vendor.

12.1 Performance Guarantee:

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The cranes with its drives and other equipment shall be tested at site to verify the electric consumption, various speeds, deflection and other performance figures guaranteed by the Vendor.

Noise levels at 1.0 M distance from package machine's surface shall not exceed 85 d B(A).

13.0 PRIORITY:

In case of any conflict between the data sheets & the technical documents referred / enclosed, the information given in data sheets shall govern.

14.0 SUB-VENDOR(S):

The Sub vendor / manufacturer/ Supplier must have supplied similar model, size for two similar installations & service which are working satisfactorily. Feed Back report for the same shall be furnished to Owner / PMC prior to placement of order.

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PART II: TECHNICAL



SECTION – VI

PART 3.3

DESIGN PHILOSOPHY – CIVIL & STRUCTURAL WORKS



PROJECT: ELECTRICAL DISTRIBUTION SYSTEM

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1.0 DESIGN PHILOSOPHY FOR SCOPE OF WORK - CIVIL & STRUCTURAL WORK

This section of the Tender Documents deals mainly with the Scope and Technical Specifications needed for the Detail design, preparation of detailed Drawings and getting the design/ drawings approved by Owner/Consultant, execution and construction of complete Civil, Structural and other Allied Works on turnkey basis.

The scope of Civil Structural and Architectural Works under this Contract shall include carrying out Grading & Leveling, Detailed Design, Drawings, Supply, Procurement of all materials, Construction, Demolitions, Supervision of all relevant Civil and Structural Works including providing all labour, supervision, material, scaffolding, construction equipment, tools, tackles and plants, supplies, transportation, all incidental items though not indicated or specified but reasonably implied or necessary for successful completion of the project.

There are three buildings and foundations in the scope:

1. Main Receiving Sub Station (MRSS)
 2. OUSS
 3. GIS Building with EOT crane facility
 4. Foundations of all electrical equipments
 5. Parking Shed
 6. Any other requirement as described in Electrical section
- The Sub-Station buildings shall be a double storied RCC framed building with Hollow/solid block work/Brick work side covering and flat roof at top. The ground floor shall be utilized as cable cellar for installation of cable trays. The first floor will have LT/HT panels, UPS & battery room, operator's room & toilets. The switchgear area of substation shall be column less design. The access to first floor shall be provided through of R.C.C. staircases as per NBC guideline. Transformer bay will be on the rear side of the building, provided with covered RCC roof with gate. Chain link fencing & gates for transformer which shall be kept in open. Separating walls shall be provided between transformers. The separating walls between sub-station

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and outdoor transformer bays shall have four hour fire rating. Switch gear room shall be having heavy duty epoxy flooring as per the specifications given within this NIT. Rest of the rooms will have heavy Duty Decorative Ceramic Tiles on floor.

- GIS building shall be double story building adjacent/attached to the MRSS substation and shall be having facility of washroom also.
- Chain link fencing around the whole EDS area may also be considered.
- Parking shed for Substation Buildings etc of appropriate size minimum 10 nos. cars.
- Development of green area with landscaping and horticulture (around the building in the free area) shall also be considered.
- Access and Internal roads (within Battery limit) shall also be included.
- The scope of work includes providing all required services such as HVAC system, water supply, conduiting provision for LAN, drainage system, storm water drains around the buildings, sewage system etc.
- Rain water harvesting is mandatory for substation buildings.
- Fire Fighting system

For more details regarding scope of work, Electrical engineering specifications and further clauses shall be followed.

Scope of the CONTRACTOR shall include but not limited to the following:-

- a) Engineering related to site leveling & preparation.
- b) Preparation of concept notes for design, engineering & construction.
- c) Structural Analysis and design calculations as per specifications laid down in Civil Engineering Design Basis, enclosed in the tender. for all Civil works including but not limited to pile, pile-cap, foundation, plinth beam, RC superstructure, steel super structure, RC underground structures and water retaining structures, trenches, drains, pits etc.
- d) Architectural design and drawings including details for doors, windows, partitions, false floor, false ceiling, toilet, finishes etc.

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- e) General Arrangement and detail design drawings for foundations, plinth beams etc.
- f) General Arrangement and structural drawings at grade level showing foundations, extent of paving, trenches, drains, pits etc.
- g) General Arrangement and detail design drawings for superstructure (RCC and structural steel) at all levels.
- h) RCC drawings showing all necessary details for all foundations and structures.
- i) Structural steel detail drawings for all steel structures.
- j) General Arrangement and detail drawings for access roads, storm water drains, , cable trenches, sewerage, manholes, pits, sumps with all necessary details.
- k) Bar Bending Schedules for all RCC works.
- l) Fabrication drawings with all details for steel structures.
- m) Coordination with OWNER / PMC for various activities including approvals of design basis, concept note, drawings, material samples, laboratory test results etc.
- n) Procurement of all items necessary for completion of scope of work.
- o) Construction of all units / structures, items of work included in scope of work.
- p) Preparation of as built drawings & final documentation.
- q) Obtaining Statutory Approvals.
- r) Adherence to Quality Assurance Plan



Detailed Scope of Work is as follows:

1.1. Soil Investigation

- 1.1.2 Soil Investigation has to be done by the contractor and shall be provided to Owner/PMC for information.
- 1.1.3 The CONTRACTOR shall adopt foundation per requirements of structure, loads, settlement & other design criteria. The CONTRACTOR shall design and construct all foundations as per requirements of soil investigation report with no extra cost to OWNER / Project Management Consultant (PMC).

1.2 Land Development Plan

The Land development plan of plant area is attached with the Tender.

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1.2.1 Site Conditions

At bidding stage, the CONTRACTOR shall visit the site and study the existing site conditions & existing structures if any.

1.3 Grading

Fairly Graded land shall be provided to the Bidder. However, micro-grading up to 300 mm, as required shall be done by the bidders in their respective areas.

1.4 Disposal of surplus earth

The CONTRACTOR shall dispose-off all surplus and unserviceable earth (if any), outside the plant in accordance to local Governing authority, at his own cost.

Disposal shall be done at a place outside the plant, with the consent of the OWNER. Location of disposal area shall be decided by the CONTRACTOR and the required necessary approvals from the local bodies shall be the CONTRACTOR's responsibility.

1.5 Site cleaning

During construction and on completion of construction (inclusive all internal and external finishes), cleaning all the debris, waste materials scattered in and around the site and disposal of the same shall be in the scope of the CONTRACTOR with the consent of the OWNER.



1.6 Roads

The contractor is responsible for all access/internal roads (which shall be RCC roads) for equipments within its battery limit and connectivity to the nearest plant road.

Drawing of plant road outside bidders battery limit is attached for reference.

1.7 Surface Drainage

The scope of work includes also providing all internal services such as water supply, sanitary sewerage, drainage and storm water drains around the Substation buildings etc. and their connection to external prevailing facilities complete in all

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respects. All the above work shall be carried out strictly in accordance with the "Technical Specifications (ES- 2517)" enclosed with the tender.

1.8 Contaminated Rain Water System and Oily Water Sewer (OWS) System

DELETED

1.9 Sewage Disposal

The CONTRACTOR scope is to provide proper underground drainage system for sewage disposal and its connection to Sewage treatment plant for Substation buildings.

1.10 Paving

Paving (150mm thick) around major structures etc. shall be provided, if required.

1.11 Structures buildings etc.

Contractor's scope shall include RCC Sub-station buildings, pits, cable trench, DG sheds, transformer and DG foundations etc. as per the mentioned in this tender document, required for the complete execution and commissioning.

1.12 Surface Finishing's

The CONTRACTOR shall be responsible for complete planning and detailing of all surfaces finishes viz. painting, flooring etc as per specifications given in the Tender.



1.13 Acid / Alkali Proof Lining

The CONTRACTOR shall be responsible for surface treatment of floors, exposed portion of foundations, pits and basins against acid / alkali as per design requirement. Switch gear room shall be having heavy duty epoxy flooring.

1.14 Anti-termite Treatment / Damp proof course / Water proofing

The CONTRACTOR shall provide anti-termite treatment, damp proof course and water proofing.

1.15 Miscellaneous

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These shall include local platforms, pipe sleepers, local foundations, local supports, etc. as per requirement.

1.16 Engineering and construction

Preparation of detailed design, drawings, supply and construction of all civil, structural, architectural, plumbing & sanitary and building works shall be in the scope of contractors work.

1.17 Removal of Underground and Above Ground Structures

All above ground structures will be demolished by Owner. All underground facilities/structures shall be demolished/ removed by the Contractor provided removal of former will not disturb the functions of existing plant. Rerouting of cables / pipes, etc. encountered during excavation in the plot shall be in Bidder's scope of work. Existing piles if any, needs to be adjusted while making new piling/foundations.



In the event, CONTRACTOR encounters any underground obstructions which entails cost and/or time implications to CONTRACTOR, the CONTRACTOR shall be entitled to submit CHANGE ORDER request. The decision of the PROJECT MANAGER (Owner/PMC) 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 the PROJECT MANAGER, the dispute shall be settled as per the provisions of Clause 39.0 of GCC.

1.18 Transfer of benchmark

The Benchmark will be made available inside plant premises. However, the CONTRACTOR shall provide two more Benchmarks near the Substation buildings..

1.19 Sizing of various facilities

Sizing, nos., location etc. of various facilities viz. buildings, , structures, equipments, etc. shall be in the scope of the bidder.

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Any change of sizing, addition of any structure / facility, indicated by Owner/PMC during design stage, based on functional requirements and as well as local rules and regulations, etc, shall be in the Contractor's scope, at no extra cost to OWNER / PMC.

1.20 Scope of work in outside battery limit (OSBL) Area

As mentioned in Electrical section

1.21 Rules and regulations

All the facilities shall conform to all Local Rules and Regulations, Factory Inspector, Rules, TAC rules etc. whichever is more stringent.

Getting the approval of the various documents through the various authorities shall be in the Contractor's scope at no extra cost to OWNER / PMC.

2.0 DETAILED ENGINEERING



2.1 General

2.1.1 The CONTRACTOR shall carryout Analysis and Design of the structures required for this document and shall prepare all the required Architectural, Civil and Structural drawings needed for correct and accurate construction as per the Design Specifications given in this document.

2.1.2 The CONTRACTOR shall submit a Detailed Schedule for release of documents and drawings for review / approval to PMC/CLIENT, within 2 weeks/or mutually agreed period of date of award of the Contract. Such a schedule shall be made in line with the overall Project Schedule given in the document. The CONTRACTOR shall strictly adhere to the approved schedule.

The Format of Submission of the above mentioned schedule shall be mutually discussed and finalized after award of the job.

2.1.3 Construction of various structures / facilities, whose designs and / or drawings are specially identified in the document submission requirements for approval by PMC,

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shall not be taken up for construction at site till they are approved by PMC and comments given by PMC are incorporated.

For other structures / facilities, the CONTRACTOR shall directly submit the Approved for Construction (AFC) drawings to PMC for information before, taking up construction.

- 2.1.4 It shall be the responsibility of the CONTRACTOR to accommodate all the functional requirements such as access, cutouts, clearances, interference etc. while designing / detailing of various structures / facilities.
- 2.1.5 Complete analysis, design and all drawings of each independent structure / facility shall be submitted in one lot so as to facilitate overall systematic review by PMC.
- 2.1.6 Only after the necessary architectural drawings are approved by the OWNER / PMC to their satisfaction, then the design drawings shall be reviewed and approved by PMC.
- 2.1.7 The CONTRACTOR shall keep the OWNER / PMC informed of any major design revisions simultaneously in progress.

2.2 Design calculations

The CONTRACTOR shall prepare the design calculations based on the standard accepted practice and guidelines from PMC / OWNER.



All design calculations shall be written systematically, legibly and submitted in Staad files, excel sheets as well as pdf for approval.

For structures, analysis and design shall be done on latest version of **STAAD-PRO SOFTWARE**.

For other miscellaneous works, Excel and Word shall be used. Design calculations shall be done on A4 size sheet only.

2.3 Drawings

The CONTRACTOR shall prepare



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- Civil & structural design & construction drawings, architectural drawings based on the standard accepted practice and guidelines from PMC / OWNER.
- Bar bending schedules.
- Fabrication drawings.
- As-built drawings.
- Detailing / drafting shall be done on AUTOCAD Latest Version only. Drawing size used shall be preferably of A1 size only. For foundation layout, drainage plans and paving plans, A0 size drawings can be used if necessary.

3.0 CONSTRUCTION

3.1 General

- 3.1.1 Construction of all civil and structural works including all material, labour, Supervision, tools and tackles etc. shall be carried out by the CONTRACTOR
- 3.1.2 Procurement and supply of all materials viz. cement, reinforcement, structural steel etc. shall be in the scope of CONTRACTOR.
- 3.1.3 All materials shall be procured in consultation with the Owner or as per the approved vendor list given elsewhere in this document. All materials of construction must be of ISI approved brand.
- 3.1.4 All materials and construction shall conform to the specification given elsewhere in this document.
- 3.1.5 Materials of construction, construction methodology etc. shall be such, so as to protect the structures and foundations against the harmful effect of chemical, fumes etc. present in the plant, its vicinity, in ground and / or subsoil water.

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- 3.1.6 The CONTRACTOR shall be responsible for obtaining the statutory approval from local authorities such as Inspector of Factories, Development Authorities, Municipal Corporation and other concerned authorities before starting the work.
- 3.1.7 The CONTRACTOR shall ensure that the facilities are constructed in accordance with the APPROVED FOR CONSTRUCTION drawings and specifications.
- 3.1.8 The CONTRACTOR shall maintain and operate an adequate system of control of availability of latest drawings and specifications, at all the places where work is performed.
- 3.1.9 Construction shall include excavation in all types of soils / rock inclusive of necessary dewatering as applicable.
- 3.1.10 The CONTRACTOR shall redo / repair all the existing facilities viz. roads, paving, drainage etc. which are damaged during transportation, construction and erection activities performed by him.
- 3.1.11 Rain water harvesting is mandatory for Substation buildings as well as all major buildings having roof area more than 100 sq m.

4.0 Quality Assurance Plan



Contractor shall ensure the quality of civil works by supervision /inspection and provide test results to Owner/PMC for information. The Quality Assurance Plan is attached for reference as Annexure VIII and the contractor is obliged to follow it.

5.0 COMPLETENESS OF WORK / CONTRACT

- 5.1 The scope of work mentioned in the contract/NIT is not the comprehensive one, but gives total idea/outline of the scope of work; however contractor shall be responsible for completeness of the job for the purpose indicated elsewhere to make the system fully functional and operational.
- 5.2 In case there is any conflict in the specifications appearing in different contractual documents then the specification whichever is stringent shall be applicable without any technical or commercial implications.



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- 5.3 The work furnished shall be complete in every respect with all mounting, fittings, fixtures and standard accessories etc. normally provided for such item/equipment and or needed/required for erection, completion and safe operation of the item/equipment/system as required by applicable codes though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions.
- 5.4 Any additional items and materials which are not specifically mentioned but are required to complete the system offered, in every respect in accordance with the technical specifications and required for safe operation and guaranteed performance shall also be deemed as included in the scope of work of this tender. Contractor shall not be eligible for any extra payment in respect of such mountings, fittings, fixtures, accessories etc. which are needed/required for safe operation of the item/ equipment/system, as required by applicable codes of the country though they may not have been explicitly spelt out in the NIT/Contract.

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ANNEXURE - I

DESIGN PHILOSOPHY – ARCHITECTURAL

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1.0 GENERAL

1.1 SCOPE

The design philosophy defines the minimum design requirements and procedures for carrying out architectural design and engineering of buildings covered under this project. Relevant criteria shall be taken into consideration to achieve satisfactory and trouble free performance of the facilities.

1.2 UNITS OF MEASUREMENT

Units of measurement in design shall be in metric system.

1.3 DEFINITIONS



CCE	Chief Controller of Explosives
TAC	Tariff Advisory Committee
NFPA	National Fire Protection Association
IS	Bureau of Indian Standards

1.4 CODES AND STANDARDS

The design shall be in accordance with established codes, sound engineering practices and shall conform to the applicable statutory regulations.

The main codes, standards and statutory regulations considered as minimum requirements are as follows. Latest revision of these shall be followed.

- 1.0 National Building Code of India
- 2.0 Factories Act of State
- 3.0 Local Municipality or any other Authority's Bye-laws as applicable.
- 4.0 Bye-Laws applicable of Town & Country Planning Organization.
- 5.0 Code of practice for building bye-laws IS : 1256

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- 6.0 TAC (Tariff Advisory Committee) Rules
- 7.0 Indian Electricity Rules
- 8.0 Bureau of Indian Standards

Note: The above list is suggestive and not exhaustive. Apart from the basic codes any other related codes shall also be followed wherever required.

1.4.1 Order of Precedence

In case of any conflict / deviations amongst various documents, the order of precedence shall be as follows:

- Statutory Regulations
- Job Specifications
- Engineering Design Basis
- Standard Specifications



2.0 DESIGN PHILOSOPHY / CRITERIA – GENERAL

2.1 ARCHITECTURAL DESIGN

Architectural design of buildings / sheds shall be in accordance with this design basis and references as stated herein, to facilitate the intended functions. The various types of requirements to be considered are described further. In Plant Area no underground/ basement shall be provided in the building (apart from functional requirement of the system).

2.2 BUILDING REQUIREMENTS

2.2.1 Spatial, Functional and Utility Requirements

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Toilet, Drinking water, First Aid enclosures, emergency exits shall be mandatory requirement for occupied buildings / sheds. Other facilities shall be provided as required.

Utility spaces shall also be taken care which materialize due to provision of services like air-conditioning, pressurization, fire fighting, electrical, telephone, LAN etc.

Max distance to an exit from any point in a building shall not exceed 30 m. A minimum of two staircases and two exits per floor shall be provided in each building. Width of passage / corridor shall not be less than 1500 mm.



2.3 BUILDING SERVICES

Following services shall be provided for all building / sheds as essential services. Drinking water provisions, including one number water cooler per area (of approx 20 m x 20 m) shall be provided within an enclosure separated from the toilets. Space for janitor shall be provided in the toilets. All service pipes showing on the external wall shall be suitably concealed or shall be provided within a shaft.

Each building shall be equipped with approved PVC overhead water tanks of capacity not less than 2000 litres.

2.3.1 Electrical Services

This service shall be provided as essential service for all building / sheds. Electrical services for buildings shall consist of electrical supply and distributions, electrical lighting installations, telephone network, fans, exhaust fans, lighting protection system etc. including all accessories, cabling etc. including emergency power supply, all as per requirement. All electrical switches / sockets shall be of modular type as per the approved makes given separately.

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Air conditioning and Heating

Both the Substation building shall be fully air conditioned. Therefore, false ceiling along with under deck insulation shall be there.

2.4 BUILDING ELEMENTS



2.4.1 Plinth protection

All the buildings & sheds shall be provided with minimum 1000 mm wide plinth protection around the building / shed. Level wise, it shall be 100 mm high above top of approach road level. In order to avoid accumulation of water outside the buildings, requirement of surface drains shall be examined on case to case basis for individual building and provided if necessary.

2.4.2 Finished Floor Level (Plinth FFL)

In general, Plinth FFL of the buildings, sheds shall be determined with respect to top of approach road or pavement. Unless noted otherwise on the reference drawings, following schedule shall be adhered to for FFL of various buildings & sheds.

a)	Sub Station Building		
	> Cable cellar floor	-	Top level of approach road + 450 mm/or as specified in Electrical section of NIT
	> Transformer bay with pebbles	-	Top level of approach road + 150 mm /or as specified in Electrical section of NIT
	> Single storey substation with trenches	-	F.G.L. (+) approx. 1000 mm high from top of road /or as specified in Electrical section of NIT
b)	Transformer bay	-	Top level of approach road + 150 mm/ or as specified in Electrical section of NIT
c)	Vehicle, scooter, cycle shed including	-	Top level of approach road + 300 mm

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	fire tender bays, repair shop		
d)	False floor areas (Control Room)	-	DELETED
e)	Loading, Unloading bays, platforms	-	Top level of approach road + 1100 mm
f)	Electrical rooms	-	As specified in the Electrical section of NIT
g)	Other Buildings / Shed (Process Operator's Cabin)	-	Top level of approach road + 450 mm from surrounding ground level.



Notes:

- a) In case of approaches with different top levels, the highest top level of approach road / pavement shall be considered.
- b) FFL shall be same throughout in a building / shed. Split levels any be considered in exceptional cases due to ground terrain etc.
- c) FFL of external loading / unloading bays / platforms, toilet, pantry, kitchen shall be 6 – 12 mm lower than that of the building / shed's FFL to check ingress / spillage of rainwater.
- d) FFL of Warehouses, stores may be kept lower than loading / unloading bays / platforms where forklifts etc. are used for internal movement of items. Adequate arrangement for negotiating the level difference shall be provided in that case.
- e) Where applicable, existing levels of building / sheds shall be followed.

2.4.3 Steps / Ramps

Steps / ramps shall be provided for access to the buildings / sheds for pedestrian /vehicular movement, equipment entry, etc. Minimum 1500 mm wide platform shall be provided in between entrance door and steps / ramps. Following dimensions of the steps / ramps shall be adhered to:

a)	Tread	:	300 mm minimum
b)	Riser	:	175 mm maximum
c)	Slope of ramp	:	Not steeper than 1:10 slope
d)	Ratio of tread & riser	:	2 Riser + Tread = 600 to 650 mm

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e)	Landing width	:	1500 mm minimum
f)	Flight width	:	1500 mm minimum

Edge of treads shall be provided with friction grip strips

2.4.4 Wall

Following schedule shall be adhered to for wall material and thickness

1		
2	Rain water duct / shaft	Min. 230 mm thk. hollow/ solid concrete block work
3	External walls	230 mm thk. hollow/ solid concrete block work
4	Fire wall (Around transformers)	240 thk RCC or 355 mm (including plastering) thick hollow/ solid concrete block work wall / OR as per Electrical requirements. (IER/TAC)
5	Internal partition wall	230 / 115 mm thk. hollow/ solid concrete block work wall depending on the overall length and height of the wall (refer notes below)



Notes:

- a) 115 mm thick partition walls shall be provided with RCC transoms and mullions for suitability.
- b) Wherever conduits or pipes are required to be concealed within partition wall, the local wall thickness shall be increased suitably.

2.4.5 Doors

Doors shall be provided for access, security and safety to all rooms, functional areas in a building. Emergency door shall be opened outwards. Sizes of the doors shall be determined on the basis of the following schedule:

a)	Equipment, Panel area	:	Maximum size of equipment including packing
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b)	Other areas	:	Volume of movement through door
c)	Minimum door size at entrance	:	1500 mm x 2500 mm (masonry opening size)
d)	W.C. bath Cubicle door	:	800 mm x 2100 mm (masonry opening size)
e)	Minimum size of other doors	:	1000 mm x 2100 mm (masonry opening size)

Notes:



- a) Entrance doors shall be provided covering full width of the entrance lobby. In that case the door shall be of composite type consisting of openable shutters & fixed panels. Entrance lobby shall be provided with elaborate canopy.
- b) Rolling shutters min 2500 mm wide shall be provided for equipment entry for Switchgear room, Electrical room, A.C. Plant room etc. and also wherever size of opening exceeds 2500 mm x 2500 mm.
- c) Mechanically operated rolling shutters shall be provided for main equipment entry opening, and also where opening size exceeds 8 m².
- d) .

2.4.6 Windows / Ventilators

Windows / ventilators shall be provided in all areas for natural lighting, ventilation, and visibility of working level. For the purpose of ventilation, total openable area of the windows / ventilators shall be as per Factories Act subject to a minimum of 15% of the floor area to be ventilated. However, for Subsation/control room and in office areas, etc. where visibility from inside is also important, increased window area (as per discussion with Owner/PMC) shall be provided. Areas accommodating panels / equipment shall be normally provided with ventilators at high level for uniformity distributed lighting.

Notes :

- a) Requirements of window / ventilation area as stipulated above is for maximum room height of 4000 mm. For heights more than 4000 mm, additional window / ventilator shall be provided in the same manner at every work area / platforms at all levels.

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- b) Wherever due to limitation of external wall area or other reasons, stipulated area of window / ventilator cannot be provided, suitable mechanical / electrical system shall be employed.
- c) External windows shall have P.C.C. (1:3:6) sills, 100 thk.
- d) All glasses in windows & doors shall be toughened glass. Outside glasses shall be tinted toughened.

2.4.7 Canopy / Overhang

- a) For all offices, composite buildings / sheds accommodating offices, canopy shall be provided at all entrances. Size of the canopy shall be decided based on vehicle parking & pedestrian movement in addition to aesthetics of the building / shed. Bottom of canopy shall be minimum 2800 from top of drive way.
- b) Overhangs shall be provided over all exits. Size of the overhang shall be decided on the aesthetics of the building / shed subjected to minimum of 1000 mm.

2.4.8 Shading Devices



RCC Shading devices shall be provided over all windows, openable ventilators for rain & sun protection. These devices shall be in form of horizontal projections, vertical projected fins or combination of both as per building façade treatment. Minimum projection shall be 600 mm.

2.4.9 Parapet

Parapets shall be of RCC for all buildings with minimum 500 mm high for non-approachable roof and 1100 mm high for approachable roof.

2.4.10 Roof Gutter

Gutter with rainwater pipes shall be provided for all the buildings / sheds for roof water drainage. Sizing of the gutter shall be based on areas to be drained and

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number of outlets. Gutters shall be of RCC or sheet metal depending on type of structure.

2.4.11 Rain Water Pipes Spouts

PVC rain water pipes shall be provided for roof water drainage. Number of rain water pipes shall be decided on the basis of roof area, slope and rainfall intensity as per NBC-IX, Section-2. Rain water pipes shall be concealed as far as possible. RCC or GI spouts may be used for drainage of chajja / small canopies of ground floor. Dia of rain water pipe shall be 150 mm minimum.



2.4.12 Emergency Exits

Emergency exits shall be provided for all the building / sheds as per statutory requirements. Emergency exits for individual function spaces such as console area, cable cellar, and switchgear hall shall also be provided. Emergency exits shall be located in such a manner that escape route is unobstructed & without passing through any other function areas. Corridors / staircases shall be provided as escape route.

2.4.13 Staircases

Staircases shall be provided in multi floor buildings for vertical circulation & emergency exits. Number of staircases shall be based on building / shed sizes, emergency exit requirements, and travel distances to exit points as per statutory regulations. More than 500 sq m ground covered area shall have at least two stairs in line with NBC-Part-IV. Emergency exit requirements shall be as per safety distance requirement. At least one staircase shall be provided for access to the flat roof tops for maintenance. Following dimensions for staircases shall be adhered to.

a)	Stairs width	:	1500 mm minimum, (1000 mm minimum for emergency exit)
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b)	Tread	:	300 mm minimum
c)	Riser	:	150 mm maximum
d)	Ratio of tread & riser	:	2 Riser + Tread = 600 to 650 mm

2.4.14 Railings

Railings shall be provided in roofs, stairs and in all unprotected openings in slabs as a safety device. Railings in high level loading / unloading bay of substations shall be of removable type. Parapets shall be given precedence over railings in roofs.

2.4.15 Toilets

Toilets shall be provided for all habitable buildings / sheds. Gents & ladies Toilet, drinking water enclosure & janitor space, all shall be provided as required. The fittings / fixtures provided for bath / toilet shall be of luxury / colored type.

2.4.16 False Ceiling

a) In fire rated areas where walls and doors are required to be fire rated, false ceiling shall also have complementing fire rating. It is appreciated that false ceiling have limitations in their fire performance due to openings in them for lighting and air conditioning. Therefore alternative systems to prevent puncturing the ceiling must be employed.



2.4.17 Under deck Insulation

Under deck insulation below RCC roof and over false ceiling (both locations) shall be provided for air-conditioned office / space.

2.4.18 Waterproofing on roofs

Water proofing treatment using High solid content, liquid applied Elastomeric Polyurethane Waterproofing Membrane. The two component Solvent free Polyurethane coat shall have the following properties -

1. Solid content ASTM D 2369- $\geq 90\%$

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2. Mixing ratio - 8:1
3. Elongation ASTM D 638 - 700-900%
4. Tensile strength ASTM D 638- 1-2 MPa

The coating shall be applied to a minimum thickness of 600 microns (300μX2) thickness with separate wearing course (as per ASTM C 898 & 836) over application of 2 component, solvent free Epoxy Primer of 200 microns with tensile of 20-30 MPa and elongation of 4-5% for smooth surface and act as primer coat at all elevations in vertical and horizontal surface etc including labour, material, equipment handling, preparation of surface, transportation, placing, leveling, curing, testing, etc complete as per specifications, drawing and instruction of the Engineer

2.4.19 Dash fasteners, if used, shall be of approved make or as directed.

3.0 ARCHITECTURAL TRADES

All the buildings shall be provided with Architectural finishes such as floor finishes, plastering & painting on walls & ceilings, doors / windows / ventilators, roof treatment, plinth protection, etc. pertaining to approved make/brand and best quality for industrial usage.

4.1 EXTERNAL FINISHES



4.1.1 External Wall

- a) Substation Room, Operator & Maintenance building - Water proof/ whether shield acrylic paint of approved Quality.

4.2 INTERNAL FINISHES

4.2.1 Floor Finishes

- a) Office area of Sub station
Vitrified tiles in glazed or matt finish / Marbo-granite tiles
- b) Toilet, Drinking Water area

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- Anti skid ceramic tiles
- c) Circulation area (Corridor / Passage/Entrance Lobby) of Substation - Kota stone flooring/Granite flooring
- d) Switch Gear, Cable Cellar, A.C. Plant Room, storage area
Switch gear Room for substation will have heavy duty epoxy flooring. Rest of the rooms will have heavy Duty Decorative Ceramic Tiles. / Hardcrete Floor, as directed by E.I.C
- e) Battery Room
Acid resistant epoxy coating over IPS-flooring & 2100 high dado.



Note:

Skirting shall be provided in all areas, which shall be of same material as that of flooring. Glass strip panel shall be provided in cement concrete flooring.

4.2.2 Internal Wall Finishes

- a) Entrance lobby, Corridor lobby:
Granite stone cladding and plastic emulsion paint of approved quality.
- b) Office area, Circulation areas (Corridor / Passage etc. excepting Entrance lobby) of buildings, Switch gear Room etc
Cement plaster, POP punning & plastic emulsion paint of approved quality
- c) Battery Room
Acid resistant epoxy coating over cement plaster up to 2100 height. Plastic emulsion paint above 2100 height. of approved quality
- d) Toilet, Drinking water area
Glazed finish Ceramic tiles (up to lintel level) as directed by E.I.C

4.2.3 Internal Ceiling Finishes

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- a) Electric Operator, Rack room, MCC panel room, UPS Room, Equipment Room, Switch gear Room, conference room, Office rooms or areas where Air conditioning is required

False ceiling (Gypsum Board) along with 50 mm thick under deck insulation with best quality expanded polystyrene(TF Thermocol) blocks fixed underside of slab with Bitumen paint or CRPX compound, sealing the joints with Self adhesive BOPP tapes and 18 guage GI wire mesh fixed with chromium plated screws. Also follow Electrical specifications
Electrical specifications

- b) Other areas which do not have false ceiling
Cement plaster & white / color wash, plastic emulsion paint etc., as in the case of wall finish.

4.3 DOORS, WINDOWS & VENTILATORS



4.3.1 DOORS

All frame works shall be in Sal/chap wood in size 125 x 65 mm.

- a) All doors in Toilet / WC / Bath
35 mm flush door laminated with 01mm laminate from both sides.
- b) All doors of Electrical Switchgear Room, A.C. Plant Room, Battery Room
Pressed steel frame with pressed steel shutter (or as specified in Electrical section).
- c) Inside Control Room (if applicable)
Fire check door with 2 hours rating as required in perfect partition wall separating various fire zones (or as specified in Instrumentation section)
- d) All other door of Sub station
Glazed, powder coated Aluminum door with decorative etching (or as specified in Instrumentation section).

4.3.2 WINDOWS & VENTILATORS

- a) Windows / ventilators
Glazed, powder coated aluminum window / ventilator.



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4.4 SANITARY FITTINGS (Make: Jaquar/Cera/Hindware/Perryware or equivalent)

- a) Water Closet for Sub Station.
Pedestal type white European designer type W.
Water Closet (Indian).
Orissa type (Indian) pan white WC.
- b) Wash basins for Sub Station / Satellite Control Room.
Wall hung wash basin with pedestal.
- c) Plumbing fixtures.
Stainless steel bib cock, stop cock etc. fittings.
- d) All other necessary sanitary items such as towel hangers, soap fixtures etc.

5.0 Miscellaneous

- 5.2.1 Water tanks, AC plant, cooling tower, Chiller units etc., where required, shall be located on building roof as far as possible and it shall be positioned and supported to transfer its load on to beams and columns and not to the slab. Such facilities should not be visible from outside. Suitable side cladding shall be provided for this purpose.
- 5.2.2 Access to all roofs via steel ladder. In case of accessible roofs at least one staircase shall go up to the roof.
- 5.2.3 Plinth beams level shall clear trenches if any.
- 5.2.4 Vertical ducts for running services must be examined.
- 5.2.5 Gaps in floor cut outs shall be sealed with fireproof material for fire safety.
- 5.2.6 All Instrument / Electrical cables at the junction of the building (outside) shall be covered with pre-cast RCC slab. Sleeve pipes should be provided for the cable in the masonry wall including its sealing.

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ANNEXURE II

DESIGN PHILOSOPHY – GENERAL CIVIL & DESIGN BASIS





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1.0 GENERAL

1.1 SCOPE

This engineering design basis defines the design criteria that shall form the basis for carrying out design and engineering of items under general civil, viz. roads, paving, drainage, etc.

1.2 UNITS OF MEASUREMENTS

Units of measurement in design shall be metric system.

1.3 DEFINITIONS



CCE	Chief Controller of Explosives
TAC	Tariff Advisory Committee
NFPA	National Fire Protection Association
IS	Indian Standards

1.4 CODES AND STANDARDS

The design shall be in accordance with established codes, sound engineering practices and shall conform to the statutory regulations applicable to the country.

1.4.1 The main codes, standards and statutory regulations considered as minimum requirements are as follows. Latest revision of these shall be followed.

IS: 456	Code of practice for plain and reinforced concrete
IS: 800	Code of practice for general construction in steel



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IS: 875	Code of practice for design loads (Other than earthquake for buildings & Structures
IS: 13920	Code of Practice for ductile detailing of reinforced concrete structures subjected to seismic forces.
IS: 1893	Criteria for Earthquake Resistant Design of Structures (Part 4 – Industrial Structures including Stack-Like Structures).
IS: 1172	Code of basic requirements for water supply, drainage & sanitation
IS: 1742	Code of practice for building drainage
IS: 1905	Code of practice for structural use of unreinforced masonry
IS: 2065	Code of practice for water supply in buildings
IS: 2212	Code of practice for brick work
IS: 8835	Guidelines for design of surface drains.
IRC: 6	Code of practice for road bridges, Section-II Loads and stresses
IRC: 19	Standard Specifications and Code of Practice for Water Bound Macadam
IRC: 37	Design of flexible pavements
IRC: 58	Design of rigid pavements
	Factory Rules for State

Note: The above list is suggestive and not exhaustive. Apart from these basic codes any other related codes shall be followed wherever required.

1.4.2 In case of any conflict / deviations amongst various documents, the order of precedence shall as follows –

- Statutory regulations
- Job specifications
- Engineering design basis
- Standard specification

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2.0 DESIGN CRITERIA –GENERAL

2.1 SITE GRADING

Finished Ground Levels (FGL) shall be provided by the Owner and Highest Point of Paving (HPP) shall be finalised by the CONTRACTOR, in consultation with OWNER / PMC, based on contour survey of the Unit, levels of adjacent units and levels of adjacent Roads.

2.1.1 Slope in Graded Areas

a. General Site Grading	1 in 500 to 1 in 1000
b. Micro grading, after completion of major construction (for road corridors)	1 in 200

2.2 ROADS



RCC roads for access of equipments etc within Substation building complex

2.3 CONCRETE PAVING (WITHIN PLANT AREAS)

2.3.1 General

RCC paving to be done for entire battery limit and extend up to the adjacent roads around the unit. The contractor's scope is limited to all round the peripheral roads. Heavy duty paving shall be designed for heavy vehicular traffic movement as per IRC Loading.

Concrete paving shall be laid in cast-in-situ panels of 3.0 meter X 3.0 meter size, with expansion joints spaced approximately 15.0 m c/c, each panel being cast in a single pour.

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Hard stands should be designed and provided by contractor, based on required crane capacity, here called for by Owner, the same shall be demolished after erection, and surface made good.

Provision of trenches, drains, sealing of trench covers, inserts, thickening for pipe / equipment supports etc. shall be made while construction pavements, as detailed in drawings.

Acid / alkali / chemical resistant coating as required shall be applied in areas where such corrosive materials are likely to come in contact with concrete.

Suitable drainage arrangements will be provided within curbed areas around pumps, for drainage leaks. Similarly, suitable drainage arrangement shall be provided at streaming points also.

2.3.2 Joints

Expansion joint of 20 mm shall consist of 20 thick impregnated fibre boards. Filled at top with joint sealing compound 20 x 25.



Equipment / column pedestals will be separated from paving with 20 thick sand fill and Sealing compound 20 x 25.

Contraction joints will be sealed by sealing compound 10 x 40.

2.3.3 Slope: 1 in 100 (minimum)

2.3.4 Minimum requirements of paving in various areas Non vehicular movement areas



i.	Unit	:	Type –II (150 mm thick RCC)
II.	Offsite pump station	:	Type –III (100 mm thick RCC)
II.	Bullet Area	:	Type –III (100 mm thick RCC)
II.	Utilities	:	Type –II (150 mm thick RCC)

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2.4 SURFACE TREATMENT

The surface treatment for the various areas shall be provided as enumerated in the table below.

AREA	RCC PAVING	ASPHALT PAVING	50 thick PCC 1:3:6 ON 115 thick brick soling	GRAVEL	100 THK PCC 1:3:6	ACID / ALKALI PROOF COATING
Operating Areas of Process units (including Roads for crane movement)	X (Type I /II Paving as per cl. 2.3.4)					
Around Transformers In substation				X		
Roads (excluding roads having crane movement)		X				
Approaches to units		X				
Tank farms			X			
Acid / alkali / storage / handling area						X
Parking		X				
Hardstands	X					
Pathways	X					
Pipe ways					X	
‘ X ’ Indicating applicable option						
Notes:						
1. Existing services where interfering with the new construction should be located and rerouted as instructed by Owner / Consultant.						
2. Micro-grading shall be carried out by the Contractor over graded areas to bring the FGL to indicated levels including provision of required slopes and finishes.						

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2.5 STORM WATER DRAINAGE

2.5.1 Storm water drains shall be sized for the higher discharge arising out of either rain water or fire fighting water.

2.5.2 Rain water run-off shall be computed by the formula:-

$$Q = KIA / 360$$

K is run-off coefficient given below.

A is area (hectares) contributing to the drain

I is rain fall intensity (mm / hr.)

Q is the discharge.

2.5.3 Design of drains shall be based on Manning's formula:-

$$V = R^{2/3} S^{1/2} / n$$

V is velocity of flow m/s,

R is hydraulic radius,

S is slope,



n is roughness coefficient taken as 0.013 for plaster surface, 0.015 for cast-in-situ concrete, 0.017 for brick lined.

The following parameters are to be ensured to be within limits specified while sizing

Minimum velocity of drains	:	0.6 m/s
Maximum velocity of drains	:	2.4 m/s
Minimum depth of drains	:	300 mm
Minimum width of rectangular drains	:	300mm (for depth<500mm)
Minimum width of drains	:	500 mm (depth > 500mm)

Run off coefficient 'K'

a.	paved area	concrete	-	1.0
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	Bituminous	-	0.9
b.	unpaved areas	-	0.7
c.	unusable areas like Green belt	-	0.4

2.5.4 Drains within Process Units

DELETED.

2.5.5 Culverts and Road/Rail Crossings

DELETED

2.5.6 Tank Farm Drainage

DELETED

2.5.7 Disposal of Storm Water

DELETED

2.5.8 Oil Catcher



DELETED

2.6 WATER SUPPLY

Existing drinking water piping shall be extended to new facilities. Adequacy of header branch line etc. shall be ensured; else additional lines shall be run.

2.7 SANITARY SEWERS

2.7.1 General

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Sanitary sewerage will not be combined with storm water.

Building drainage shall be designed as a dual pipe system with separate soil & waste pipe.

Sewers shall be designed for discharging 3 times average flow flowing half full in case of lateral sewer, and flowing 2/3 full in case of Main sewer. The minimum and maximum clearing velocities shall be 0.75 m/s and velocity 2.4 m/s respectively.

Velocity shall be calculated by Manning's formula with $n=0.015$

Minimum pipe size shall be 100 mm and all pipes shall preferably be salt glazed stoneware unless abnormal soil conditions or high velocity dictates otherwise.

2.7.2 Sanitary sewer shall be led into the sewerage system leading to waste water treatment plant (WWTP). Where system is not available, septic tank/soak pit shall be provided.

2.7.3 Cover for Sewer Line shall be minimum 600 mm.

Under road, sewer shall be protected by concrete encasement or minimum cushion shall be 1200 mm.



Under railway, the sewer shall be protected as per railway standards.

2.7.4 Material of Construction

- a. Material of Construction for Manholes shall R.C.C. M30.
- b. Material of Construction for Sewer

Sanitary Sewer

- i. Toilet block to inspection - CI pipes as per IS: 3486/1729)
chamber or UPVC, as directed.
- ii. Gravity main & lateral - Salt glazed stoneware / C.I./ R.C.C. Class
P1 (as per IS:458)

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- iii. Pressure main - C.I. pipes (as per IS: 1536 an IS: 1537)
- iv. Offsite Pumping, if any - CPVC pipes/GI as per PMS J2A(as directed)
- v. Manholes - R.C.C. M30

2.8 CONTAMINATED RAIN WATER SEWERS

2.8.1 DELETED

2.8.2 Tank Farm Area

DELETED

2.9 OTHER PROCESS DRAINS

DELETED

2.10 STORAGE TANK FOUNDATION AND DYKE WALLS



DELETED

2.11 BARRICADE

Contractor shall design a suitable barricading system for protection of existing facilities if required. Barricade shall be of G.I. sheet cladding with suitable supporting system of height and extent shown in drawings or as instructed by Owner / Consultant. Water spray system shall be incorporated where felt necessary by Owner / Consultant. Localized G.I. sheet barricading shall be provided from operational constraint requirements as directed by Owner / consultant.

2.12 TRENCHES

Trenches shall be of RCC with inserts or other suitable arrangement required to support Cables pipes etc. Pre-cast concrete covers with lifting arrangement shall be provided on top. In paved areas, the top will be flush with finished floor level.

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Covers shall overlap walls and joints with paving shall be sealed to prevent water entry. In unpaved areas, walls shall be raised above ground level by 100 mm. Trench floors shall be provided with a nominal slope to drain pits, where any water entering trenches can collect and be detained to the nearest contaminated rain water sewer / storm water sewer. Trench covers shall be designed for the vehicle load relevant to the area where the trench is located. Cable trench shall be of leak proof construction.



2.13 HARD SURFACES

Hard surface of PCC 1:3:6, (100 mm thick) over suitable bedding (brick / stone soling) shall be provided below all new pipe tracks and / or extended portion of existing pipe Tracks (if any). This shall extend 600 mm on one side for track width less than 6 m, and 900mm On either side for pipe track having width 6 m or more, end it shall have approach @ 500 M c/c from nearest road.

Hard surface of PCC 1:3:6 (100 mm thick) over suitable bedding (brick / stone soling) of approximate size 1 m x 1 m shall be provided with proper approach near drain point of offsite piping, near drinking water installations, at washing facilities, etc., with suitable curbing and drainage arrangements as required for the fluid being handled.

2.14 REMOVAL / REROUTING OF OBSTRUCTIONS



All underground or above ground structures / foundations which will cause obstruction to new structures / foundations, and which can be removed without disturbing any functions of the existing structures if any, shall be removed by the Contractor.

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All existing underground or above ground facilities requiring rerouting due to fouling with new facilities shall be rerouted by the Contractor in such a manner that rerouted facilities keep on functioning as before.

NOTE:

Before finalizing the route connection to existing system, adequacies of existing system shall be checked by the contractor.

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ANNEXURE- III
CIVIL ENGINEERING DESIGN BASIS
(STRUCTURAL)



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1.0 GENERAL

1.1 SCOPE

This engineering design basis defines the minimum design criteria that shall form the basis for carrying out detailed structural design and engineering of all plant and non-plant structures and buildings. All data required in this regard shall be taken into consideration for acceptable, satisfactory and trouble-free engineering of the structures.



Compliance with this design basis and / or review of any of the contractor documents shall in no case relieve the contractor at the contractual obligations. All structures shall be designed for the satisfactory performance of the functions for which they are being constructed.

1.2 UNITS OF MEASUREMENT

Units of measurement in design shall be in metric system.

1.3 DEFINITIONS

CCE	Chief Controller of Explosives
TAC	Tariff Advisory Committee
NFPA	National Fire Protection Association
IS	Indian Standards

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1.4 CODES AND STANDARDS



The design shall be in accordance with established codes, sound engineering practices and shall conform to the statutory regulations applicable to the country.

1.4.1 The main codes and standards and statutory regulations considered as minimum requirements are as follows **Latest revision** of these shall be followed.

- 1) National Building Code of India
- 2) IS: 875 (Part 1) – Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures (Part 1 – Dead Loads).
- 3) IS: 875 (Part 2) - Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures (Part 2 – Imposed Loads).
- 4) IS: 875 (Part 3) - Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures (Part 3 – Wind Loads).
- 5) IS: 1893 (Part 1): –Criteria for Earthquake Resistant Design of Structures (Part 1 – General Provisions and Building).
- 6) IS: 1893 (Part 2): –Criteria for Earthquake Resistant Design (Liquid Retaining Tanks).
- 7) IS: 1893 (Part 4): –Criteria for Earthquake Resistant Design of Structures (Part 4 – Industrial Structures including Stack-Like Structures).

1.4.2 STRUCTURAL STEEL



- 1) IS: 800 – Code of Practice for General Construction in Steel
- 2) IS: 802 – Code of Practice for use of structural steel in overhead transmission line towers.
- 3) IS : 808 - Dimensions For Hot Rolled Steel Beam, Column, Channel And Angle Sections

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- 4) IS:806 – Code of Practice for Use of steel tubes in General building Construction
- 5) IS: 1161 – Code of Practice for Circular hollow sections/pipes.
- 6) IS: 4923 – RHS & SHS sections.
- 7) IS: 2629 – Recommended practice for hot dipped galvanizing on iron and steel.
- 8) IS: 2633 – Methods for testing uniformity of coating of zinc coated articles.
- 9) IS: 6533 – Code of Practice for design and construction of steel chimney.
- 10) IS: 6745 – Method for Determination of mass of zinc coating.
- 11) IS: 814 – Covered Electrodes for manual metal arc welding of Carbon and carbon manganese steel.
- 12) IS: 816 – Code of Practice for use of Metal arc welding for General Construction in mild steel.
- 13) SP-06 – (Part 1 to Part 7)- Handbook for Structural Engineers.

1.4.3 REINFORCED CONCRETE AND MASONRY WORK

- 1) IS: 456 – Plain and Reinforced Concrete – Code of Practice
- 2) SP:16 - Design Aids for Reinforced Concrete to IS: 456
- 3) SP: 34 – Handbook of Concrete Reinforcement and Detailing.
- 4) SP:24 – Explanatory Handbook on Indian Standard Code of Practice for Plain and Reinforced
- 5) SP: 20(S & T) – Explanatory Handbook on Masonry Design and Construction.
- 6) IS: 2911 (Part 1 to Part 4) – Code of Practice for Design and Construction of Pile Foundation.
- 7) IS: 2950 (Part 1) – Code of Practice for design and construction of Raft foundation.
- 8) IS: 2974 (Part 1 to Part 5) – Code of Practice for design and construction of Pile Foundations.
- 9) IS: 3370 - Code of Practice for Concrete Structures for storage of liquids.

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- 10) IS:4326 – Code of Practice for earthquake resistant design & construction of buildings
- 11) IS: 13920 – Code of Practice for ductile detailing of reinforced concrete structures subjected to seismic forces.
- 12) IS:1172 - Code of basic requirements for water supply, drainage & sanitation
- 13) IS:1742 - Code of practice for building drainage
- 14) IS:1905 - Code of practice for structural use of unreinforced masonry
- 15) IS: 2212 - Code of practice for brick work

1.4.4 ROADS AND SANITARY WORKS



- 1) IS: 2065 - Code of practice for water supply in buildings
- 2) IS: 8835 - Guidelines for design of surface drains.
- 3) IRC: 6 - Code of practice for road bridges, Section-II Loads and stresses
- 4) IRC: 19 - Standard Specifications And Code of Practice for Water Bound Macadam
- 5) IRC: 37 - Design of flexible pavements
- 6) IRC: 58 - Design of rigid pavements

Note: The above list is suggestive and not exhaustive. Apart from these basic codes any other related codes shall also be followed wherever required.

In case of any difference between Codes provision and this design basis, the stringent one should govern the design.

1.4.5 In case of any conflict / deviations amongst various documents, the order of precedence shall be as follows.

- Statutory Regulations
- Job Specifications
- Engineering Design Basis
- Standard Specifications

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2.0 MATERIALS OF CONSTRUCTION

Type of Structure	Materials of Construction
Foundation of all equipments (Static and Dynamics) , Structures and Tanks	RCC
Substation building	RCC framed with brick/RC blockwork cladding
Platforms,sheds	Structural Steel

3.0 DESIGN LOADS (DL)

The following design loadings shall be considered

- 1)Dead loads including self weight
- 2)Live load
- 3)Wind load
- 4)Seismic load
- 5)Equipment load
- 6)Dynamic load
- 7)Load from lifting appliances
- 8)Erection loads / maintenance loads
- 9)Thermal load
- 10)Earth pressure / Hydrostatic Loads
- 11)Any other load not mentioned above, but applicable



These loadings shall be applicable to all structures irrespective of the material employed for construction.

3.1 DEAD LOADS

Dead load shall comprise of the weight of all permanent construction including walls, fire proofing, floors, roofs, partitions, stairways and fixed services.

Unless noted otherwise following unit weights shall be adopted.

Reinforce Concrete	:	2500 kg/m ³
Plain Concrete	:	2400 kg/m ³
Structural steel	:	7850 kg/m ³

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Backfill Soil	:	1800 kg/m ³
Operating floor with grating	:	100 kg/m ²
Staircase (steel)	:	140 kg/m ²
Ladder	:	40 kg/m ²
False ceiling	:	60 kg/m ²
Heavy duty tar felting	:	30 kg/m ²

3.2 EQUIPMENT LOADS

- **EQUIPMENT CATEGORY I**

The weight of equipment category I such as pumps, compressors, motors etc., shall be derived as far as possible from Manufacturer's data and shall include controls, auxiliary machinery, piping etc. The equipment load shall be categorized if required for use in various loading combinations as empty and operating.

- **EQUIPMENT CATEGORY II**

This category consists of loads from equipments such as vessels, columns, heat exchangers, condensers, settlers, filters and the like, complete with their piping.

In accordance with the various load combinations for the category of equipment, the following weights/loads shall be included in the calculations.

a) EMPTY WEIGHT (EL_e)



This is the dead weight of vessels, columns, etc. completely installed) including platforms and ladders, piping, insulation and fireproofing) and ready for operation, however, without liquid filling. Weights will be derived from manufacturer's data.

b) OPERATING LOAD (EL_o)

This is the empty weight plus the maximum weight of contents of vessels, columns, etc. during normal operation of the plant, Weight of pipes full of product (liquid/gases) plus the weight of insulation and anchor loads if any.

c) HYDROSTATIC TEST LOAD (EL_t)

When Hydrostatic pressure testing of equipment is required at site and is done after installation, the weight of equipment, completely filled with water shall be

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incorporated in the design of the supporting structure. Only one biggest system shall be considered to be tested at a given time.

The empty / operating / test weight of process equipment including contents and all fixtures, platforms, ladders and attached piping etc, shall be considered. If piping weight is not indicated separately or not included in the weight of the equipment, the same shall be taken as 10% of the weight of the equipment.

3.3 LIVE LOADS (LL)

Live loads shall, in general, be as per IS: 875. However, the following minimum live loads shall be considered in the design of structures to account for maintenance and erection phases; if equipment layout / vendor drawings indicate loads of greater magnitude, the same shall be adopted.

i. Substation

Panel floor	-	10.0 kN/m ²
Miscellaneous partition	-	1.0 kN/m ²
Other areas	-	5.0 kN/m ²

Loads on account of equipment and incidental loads shall be taken over and above the loads indicated in the table.



For all other buildings not covered in above Table as well as roofs of various structures, the imposed loads shall be taken as specified in IS: 875 (Part II)

1 KN/m² allowance shall be made for services supported from below the floor.

Live load on various types of roofs shall be as per the requirements given in IS: 875.

3.4 WIND LOADS (WL)

Wind loads shall generally be as per IS-875 (Part-3) except for switchyard structures and transmission towers for which IS: 802 shall be applicable. Design

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wind speed and pressure shall be worked as per the latest revision of IS 875 Part-3.

3.5 SEISMIC LOADS(SL)

Seismic loads shall be as per IS: 1893 (latest version).

3.6 IMPACT AND VIBRATORY LOADS

Structures subjected to impact or vibratory loads shall be designed as per the provision of IS: 875 & IS: 2974. Requirements for monorails and overhead cranes shall be as per IS: 800, IS: 875 or manufacturer's data, whichever is more stringent.

3.7 MISCELLANEOUS LOADS

Apart from the specified live loads, possible overloading during construction / hydro-test maintenance / erection shall also be considered in the design Job specifications shall also be referred to, for any specific loading.



Hydrostatic pressure shall be adequately accounted for, in the design of structures, below ground water table.

All the handrails, parapets, parapet walls, balustrades shall be designed for horizontal load mentioned in Table 3 of IS-875 (Part-2).

3.8 LOAD COMBINATIONS

Structural analysis and design shall take into consideration, worst combination of the above loads under different phases, such as, Erection, Operation, Hydro-test, Shutdown, Maintenance, and Blast for control room, as applicable.

The design shall be governed by worst load combinations as per the procedures of relevant BIS codes.

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4.5 FOUNDATION BOLTS

All holding down bolts or threaded rods for non-post tensioned applications shall be out of Mild Carbon steel conforming to IS: 2062 with $F_y = 250$ MPa unless Noted Otherwise.

4.7.1 Minimum cover to Foundation Bolts

Minimum distance between a Standard Holding down Bolt or Anchor Sleeve and the face of Foundation/pedestal shall not be less than $6 \times (\text{dia of bolt})$ mm.

4.7.2 All equipment foundation bolts / templates shall be designed and supplied by equipment vendor. Foundation bolts for steel structures shall be designed and supplied by contractor as per standard drawings or approved equivalent.

4.7.3 Other Inserted And Embedded Items

Unless otherwise specified, all structural steel shall be weldable structural steel "Standard Quality" (Fe 410 WA), in accordance with code IS: 2062.

All embedded steel items (exposed to atmosphere) shall be hot-dip galvanized in accordance with IS: 2629, except if noted otherwise on the design drawings.



All inserted and embedded items shall be accurately placed or template in and be securely anchored prior to placing concrete.

At sliding ends of vessels and horizontal exchangers, sets of plain steel plates shall be provided. In order to reduce the horizontal force due to friction at sliding ends sets to PTFE bonded steel plates may be provided.

4.9 GROUTING

The minimum thickness of grout shall be 25 mm.

All anchor bolts sleeves / pockets and spaces under column bases, shoe plates etc. shall be grouted with free flow, non shrink (premix type) grout, with 28 days minimum cube crushing strength of 40 N/mm^2 . Ordinary grout consisting of 1 part

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of OPC and 2 parts of clean, dry well graded sand mixed with water to obtain the required consistency shall only be used under the base plates of cross-overs, short pipe supports (not exceeding 1.5 m height) and small operating platforms (not exceeding 2 m height) not supporting any equipment.

For rotating equipment bases, (above 300 KW rating), grout shall be as per requirements of equipment vendor, as per the approved list / as per the decision of EIC.



5.0 DESIGN CRITERIA FOR REINFORCED CONCRETE STRUCTURES

5.1 GENERAL

- a) All buildings, structures, foundations, machine equipment foundations, liquid retaining storage structures, trenches, pits etc. shall be of RCC and designed based on the following IS codes (latest revision with all amendments, issued there to) in general, and other relevant IS codes applicable : IS:456, 875, 1893, 1904, 2911, 2950, 2974, 3370, 4326, 4991, 4998, 5249, 6403, 8009, 13920.
- b) Only limit state method as per IS: 456 shall be followed for the design unless otherwise specified elsewhere in this document for special structures.
- c) All skeletal structures shall be of frame type construction, and detailing shall be as per provision of IS: 13920.
- d) Where the specified design depth of groundwater table so warrants, all underground pits, tunnels, basements, etc. shall be leak-proof R.C.C. construction using water proofing compounds.

5.2 CONCRETE GRADE

All cast-in-situ structural concrete shall be Reinforced Concrete conforming to IS: 456. Minimum grade M30 shall be used for all sub-structures (foundations/ Pile foundations, water retaining structures etc) except for grade slabs / paving for which M20 may be used. M25 grade shall be used for all super-structures.

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Pre-cast concrete shall be of minimum grade M35.

From durability consideration, the minimum and maximum cement content and water-cement ratio shall be followed as per latest IS code.

If soil investigation report recommends high cement content and / or specified type of cement, the same shall have precedence.

75 mm thick PCC of grade M15 (nominal mix) shall be provided under all RCC foundations except under base slab of liquid retaining structures where 100 mm thick concrete of mix M15 (nominal mix) shall be used.

Plain cement concrete (PCC) of grade M15 (nominal mix) of minimum 150 mm thickness shall be provided under all masonry wall foundations. Plain cement concrete of grade M20 of minimum 40 mm thickness shall be provided as damp proof course, at plinth level of all masonry walls and to be coated with 3 mm thick bitumen emulsion.

Lean concrete of grade 1:5:10 shall be used as filler material wherever loose sub-grade exists by removing the loose soil/fill.



Any specific requirement regarding grade and thickness of PCC to be provided shall be incorporated in the drawing.

5.3 REINFORCEMENT BARS

High yield strength deformed TMT steel bars of grade Fe500D conforming to IS: 1786 shall be used. The Minimum dia. used shall be 8mm. All structural steel and reinforcements shall be procured from SAIL / TISCO /RINL or Owner's approved Vendor List. HYSD Fe500 corrosion resistant bars conforming to IS: 1786 shall be used in foundations and sub structures.

Binding wire of 16 Gauge GI shall be used for tying the reinforcement conforming to IS: 280 unless specifically mentioned herein or in engineering drawings or other engineering design basis prepared for the individual units/structures.

5.4 MINIMUM THICKNESS OF STRUCTURAL CONCRETE ELEMENTS

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As per IS codes

5.5 MINIMUM COVER TO REINFORCEMENT

As per IS codes

5.6 EXPANSION JOINTS

Expansion points in concrete structures shall be provided at 30-35 m centers. The expansion joint shall be provided preferably by way of twin columns on a common foundation. Sliding joints shall be avoided as far as possible.

5.7 DEFLECTIONS

Deflections in concrete structures shall in general be limited by adherence to the limits on span by depth ratio for beams and slabs and length to lateral dimension ratios for columns as prescribed in IS: 456.

5.8 MISCELLANEOUS APPLICATIONS



5.8.1 Admixtures

Admixtures shall conform to IS: 9103 and to be mixed with concrete (if required) strictly as per manufacturer's recommendations.

5.8.2 Water for Construction

Water used for mixing and curing shall be clean and free from injurious amounts of soils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete or steel. Portable water is generally considered satisfactory for mixing concrete. It should meet the requirement of IS: 456-2000.

5.8.3 Aggregates

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These shall conform to IS: 383, specification for Coarse and Fine Aggregates from Natural resources.

5.8.4 Plinth protection

Each building shall be provided with 1.0 m wide concrete M10, 100 thick laid on 75 mm thick M7.5 concrete with 8 Tor @ 250 c/c both ways Reinforcement bars all round as plinth protection. A surface drain to be provided along-with plinth protection which shall be connected to the drainage system.

5.8.5 Ramps



Ramps for building entrance shall be cast in situ R.C.C. designed as a grade slab and the slope of ramps shall not be less than 1 in 10. Minimum thickness of the slab shall be 150 mm.

5.8.6 Hot Bitumen Paint

All underground structures including top surface of foundations shall be painted with two coats of hot bitumen paint of grade 20/30 with quantity of bitumen at least 1.2 kg/m² per coat.

5.8.7 Masonry Wall

- a. All masonry walls from ground floor shall be placed on R.C.C. grade beams. However, light internal partitions may be placed on ground floor slab.
- b. All brick masonry (M 7.5 MPa) grade walls shall be considered as 230 mm thick, except for partition walls which will be 115 mm thick. However, for fire barrier walls minimum thickness shall be considered as 350 mm.
- c. All in-filled brick (M 7.5 MPa grade) panels shall be designed to transfer horizontal loads from wind and seismic to the structural frameworks without

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damage and the extent of brick panel dimensions shall be as per the recommendations in IS. All brickworks shall be provided with reinforcement consisting of 2 Nos. of 6 mm diameter bars at every fourth layer.



5.8.8 Anti-termite treatment

Anti-termite treatment shall be provided under all buildings as per IS: 6313. Materials shall be as per IS: 8944.

5.8.9 Building Slabs on Grade

The specifications given in Table below shall be followed.

Sl. No.	DESCRIPTION		FLOORING TYPE		
			I	II	III
1.a	Sub Grade	Earth fill base compacted to 95% dry density	Yes	Yes	Yes
1.b		Rubble soling	230 Thick	230 Thick	150 Thick
2.a	Structural Grade Slab	Lean concrete 1:5:10 over 1.b layer	50 Thick	50 Thick	50 Thick
2.b		Stable in Grade M20 concrete (Reinforced with 8 mm dia bars @ 200 c/c both ways) over lean concrete	150 Thick	150 Thick	100 Thick
			R/F placed centrally	R/F placed in two layers at top & bottom	No reinforcement required
3	Finish	Floor finish	As/Architectural detail	As/Architectural detail	As/Architectural detail

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TYPE I: Plant buildings such as Sub-stations, Control Rooms, Process Operators' Room, Pump Houses, Utility Compressor Houses, D.M. Plant, E.T.P., Parking Areas, Stores, Porches.

TYPE-II: Warehouses, Workshops, Cement Godowns, Fire Stations, Process Compressor House.

TYPE III: Non Plant Buildings (viz. Administration, Laboratory, Canteen, Time Office, Gate House, Training Centre, Guest House, Residential Building)

Note: 1. Reinforcement steel shall be as per clause 5.5

5.8.10 Insulation



For equipment with temperatures over 200° C, or sub zero temperatures, insulation shall be provided between equipment base / lugs and concrete / steel structure.

6.0 DESIGN CRITERIA FOR STEEL STRUCTURES

6.1 GENERAL / DESIGN METHODS



6.1.1 Design fabrication and erection of the above work shall be carried out in Limit state of design method accordance with the following IS Codes as applicable to the specific structures, viz, IS: 800(2007), 801, 802, 806, 814, 816, 875, 1893, 6533, 9595, etc. Basic consideration of structural frame work shall primarily be stability, ease of fabrication/erection and overall economy, satisfying relevant Indian Standard Codes of Practice. Steel structures adequately braced in vertical and horizontal planes, consistent with functional requirements, shall be preferred over structure having moment connections. Moment connections, if adopted, shall be fully rigid as per IS:800. Where fully rigid joints are adopted they shall generally be confined to the major axis of the column member.

Structural elements, continuously exposed to temperatures above 200° C, shall be designed for reduced stress as per Table-4 of IS: 6533 (Part-2). The expected temperature of steel components shall not be allowed to exceed 400 ° C. The structures connected to column, heater vessels working at high temperatures shall

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not be rigidly connected with staircase and adjoining structures, which are on ambient temperatures.

- 6.1.2 Steel staircases shall have channels provided as stringers with minimum clear width of 750 mm and maximum slope of 41 degree. The vertical height between successive landings shall not exceed 4.0 meters. Treads shall be minimum 230 mm wide made of grating (with curved chequered plate nosing) spaced equally so as to restrict the rise to maximum 200 mm. If relevant local by-laws or applicable Factory Act Rules stipulates more stringent requirements in this regard, the same shall be adhered to.
- 6.1.3 Hand rails, 1000 mm high, shall be provided to all walkways, platforms, staircases. Toe plate (100 mm x 5 mm) shall be provided for all hand railing (except for staircases). Spacing of uprights shall be 1500 mm (maximum). Two types of hand railing shall be provided.
- a. For walkways, platforms (except platform around/on circular & horizontal vessels), and staircases: Top rail, mid rail and upright shall be 32 mm dia. (NB) galvanized MS tubes.
 - b. For platforms around circular vessels : Top rail shall be 32 mm dia. (NB) galvanized MS tubes, but mid rail and upright shall be of structural steel.
- 6.1.4 Electro-forged/Welded hot dip galvanized MS gratings shall be minimum 25 mm deep. The maximum size of voids in the grating shall be limited to 30 mm x 55 mm. The minimum thickness of galvanizing shall be 120 microns. Gratings shall be suitable for the operation and maintenance loads for the floors
- 6.1.5 Welded connections shall be adopted during shop fabrication, except where only bolted connections are required (viz. removable members, galvanized electrical switchyard structures and transmission towers). Minimum no. of field welding shall be done, if required, based on decision of EIC. Minimum no. /size of erection bolts shall be 2-16mm dia.

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6.1.6 Lock nuts shall be provided for anchor bolts of tall structures, tall process columns, vibrating equipment, etc.

6.1.7 Minimum two nuts shall used for all anchor bolts except for ladder, stair and hand rail.

6.2 EXPANSION JOINTS



Expansion joints shall be provided at 80 – 100 m centres, where possible, column bracing shall be provided at the center of a longitudinal frame, rather than at the ends so as to avoid constraints on free expansion.

6.3 STEEL GRADE

Structural steel shall be of yield stress of 250 Mpa conforming to grade B of IS: 2062. Tubular steel shall conform to Yst 310 of IS: 1161 & IS: 4923. Structural pipes shall be either seamless or mild welded. Spiral welded pipe is not acceptable.

6.4 LIMITING PERMISSIBLE STRESSES

- Permissible stresses in structural members shall be as specified in:
 - IS: 800 - Hot rolled sections (excluding transmission towers and Switchyard structures).
 - IS: 801 - Cold formed light gauge sections
 - IS: 802 - Transmission towers & switchyard structures
 - IS: 806 - Tubular Structures
- Permissible stresses in bolts shall be as specified in :-
 - IS: 800 - Hot rolled sections
 - IS: 801 - Cold formed light gauge sections
 - IS: 802 - Transmission towers & switchyard structures
 - IS: 806 - Tubular Structures
- Permissible stresses in welds shall be as specified in :-
 - IS:801 - Cold formed light gauge sections

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- IS: 806 - Metal Arc Welding

6.5 LIMITING DEFLECTION

- a. The limiting permissible vertical deflection for structural steel members shall be as as per relevant IS codes.

6.6 ELECTRICAL SWITCHYARD STRUCTURES AND TRANSMISSION TOWERS

DELETED

6.7 PAINTING

Painting including shop primer to structural steel shall be as per the painting specification for this project, included elsewhere in Technical Specification.

6.8 GROUTING

For structural columns : As required but not less than 25 mm

For equipment : As required but not less than 25 mm



6.9 CLADDING AND RAINWATER GUTTERS

All roof and cladding sheets should be galvalume sheet of 0.5 mm total coated thickness with 550 MPA grade steel confirming to AS 1397 with AZ150 grade coating.

Translucent sheets shall be provided, in non-process areas only, intermittently where day lighting is required. Rainwater gutters of Galvanized / Zinc coated sheets and UPVC rainwater pipes shall be provided for proper roof drainage.

7.0 CRITERIA FOR MASONRY WORKS

7.1 GENERAL

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All masonry works shall be designed in accordance with IS: 1905, IS: 1597, IS: 2185, IS: 4326 and other relevant IS Codes as applicable. All external brick, stone and hollow concrete block masonry walls shall be of minimum 230, 350 and 250 mm thickness respectively. Hollow concrete blocks shall conform to IS: 2185. Masonry shall be plastered with CM 1:6, 12 mm thick on inside surfaces and 20 mm thick on outside surfaces.

7.2 CEMENT MORTAR

All masonry work shall be constructed in 1:6 cement sand mortar except half brick partition walls which shall be constructed in 1:4 cement sand mortar with two numbers of 6 mm diameter MS bars provided a every fourth course properly anchored with cross walls or pillars.

7.3 FIRE WALLS

Thickness of all masonry firewalls shall be as per Electricity Rules but not less than 345 mm.

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ANNEXURE-V

ES-2516



TECHNICAL SPECIFICATIONS

FOR

CIVIL, STRUCTURAL



AND

OTHER ALLIED WORKS

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1.1 CONTRACTOR shall procure and maintain copies of the latest CPWD Specifications at site for reference.

1.2 These technical Specifications shall be supplementary to the specifications contained in the CPWD specifications, wherever at variance, these Particular Specifications shall take precedence over the provisions in the CPWD Specifications.

2.0 Reference Codes & Standards

2.1 Wherever reference of IS Specifications/ or IS Codes of Practice are made in the Specifications/ Schedule of Rates or Preambles, reference shall be to the latest edition of IS (Bureau of Indian Standards).

IS - 383 Coarse & Fine aggregates from natural sources for concrete.

IS - 427 Distemper, dry, colour as required.

IS - 432 Mild Steel & Medium tensile steel bars.

IS - 456 Code of Practice for Plain and Reinforced Concrete.

IS - 515 Natural and Manufactured aggregates for use in mass concrete



IS - 730 Hook bolts for corrugated sheet roofing

IS - 800 Code of Practice for General Construction in Steel



IS - 1079 Hot rolled carbon steel sheets & strips

IS - 1081 Code of practice for fixing and glazing of metal (steel & aluminium) doors, windows and ventilators.

IS - 1161 Steel tubes for structural purposes.

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- IS - 1285 Wrought aluminium & aluminium alloy extruded round tube and hollow sections
- IS - 1361 Steel windows for Industrial Buildings.
- IS - 1363 Hexagon head bolts, screws & nuts of product grade C : Part - I Hexagon head bolts (size range M5 to M64)
- IS - 1367 Technical supply conditions for threaded steel fasteners
- IS - 1566 Hard - Drawn steel wire fabric for concrete reinforcement.
- IS - 1786 High strength deformed steel bars & wires for concrete reinforcement.
- IS - 2062 Steel for general structural purposes.
- IS - 2116 Sand for masonry mortars.
- IS - 2212 Code of practice for brickwork.
- IS - 2386 Methods of test for aggregates.
- IS - 2835 Flat transparent sheet glass
- IS - 4021 Timber door, window and ventilator frames
- IS - 4923 Hollow Steel sections for structural use.
- IS - 4925 Concrete batching and mixing plant.
- IS - 5410 Cement Paint
- IS - 6477 Dimensions for wrought aluminium & aluminium alloys, extruded hollow sections.
- IS - 7318 Fusion welding of steel.
- IS - 10262 Recommended guidelines for concrete mix design.
- IS - 14871 Products in Fibre Reinforced Cement – Long Corrugated or



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Asymmetrical Section Sheets and Fittings for Roofing and
Cladding - Specification

3.0 Earthwork



3.1 Excavation

- 3.1.1 Excavation shall be carried out in soil of any nature and consistency, in the presence of water or in the dry, met on the site to the lines, levels and contours shown on the detailed drawings and **CONTRACTOR** shall remove all excavated materials to soil heaps on site or transport for use in filling on the site or stack them for reuse as directed by the Engineer-in-Charge.
- 3.1.2 Surface dressing shall be carried out on the entire area occupied by the buildings including plinth protection as directed without any extra cost. The depths of excavation shown on the drawings are the depths after surface dressing.
- 3.1.3 The site around all buildings and structures to a width of 3 metres beyond the edge of plinth protection, ramps, steps, etc. shall be dressed and sloped away from the buildings.
- 3.1.4 Black cotton soil, and other expansive or unsuitable soils excavated shall not be used for filling in foundations, and plinths of buildings or in other structures including manholes, septic tanks etc. and shall be disposed off within the contract area marked on the drawings, as directed, levelled and neatly dressed.
- 3.1.5 In case of trenches exceeding 2 metres depth or where soil is soft or slushy, the sides of trenches shall be protected by timbering and shoring. The **CONTRACTOR** shall be responsible to take all necessary steps to prevent the sides of trenches from caving in or collapsing. The extent and type of timbering and shoring shall be as directed by the **Engineer-in-Charge**.
- 3.1.6 Where the excavation is to be carried out below the foundation level of adjacent



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structure, the precautions to be taken such as under pinning, shoring and strutting etc. shall be determined by **Engineer-in-Charge**. No excavation shall be done unless such precautionary measures are carried out as per directions of **Engineer-in-Charge**.

- 3.1.7 Specification for Earth work shall also apply to excavation in rock in general. The excavation in rock shall be done such that extra excavation beyond the required width and depth as shown in drawings is not made. If the excavation done in depth greater than required /ordered. The **CONTRACTOR** shall fill the extra excavation with concrete of mix 1:5:10 as the foundation concrete at his own cost.
- 3.1.8 **CONTRACTOR** shall make all necessary arrangements for dewatering / defiling as required to carry out proper excavation work by bailing or pumping out water, which may accumulate in the excavation pit from any cause/ source whatsoever.
- 3.1.9 **CONTRACTOR** shall provide suitable draining arrangements at his own cost to prevent surface water entering the foundation pits from any source.
- 3.1.10 The **CONTRACTOR** is forbidden to commence the construction of structures or to carry out concreting before **Engineer-in-Charge** has inspected, accepted and permitted the excavation bottom.
- 3.1.11 Excavation in disintegrated rock means rock or Boulders including brickbats which may be quarried or split with crow bars. This will also include laterite and hard conglomerate.
- 3.1.12 Excavations in hard rock - meant excavation made in hard rock to be done manually, or by blasting using only explosives and / or pneumatic hammers. In case of blasting, control blasting should be adopted depending on site conditions. For using explosives **CONTRACTOR** shall follow all provisions of Indian Explosives Act / Rules 1983, corrected / revised up to date.

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- 3.1.13 In case of hard rock excavation to be carried out using explosives the, **CONTRACTOR** shall obtain the written approval in advance.
- 3.1.14 The measurements for excavations shall be restricted and limited to minimum excavation line as per drawing for payment purposes.
- 3.1.15 Adequate protective measures shall be taken to see that the excavation does not affect or damage adjoining structures. The **CONTRACTOR** shall take all measures required for ensuring stability of the excavation and safety of property and people in the vicinity. The **CONTRACTOR** shall erect and maintain during progress of work, temporary fences around dangerous excavations at no extra cost.
- 3.1.16 Excavation in ordinary soil means excavation in ordinary hard soil including stiff heavy clay, hard shale, or compact moorum, or any materials, which can be removed by the ordinary application of spades, shovels, picks and pick axes. This shall also include removal of isolated boulders each having a volume not more than 0.50m³.
- 3.1.17 Excavation in soft rock includes limestone, sandstone, laterite, hard conglomerates, etc. or other rock which can be quarried or split with crowbars or wedges. This shall also include excavation of tarred pavements, masonry work and rock boulders each having a volume of not more than 0.25m³.
- 3.1.18 Excavation in hard rock includes any rock bound in ledges or masses in its original form or cement concrete for which in the opinion of the Engineer-in-Charge, requires the use of compressed air, equipment, sledge hammer and blasting or non-explosive materials viz. Acconex manufactured by A.C.C. Ltd. Specifications and instructions for use shall be as per manufacturer.

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3.1.19 In case of any difficulty concerning the interpretation of type of soil as mentioned above, the Engineer-in-Charge shall decide whether the excavation in a particular material is in ordinary soil, soft rock or hard rock and his decision in this matter shall be final and binding on the CONTRACTOR and without appeal.

3.2 **Filling**

3.2.1 Back filling of excavations in trenches, foundations and elsewhere shall consist of one of the following materials approved by **Engineer-in-Charge**.

Soil

Sand

Moorum

Hard-core

Stone/gravel

All back filling material shall be approved by the **Engineer-in-Charge**.



3.2.2 Soil filling - Soil material shall be free from rubbish, roots, hard lumps and any other foreign organic material. Filling shall be done in regular horizontal layers each not exceeding 20 cm. depth.

3.2.3 Back filling around completed foundations, structures, trenches and in plinth shall be done to the lines and levels shown on the drawings.

3.2.4 Back filling around pipes in the trench shall be done after hydro testing is done.



3.2.5 Back filling around liquid retaining structures shall be done only after leakage testing is completed and approval of **Engineer-in-Charge** is obtained.

3.2.6 Sand used for filling under foundation concrete, around foundation and in plinth etc. shall be fine/ coarse, strong, clean, free from dust, organic and deleterious

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matter. The sand filling under foundation shall be rammed with Mech. compactor. Sand material shall be approved by **Engineer-in-Charge**.

- 3.2.7 Moorum for filling, where ordered, shall be obtained from approved pits and quarries which contain siliceous material and natural mixture of clay. Moorum shall not contain any admixture of ordinary earth. Size of moorum shall vary from dust to 10 mm.
- 3.2.8 Hard-core shall be of broken stone of 90 mm to 10 mm size suitable for providing a dense and compact sub grade. Stones shall be sound, free from flakes, dust and other impurities. Hard core filling shall be spread and levelled in layers, 15 cm thick, watered and well compacted with ramming or with mechanical / hand compacts including hand packing wherever required.
- 3.2.9 If any selected fill material is required to be borrowed, **CONTRACTOR** shall make arrangements and procure such material from outside borrow pits. The material of source shall be subject to prior approval of **Engineer-in-Charge**. **CONTRACTOR** shall make necessary access roads to borrow areas and maintain the same, if such access roads do not exist, at no extra cost.
- 3.2.10 Plinth filling shall be carried out with approved material as described earlier, in layers not exceeding 150mm, watered and compacted with mechanical compaction machines. **Engineer-in-Charge** may however permit manual compaction by hand tampers in case he is satisfied that mechanical compaction is not possible. When filling reaches the finished level, the surface shall be flooded with water, unless otherwise directed, for at least 24 hours, allowed to dry and then the surface again compacted as specified above to avoid settlements at later stage. The finished level of the filling shall be trimmed to the level specified. Compacted surface shall have at least 95% of laboratory maximum dry density. A minimum of one test per 250 sq. meters of compacted area shall be done.
- 3.2.11 Whenever the fill material (earth or soil) is purchased, **CONTRACTOR** shall

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get the approval of Engineer-in-Charge. The CONTRACTOR shall arrange to determine the following properties of the soil and shall get the approval of **Engineer-in-Charge.**

1. Clay content : 15% to 20%
2. Laboratory dry density : Not less than 1600 kg/m³
3. Plasticity Index : Not more than 20

3.2.12 The fill shall be compacted using a vibrating compactor of not less than 1.5 tonne. The fill shall be thoroughly compacted in layers as directed but not more than 200 mm thick. Adequate water shall be used for compaction and the density after compaction shall be not less than maximum dry density obtained in test of IS: 2720 Part-8. Compacted surface shall have at least 90% of laboratory maximum dry density. A minimum of one test per 250 sq. meters of compacted area shall be done.



3.2.13 The Gravel fill shall be non plastic granular material, well graded, strong, with maximum particle size of 50 mm, with not more than 15% passing a 4.75 mm IS sieve, free of all debris, vegetable matter and chemical impurities.

3.2.14 All clods, lumps etc. shall be broken before compaction.

3.2.15 In case of grading/banking successive layers of filling shall not be placed, until the layer below has been thoroughly compacted to satisfy the requirements laid down in this specification.

Prior to rolling, the moisture content of material shall be brought to within +/- 2% of the optimum moisture content as described in IS 2720 Part-7. The moisture content shall preferably be on the wet side for potentially expansive soil.

After adjusting the moisture content as described, the layers shall be thoroughly compacted by means approved by Engineer-in-Charge, till the

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specified maximum laboratory dry density is obtained.

General, fill shall be placed in layers not exceeding 300 mm thickness and shall be thoroughly compacted to achieve a compaction of at least 90% of laboratory maximum dry density up to a depth of 600 mm below finished grade. Final fill of 600 mm thickness shall consist of preferably natural material in, as dug condition except that stones larger than 100 mm shall be removed. It shall be placed in layers not exceeding 150 mm thickness and compacted to achieve of at least 95% of laboratory maximum dry density. Each layer shall be tested in field for density and accepted by Engineer-in-Charge, subject to achieving the required density before laying the next layer. A minimum of one test per 250 sq meters for each layer shall be conducted.



If the layer fails to meet the required density, it shall be reworked or the material shall be replaced and method of construction altered as directed by Engineer-in-Charge to obtain the required density.

The filling shall be finished in conformity with the alignment, levels, cross-section and dimensions as shown in the drawing.

Extra material shall be removed and disposed off as directed by the **Engineer-in-Charge**.

4.0 Plain and Reinforced Concrete Work

This specifications deals with cement concrete, plain or reinforced, for general use, and covers the requirements for concrete materials, their storage, grading, mix design, strength & quality requirements, pouring at all levels, reinforcements, protection, curing, form work, finishing, painting, admixtures, inserts and other miscellaneous works.

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4.1 **Materials**

4.1.1 Cement: Any of the following cements may be used as required. If soil investigation report recommends any specified type of cement then same shall have precedence.

IS - 269	Ordinary Portland cement, 33 grade
IS - 8112	43 Grade ordinary Portland cement
IS - 12269	53 Grade ordinary port land cement

4.1.2 Water: Water used for mixing and curing concrete and mortar shall conform to the requirements as laid down in IS: 456. Sea water shall not be used for concrete work.

4.1.3 Aggregates: Coarse and fine aggregates for cement concrete plain and reinforced shall conform to the requirements of IS 383 and / or IS 515.



Before using, the aggregates shall be tested as per IS: 2386.

Coarse aggregate: Coarse aggregate for all cement concrete work shall be broken or crushed hard stone, black trap stone obtained from approved Quarries or gravel.

Sand: Fine aggregate shall consist of natural or crushed sand conforming to BIS 383 and conforming to test as per BIS 2386 parts I to IV.f. Grading of coarse sand shall be within grading zones I, II or III as laid down in IS: 383, table 4. If required the aggregates (both fine and coarse) shall have to be thoroughly washed and graded as per direction of **Engineer-in-Charge**.

4.2 **Mixing**

All cement concrete plain or reinforced shall be machine mixed. Mixing by hand may be employed where quantity of concrete involved is small, with the specific

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prior permission of the **Engineer-in-Charge**. 10% extra cement shall be added in case of hand mixing as stipulated in IS-456.

For large and medium project sites the concrete shall be sourced from ready-mixed concrete plants or from on site or off site batching and mixing plants (IS 4926)

4.3 **Water Cement Ratio, Laying & Curing**

Water Cement Ratio, Laying & Curing shall be done as per IS: 456.

4.4 **Grades of Concrete**



4.4.1 Grades lower than M 25 shall not be used in reinforced concrete.

4.4.2 A sieve analysis test of aggregates shall be carried out as and when the source of supply is changed without extra charge notwithstanding the mandatory test required to be carried out as per CPWD specification.

4.4.5 All tests in support of mix design shall be maintained as a part of records of the contract. Test cubes for mix design shall be prepared by the CONTRACTOR under his own arrangements and at his costs, but under the supervision of the **Engineer-in-Charge**.

4.5 **Design Mix Concrete**

4.5.1 Design mix shall be allowed for major works where it is contemplated to be used by installing weigh batch mixing plant as per IS 4925. At the time of tendering, the CONTRACTOR, after taking into account the type of aggregates, plant and method of laying he intends to use, shall allow in his tender for the design mix i.e., aggregate/cement and water/cement ratios which he considers will achieve the strength requirements specified, and workability for concrete to be properly finished.

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4.5.2 Before commencement of concreting, **CONTRACTOR** shall carry out preliminary tests for design mix on trial mixes proposed by him in design of mix to satisfy the **Engineer-in-Charge** that the characteristic strength is obtained. In this regard, CONTRACTOR may consult govt. approved/reputed institute to get design mix done as per IS 10262 at his own cost. The concrete mix to be actually used shall be approved by the **Engineer-in-Charge**.



4.5.3 Notwithstanding the above, the following shall be the maximum combined weight of coarse and fine aggregate per 50 kg of cement.

Grade of Concrete	Maximum weight of fine & coarse aggregates together per 50 kg of cement (for nominal mix only)
1. M - 10	480 kg
2. M - 15	350 kg
3. M - 20	250 kg

4.5.4 The workability of concrete produced shall be adequate, so that the concrete can be properly placed and compacted. The slump shall be as per IS 456.

4.5.5 The minimum consumption of the cement irrespective of design mix shall not be less than the following:

M 7.5 (1:4:8)	170 kg/cu m
M 10 (1:3:6)	240 kg/cu m
M 15	300 kg/cu m
M 20	330 kg/cu m
M 25	350 kg/cu m
M 30	400 kg/cu m

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4.6 **Testing of Concrete**

4.6.1 Testing of concrete, sampling and acceptance criteria shall be in accordance with IS 456.

4.7 **Proportioning**



Mixes of cement concrete shall be as ordered. Where the concrete is specified by grade, it shall be prepared by mixing cement, sand and coarse aggregate by weight as per mix design. In case the concrete is specified as volumetric mix, then dry volume batching shall be done, making proper allowances for dampness in aggregates and bulking in sand. Equivalent volume batching for concrete specified by grade may however be allowed by the **Engineer-in-Charge** at his discretion.

4.8 **Pre Cast Concrete**

The specifications for pre cast concrete will be similar as for the cast in situ concrete. All pre cast work shall be carried out in a yard made for the purpose. This yard shall be dry, properly levelled and having a hard and even surface. If the ground is to be used as a soft former of the units, shall be paved with concrete or masonry and provided with a layer of plaster (1:2 proportion) with smooth neat cement finish or a layer of MS sheeting. The casting shall be over suitable vibrating tables or by using form vibrators as per directions of **Engineer-in-Charge**.

The yard, lifting equipment, curing tank, finished material storage space etc. shall be designed such that the units are not lifted from the mould before 7 (seven) days of curing and can be removed for erection after 28 (Twenty Eight) days of curing. The moulds shall preferably be of steel or of timber lined with G.I .sheet metal. The yard shall preferably be fenced.

Lifting hooks, wherever necessary or as directed by **Engineer-in-Charge** shall be embedded in correct position of the units to facilitate erection, even though

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they may not be shown on the drgs. and shall be burnt off and finished after erection.

Pre cast concrete units, when ready shall be transported to site by suitable means approved by **Engineer-in-Charge**. Care shall be taken to ensure that no damage occurs during transportation. All adjustments, levelling and plumbing shall be done as per the instructions of the **Engineer-in-Charge**. The CONTRACTOR shall render all help with instruments, materials and staff to the **Engineer-in-Charge** for checking the proper erection of the pre cast units.

After erection and alignment the joints shall be filled with grout or concrete as directed by **Engineer-in-Charge**. If shuttering has to be used for supporting the pre cast unit they shall not be removed until the joints has attained sufficient strength and in no case before 14 (fourteen) days. The joint between pre cast roof planks shall be pointed with 1:2 (1 cement : 2 sand) mortar.

5.0 STEEL REINFORCEMENT



5.1 Steel reinforcement shall comprise:

- 1) CRS bars
- 2) TMT bars

5.2 All joints in reinforcement shall be lapped adequately to develop the full strength of the reinforcement as per provision of IS: 456 or as per instruction of **Engineer-in-Charge**.

6.0 Form Work

6.1 The shuttering or form work shall conform to the shape, lines and dimensions as shown on the drawings and be so constructed as to remain sufficiently rigid during placing and compacting of the concrete and shall be sufficiently tight to prevent loss of liquid from the concrete. The surface that becomes exposed on the removal of forms shall be examined by **Engineer-in-Charge** or his

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authorized representative before any defects are made good. Work that has sagged or bulged out, or contains honey combing, shall be rejected. All shuttering shall be plywood or steel shuttering.



6.2 The **CONTRACTOR** shall be responsible for sufficiency and adequacy of all form work. Centering and form work shall be designed & detailed in accordance with IS 14687 and approved by the **Engineer-in-Charge**, before placing of reinforcement and concreting.

6.3 **Stripping Time**

Forms shall not be struck until the concrete has reached strength at least twice the stress to which the concrete may be subjected at the time of removal of form work. The strength referred to shall be that of concrete using the same cement and aggregates, with the same proportions and cured under conditions of temperature and moisture similar to those existing on the work. Where possible, the form work shall be left longer as it would assist the curing.

Note 1: In normal circumstances and where ordinary Portland Cement is used, forms may generally be removed after the expiry of the following periods:

1.	Walls, columns and vertical faces of all structural members	24 to 48 hours as may be decided by the Engineer-in-Charge
2.	Slabs (props left under)	3 days
3.	Beam soffits (Props left under)	7 days
4.	Removal of props under slabs	
	1. Spanning up to 4.5 m	7 days
	2. Spanning over 4.5 m	14 days
5.	Removal of props under beams & arches:	
	1. Spanning up to 6 m	14 days

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	2. Spanning over 6m	21 days
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For other types of cements, the stripping time recommended for ordinary Portland Cement may be suitably modified.

Note 2: The number of props left under, their sizes and disposition shall be such as to be able to safely carry the full dead load of the slab, beam or arch as the case may be together with any live load likely to occur during curing or further construction.

7.0 Cement Concrete Block



Cement concrete block shall be machined made in the proportion of such that mix shall not be leaner than one cement to twelve combined aggregates (by volume) but having minimum strength of 7.5 MPa. Combined aggregate shall be graded as near as possible to IS: 383. The fineness modulus of combined aggregate shall be between 3.6 and 4. The concrete block shall be properly cured as per IS-456. The surface of conc. block shall have even face without any honeycomb and free from cracks.

7.7.1 Mortar

Cement and water shall conform to the requirements laid down for cement concrete work.

7.7.2 Sand for concrete block masonry mortars shall be coarse sand generally conforming to IS: 2116. Maximum quantities of clay, fine dust, shall not be more than 5% by weight. Organic impurities shall not exceed the limits laid down in IS: 2116.

7.7.3 Mix of mortar for building concrete block shall be as specified in the item of work.

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7.7.4 Mixing of the mortar shall be done in a mechanical mixer. When quantity involved is small hand mixing may be permitted by **Engineer-in-Charge**. Any mortar remaining unused for more than 30 minutes after mixing shall be rejected.

7.8 **Concrete Block Masonry**

The thickness of joints shall be 10 mm +/- 3mm. Thickness of joints shall be kept uniform. In case of foundation and manholes etc. joints up to 15 mm may be accepted.

7.9 **Half Concrete Block**

All courses shall be laid with stretchers. Reinforcement comprising 2 nos. 6 mm dia MS bars shall be provided over the top of the first course and thereafter at every fourth course.

7.10 **Fixtures**



All iron fixtures, pipes spouts, hold fasts of doors and windows which are required to be built into the wall shall be embedded in cement concrete blocks 1:2:4 mix (1 cement :2 coarse sand :4 graded stone aggregate. 20 mm nominal size) of size indicated in the item.

7.11 **Curing**

Concrete block masonry shall be protected from rain by suitable covering when mortar is green. Masonry work shall be kept constantly moist on all faces for a minimum period of seven days.

8.0 **STRUCTURAL STEEL WORK**

This specification covers the technical requirements for the preparation of shop drawings, supply, fabrication, protective coating, painting and erection of all structural steel rolled sections, built up sections, plates and miscellaneous steel required for the completion of the work.

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Steel

All structural steel used in construction within the purview of this contract shall, comply with one of the following Bureau of Indian Standard Specifications, whichever, is appropriate or as specified.

IS – 2062 Hot rolled sections and plates

IS – 1079 Cold formed light gauge sections

IS – 1161 Tubular sections

IS – 4923 Hollow sections (rectangular or square)

Fabrication



Fabrication of steel structure shall be carried out in conformity with the best modern practices and with due regard to speed with economy in fabrication and erection and shall conform to IS-800. All members shall be so fabricated as to assemble the members accurately on site and erect them in correct positions. Before dispatch to site the components shall be assembled at shop and any defect found rectified. All members shall be free from kink, twist, buckle, bend, open joints etc. and shall be rectified before erecting in position. Failure in this respect will subject the defective members to rejection.

Fabrication Drawings:

Connections, splices and other details shall be suitably designed based on good Engineering practice.

Electrodes:

Electrodes used for welding shall comply with IS-814 or IS - 815.

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8.1 MS Black/High Strength Bolts and Nuts



M.S.Black or high strength bolts, nuts and washers etc. shall be as per IS-800, IS-1363 and IS-1367. Manufacturer's test certificate shall be made available to the **Engineer-in-Charge**. For bolted joints, shanks and threaded bolts are to be used to ensure that threaded length do not encroach within the thickness of connected members of dimension beyond the following limit:-

1. 1.5 mm for connected members of thickness below 12 mm and
2. 2.5 mm for connected member of thickness 12 mm and above and that adequate shearing and bearing values required as per design are achieved.

Every portion work shall have its erection mark or numbers stencilled on the member for guidance in erection and bear all necessary marks of erections as directed by the Owner / Consultant.

No part of the work is to be oiled, painted (except contact surfaces) packed, bundled, crated or dispatched until it has been finally inspected and approved by the Owner / Consultant or his authorized representative. The whole steel work before being dispatched from the Contractor's shop shall be dry and after being thoroughly cleaned from dust, mills scale, rust etc., and shall be given two coats of primer and one coat of final paint as per painting specification attached in this enquiry. Unless otherwise specified, all surfaces inaccessible after welding shall be given two coats of primer and two coats of paints as per painting specification attached in this enquiry.

The Owner / Consultant or his authorized representative shall have free access at all reasonable time to all places where the work is being carried out, and shall be provided by the Contractor at his own expenses all necessary facilities for inspection during fabrication and erection. The Owner / Consultant or his authorized representative shall be at liberty to reject the work in whole or in part if the workmanship or materials do not conform to the terms of the specifications

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mentioned herein. The Contractor shall remove, replace or alter any part of the work as ordered by the Owner / Consultant or his authorized representative.

9.0 PAINTING ON STRUCTURAL STEEL



Painting on Structural Steel shall be in accordance with the Painting Specification given elsewhere in the NIT documents. However, the following details may also be referred for painting of structural steel work if applicable with Owner/PMC consent.

9.1 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 structural steelwork, plate work, handrails and associated metal surfaces, which will be exposed to atmospheric for industrial plants.

9.2 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.
- DF - Dry Film thickness, the thickness of the dried or cured paint or coating film.

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9.3 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.

9.4 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.

9.5 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.

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9.6 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.

9.7 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.



9.8 Other Standards:

9.8.1 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.

9.8.2 DIN: 53151 Standards for Adhesion test.

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9.9 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.

9.10 Surface Preparation

9.10.1 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.

9.10.2 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.

9.10.3 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

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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



pH between 6 – 8

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.

9.10.4 Abrasive blasting

All C.S materials shall be abrasive blast cleaned in accordance with relevant IS Codes. 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.

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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 Degree Celsius 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/cm² 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.

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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

9.10.5 Painting system to be used is indicated below:

1. Epoxy Painting:

SL.NO	DESCRIPTION	GENERIC COATING SYSTEM
1.	SURFACE PREPARATION	Blast clean to SA 2.5
2.	PRIMER	One coat of ethyl silicate zinc rich with solvent. Thickness 75 micron per coat
3.	INTERMEDIATE	Two coat of two pack high build aliphatic amine cured epoxy coating Thickness 100 micron per coat.
4.	FINISH COAT	One coat of two pack amine cured epoxy / Acrylic aliphatic polyurethane. Thickness 50 micron per coat
5.	Total DFT	325 Micron

2. For PU painting:

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- i) P1 – One coat of Ethyl silicate inorganic zinc primer having DFT of 70 microns per coat.
- ii) IP1 – One coat of Epoxy MIO having DFT of 70 microns per coat.
- iii) FP1 - One coat of finish epoxy paint using two pack Polyamide cured epoxy having DFT of 40 microns per coat.
- iv) FP2 - One coat of Aliphatic Acrylic Polyurethane paint having DFT of 40 microns per coat.



9.10.6 All the surfaces must be abrasive blasted and 2 coats of primer plus 1 coat of finish paint applied in the fabrication shop before the same are shifted to site for erection. All the members must be suitably match marked for facilitating proper assembly.

After erection is over all surfaces shall be washed up as follows:

Washing with clean water (pressure 7 kg/cm²) using suitable nozzles. During washing broom corn brushes shall be used to remove foreign matters.



Solvent washing if required to remove traces of oil grease etc.

- a) After washing the surface as indicated above, the surfaces shall be suitably touched up to the extent required so that all the damages to the primed surfaces caused during erection are done up.
- a) The surfaces affected by welding and / or gas cutting during erection shall also be suitably touched up. Before touch up is taken up surfaces shall be prepared by mechanical means such as grinding, power brushing etc. to achieve surface finish to ST-3.
- b) After touch up work is over as indicated above, all the surfaces shall be given one coat of finish paint to the required specification.

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9.10.7 The following points must be observed for painting work:

1. Primer and paint shall be compatible to each other and should be from the same manufacturer.
 2. The recommendation of the paint manufacturer regarding mixing, matching and application must be followed meticulously.
 3. Technical representative of paint manufacturer should be available at site as and when required by **Engineer-in-Charge** for their expert advice as well as to ensure that the painting work is executed as per the instruction of paint manufactures.
- c) Paints and primers shall be supplied at site in original container with factory seal otherwise such paints and primers shall not be allowed to be used. Mode of application i.e. by spray, brush or roller shall be strictly as per recommendation of paint manufacturer.
- d) Painting materials must be used before the expiry date indicated on the containers.
- e) Number of coats and DFT per coat must be strictly followed as indicated above. If the desired DFT is not achieved for primer and finish paints in two coats (each), **CONTRACTOR** shall be required to apply extra coat (s) to achieve the desired DFT without any extra cost to **Engineer-in-Charge**.
- f) Color shade for each coat of primer and finish paint must be different to identify the coats without any ambiguity.
- g) Shade for the final finish coat shall be decided by **Engineer-in-Charge** at site.
- h) All painting materials must be accompanied by manufacturers test certificates. However, Engineer-in-Charge has any doubt regarding quality of materials, he shall have the right to direct CONTRACTOR to get the doubtful material tested or and provided (by CONTRACTOR) testing agencies for which no extra payment shall

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be made to the CONTRACTOR and the charges shall deemed to be covered in the unit rates quoted for fabrication and erection of structural work.

- i) DFT for paint shall be measured at least 20 points and mean DFT shall not vary by more than 10% than specified in DFT.
- j) Reliable and calibrated Instrument for measurement of DFT shall be arranged and provided by **CONTRACTOR** at his cost.
- k) Thickness of each coat shall also be checked regularly to ensure uniformity in DFT.

9.10.8 Abrasive blasting and painting works, being a specialized job must be carried out through the approved agencies only.

10.0 Steel / Aluminium Doors, Windows and Ventilators



10.1 The Steel doors, windows and ventilators shall be of the size and type as per IS-1361 and IS-1038. Fixing and glazing shall be done as per IS-1081 and as per manufacturer's instructions. The putty of approved make such as special gold size or equivalent conforming to IS-419 shall be used.

10.2 Aluminium doors, windows and ventilators shall be manufactured from wrought aluminium and aluminium alloy extruded round tube and / or hollow rectangular / square sections conforming to IS: 1285 & IS : 6477 or equivalent as approved by **Engineer-in-Charge**.

11.0 ROOFING & CLADDING

All roof and cladding sheets should be galvalume sheet of 0.5 mm total coated thickness with 550 MPA grade steel confirming to AS 1397 with AZ150 grade coating.

Translucent sheets shall be provided, in non-process areas only, intermittently where day lighting is required.

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12.0 FLOORING AND PAVING

12.1 Sub Base of floor



12.1.1 The area to be paved shall be divided into suitable panels. Form work shall be provided. The boarding / battens shall be fixed in position with their toe at proper level, giving slope where required. Alternatively base concrete may be deposited in the whole area at a stretch.

12.1.2 Before placing the base concrete the sub-base shall be properly wetted and rammed. The concrete of the specified mix shall then be deposited between the forms where provided, thoroughly tamped and the surface finished level with the top edge of the forms. The surface of base concrete shall be spreader uniformly. The surface shall be finished rough to provide adequate bond for the topping. Two or three hours after concrete has been laid the surface shall be brushed with wire brush to remove any scum or Latinate and swept clean so that coarse aggregate is exposed.

12.2 Cement Concrete Floor Finishes

12.2.1 The surface of base concrete shall be thoroughly cleaned by scrubbing with coir or steel wire brush. Before laying the topping, the surface shall be soaked with water at least for 12 hours and surplus water mopped up immediately before the topping is laid.



12.2.2 The forms shall be fixed over the base concrete dividing into suitable panels. Where glass dividing strips are provided, thickness of glass dividing strips shall be 4 or as indicated. Before placing the concrete topping, neat cement slurry at the rate of 2 kg/sq.m shall be then thoroughly brushed into the base concrete just ahead of the finish. The topping shall then be laid, thoroughly compacted by using screed board/plate vibrator. The surface floated with a wooden float to a fair and even surface shall be left for some time till moisture disappears from it.

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Junctions with skirting / dado or wall surfaces shall be rounded off using cement mortar 1:2 curing shall be carried out for a minimum of 7 days.



12.2.3 Electrostatic discharge flooring (ESD) for Switch gear room

<p>Base Surface Requirement: Base floor substrate should be minimum M20 grade reinforced concrete surface, clean dry (moisture below 5%), sound and finished smooth and levelled.</p>
<p>Surface Preparation: Clean the surface thoroughly by mechanical means preferably using vacuum assisted mechanical grinders to remove loose particles, dust, dirt, laitance, etc. All the stickers on the floor shall be removed and the area cleaned thoroughly. Any cracks above 1mm should be groove cut, cold/construction joints to be given suitable treatment. (Expansion /Isolation joints to be provided with flexible PU sealant and will be in the scope of civil contractor)</p>
<p>Primer Application: A coat of epoxy primer Cipoxy 11 of Cipy Polyurethane or approved equivalent from other manufacturers like KRISHNA CONCHEM/BASF/FOSROC/SIKA shall be applied on the prepared surface by using brush/roller.</p>
<p>800 microns Epoxy Screed : The 800 microns thick epoxy screed of Cipoxy 15 & aggregates of Cipy Polyurethane or approved equivalent from KRISHNA CONCHEM/BASF/FOSROC/SIKA for heavy duty movement shall be laid to take heavy load on the floor and reduce the level difference if any.</p>
<p>Conductive Grid : The self adhesive copper grid shall be provided across the area with 10 mtr spacing. The copper stripe shall be taken out at few points to connect the same to earth pit. (Connecting to earthing strip and making earthing pit will be in the scope of civil/electrical contractor)</p>
<p>Conductive Base Coat : A second coat of conductive primer Aquoxy ESD of Cipy Polyurethane or approved equivalent from KRISHNA CONCHEM/BASF/FOSROC/SIKA shall then be applied on entire area sandwiching the copper grid. This layer forms the electrical plane through static charges are dissipated. Allow coating to cure for 12 Hrs.</p>
<p>1 MM Self-Leveling Anti-Static Topping : Lay 1 mm thick dissipative grade Self Smoothing Epoxy topping "Statguard ESD 108" of Cipy Polyurethane or approved equivalent from KRISHNA CONCHEM/BASF/FOSROC/SIKA on the entire primed area. The surface resistivity of the total system shall be in the range of 1×10^6 Ohms to 1×10^9 Ohms as per the ASTM F 150, EOS/ESD Standard 7.1 or NFPA 99 A guidelines.</p>

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13.0 PLASTERING

- 13.1 Sand for plastering shall be 50% fine sand and 50% coarse sand from approved sources.
- 13.2 Preparation of surface shall be done as per CPWD specifications.
- 13.3 Cement mortar shall be of the mix as indicated in the items and shall be mixed as specified in the CPWD specifications.
- 13.4 Joints in walls etc. shall be raked to a depth of 12 mm, brushed clean with wire brushes dusted and thoroughly washed before starting the plaster work.
- 13.5 The surface shall be thoroughly washed with water cleaned and kept wet to saturation point before plastering is commenced.
- 13.6 Cement mortar as indicated, shall be firmly applied to the masonry walls in a uniform layer to the thickness specified and will be pressed into the joints. On concrete surfaces rendering shall be dashed to the roughened surface to ensure adequate bond. The surface shall be finished even and smooth. Hectoring wherever required shall be done as per directions of **Engineer-in-Charge**. Nothing extra shall be paid on this account.
- 13.7 All plaster work shall be cured for at least 7 days.
- 13.8 Integral water proofing compound shall be mixed with cement in the proportion recommended by the manufacturer. Care shall be taken to ensure that the water proofing material gets well and integrally mixed with cement. All other operations are the same as for general plaster work.
- 13.9 For sand face plaster undercoat of cement plaster 1:4 (1 cement : 4 sand) of thickness not less than 12 mm shall be applied similar to one coat plaster work. Before the under coat hardens the surface shall be scared to provide for the top coat. The top coat also of cement mortar 1:4 shall be applied to a thickness not

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less than 8 mm and brought to an even surface with a wooden float. The surface shall then be tapped gently with a wooden float lined with cork to retain a coarse surface texture, care being taken that the tapping is even and uniform.

14.0 Exterior Painting or Apex

14.1 Exterior painting shall be Apex.

14.2 Where shown on drawings for external surfaces of sand faced plaster, or any other surface, two coats of cement paint shall be applied of tint and shade as approved by the **Engineer-in-Charge**.



14.3 The surfaces shall be prepared as specified for white washing. Before applying cement paint the surface shall be thoroughly wetted to control surface suction. The surface shall be moist but not dripping wet, when the paint is applied. Not less than 24 hours shall be allowed between the two coats. In hot weather the first coat shall be slightly moistened before applying the second coat.

14.4 On external plastered surfaces (one coat primer + minimum 3 coat of paints), sand faced or plain plastered and concrete surfaces, apex weather proof paint shall be vigorously scrubbed on to work the paint into the voids and provide a continuous paint film free from pin holes and other openings.

15.0 GLAZING

15.1 Sheet glass glazing of doors, windows etc. shall be of selected quality glass conforming to IS: 2835. Toughened splinter proof industrial safety glass shall confirm to IS: 2553. No cracked chipped or disfigured glass shall be accepted Glass shall be in one piece for each pan.

15.2 Glazing shall be fixed with timber or steel / aluminium beading as called for. Glass shall be back puttied and fixed with beading for a water tight and rattle free installation. Sizes of timber/ steel / aluminium beading shall be as directed.

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16. PROTECTIVE COATING AND LINING SYSTEM

16.1 EPOXY COATING

Characteristics of coated surfaces (after application)



- Compressive strength : min. 90 N/mm²
- Tensile strength : min. 10 N/mm²
- Abrasion resistance : as per Amsler 1.5 mm after 3000 revol.
- Bonding (joining) factor : 1
- Adhesion with concrete : min. 2.5 N/mm²
- Elongation : 15%

APPLICATION:

A) ON FLOOR

1. For Chemical resistant flooring in Bagging Building

SL. NO	DESCRIPTION
1.	Surface preparation- in this case concrete columns, beams, soffitt slabs, floors & plastered brick masonry walls (for receiving IMPREGNATION, BOND COATS, COATINGS etc) with hand wire brushes or rotary wire brushes etc and removing all the dust , dirt etc complete.
2.	Impregnation with monomer (5 cps viscosity) to be applied by brush with a consumption of minimum 0.25 kg/m ²
3.	Providing and applying structural grade Epoxy Bonding agent, (with bond strength of 3 N/mm ²) over concrete prior to screed concrete. Bonding agent to be used as per application procedure of manufacturer.
4.	Self levelling cementitious screed avg. 25mm thick, using proportion 1:1:0.5 cement: sand : 8 mm down aggregates (by weight) with addition of suitable free flow and performance improving additives namely micro silica, shrinkage compensating admixtures, polymers, high range super plasticizers. W/C ratio not to exceed 0.4. Compressive strength of the



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SL. NO	DESCRIPTION
	screed to be 37.5 N/mm ² after 28 days over bonding agent.
5.	Providing and applying structural grade Epoxy Bonding agent, (with bond strength of 3 N/mm ²) over screed concrete. Bonding agent to be used as per application procedure of manufacturer.
6.	Self levelling epoxy phenolic IPN (inter penetrating polymer network) screed (min 3mm thick, solvent free resin in proportion of 1 resin hardener mix : 2 sharp silica sand 600 micron down) on dry and clean surface of the self levelling cementitious screed done earlier, using special fork type leveller tool and allowing the screed to cure for 48 hours.

1. For Anti-static epoxy flooring system in Substation –

The switch gear room in the substation shall be provided with electrostatic discharge flooring (ESD flooring- 2mm thick Anti-static epoxy flooring system)



Sr. No.	Specification
	Base Surface Requirement: Base floor substrate should be minimum M20 grade reinforced concrete surface, clean dry (moisture below 5%), sound and finished smooth and levelled.
1	Surface Preparation: Clean the surface thoroughly by mechanical means preferably using vacuum assisted mechanical grinders to remove loose particles, dust, dirt, laitance, etc. All the stickers on the floor shall be removed and the area cleaned thoroughly. Any cracks above 1mm should be groove cut, cold/construction joints to be given suitable treatment. (Expansion /Isolation joints to be provided with flexible PU sealant and will be in the scope of contractor)
2	Primer Application : Providing & Applying two component epoxy based penetrating primer, having a volumetric mixing ratio of resin and hardener as per manufacturer guidelines, to a thickness of 100 microns which has excellent bond with concrete substrate by Brush / Roller and broadcasting of chemically treated silica and allow for 5-6 hours curing.

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3	<p>Sealer Application</p> <p>Providing & applying two components epoxy mortar of homogeneous mix and leveled by trowel to form a monolithic layer to a thickness of 800 microns and allow curing for 4-5 hours.</p>
4	<p>Conductive Coat: The self adhesive copper grid shall be provided across the area with 10 mtr spacing. The copper stripe shall be taken out at few points to connect the same to earth pit. (Connecting to earthing strip and making earthing pit will be in the scope of contractor)</p>
5	<p>Conductive Base Coat: Providing & applying of epoxy ESD, at a specified ratio as per manufacturer guidelines to a thickness of 100 microns by Brush / Roller and broadcasting of chemically treated silica and allow for 12 hours curing. This layer forms the electrical plane through which static charges are dissipated.</p>
6	<p>Topcoat Application:</p> <p>Providing & applying of STAT GUARD ESD at a specified ratio and leveled by trowel to a thickness of 1000 microns and spike roller is applied for de-aeration. This can be given in any color. The entire top coat has to be dried for 24 hours before loading. Final finished floor shall be leveled smooth surface, clean and dust free. The surface resistivity of the total system shall be in the range of 1×10^6 Ohms to 1×10^9 Ohms as per the ASTM F 150, EOS/ESD Standard 7.1 or NFPA 99 A guidelines.</p>

B) ON WALLS, SLAB, SOFFITS, BEAMS, COLUMN

SL. NO	DESCRIPTION
1.	Surface preparation- in this case concrete columns, beams, soffitt slabs, floors & plastered brick masonry walls (for receiving IMPREGNATION, BOND COATS, COATINGS etc) with hand wire brushes or rotary wire brushes etc and removing all the dust , dirt etc complete.
2.	Impregnation with monomer (5 cps viscosity) to be applied by brush with a consumption of minimum 0.25 kg/m ²
3.	Impregnation of prepared concrete surface (internal walls, slab, soffits, beams, column and cut outs) with polymethyl methacrylate monomer (viscosity 5cps), brush applied @

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SL. NO	DESCRIPTION
	0.25kg/m ² . Three coat epoxy phenolic IPN solvent containing protective coating with one non pigmented primer coat and two subsequent colour coats with approved shades giving total dry film thickness of 225 +/- 10 microns over impregnated and cleaned surface.

16.2 ACID PROOF TILES:

MATERIAL

1) TILES

These tiles shall be made of clays, feldspar, quartz, talc and vitrified at high temperature in ceramic kilns and kept unglazed so as to prevent from slipperiness. Tiles shall not absorb more than 2% of their own dry weight when soaked in water. Compression strength: 700 Kg/cm² Min. & Flexural strength: 200 Kg/cm² Min. It shall not lose more than 1.5% of its weight when soaked in acid.



Chemical compositions of tiles:

- Al₂O₃ : 22-24%
- SiO₂ : 60-65%
- Fe₂O₃ : 1.0-2.0%
- Alkalise : 10-12%

2) K-BASED SILICATE MORTAR

Acid Proof cement KSC is a potassium silicate based corrosion cement. Acid tile linings carried out with KSC cement are not subject to crystal formation in the pores of cement. Besides Bitumastic surface is joint-less, hence there is no danger of Acids percolating through the surface.

Characteristics of K-based Silicate mortar:

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- Colour : White
- Density (lbs/Cub. ft.) : 130
- Water Absorption : 2-5 %
- Tensile Strength (Psi) : 400
- Compressive strength (Psi) : 2800
- Bond Strength (Psi) : 180
- Coefficient of thermal expansion : 6.0×10^{-6}

3) BITUMASTIC MORTAR

It shall consist of an acid proof inorganic filler and blended bitumen. It shall be trowelled to concrete having total thickness of 10 mm.

Characteristics of Bituminous compounds:

- Density (Kg/m^3) : 2200
- Water content by mass percent (max) : 0.5
- Flash point °C ,min. : 35

Consistency



- a) Before setting (test after 1 hr) min. : 100
- b) After setting (test after 24 hr) min. : 80

Mastic shall be heated to 150-300°C and shall be applied in 5 mm layers after surface is cleaned and dried.

4) BITUMINOUS PAINT

This is generally of heavy grade bituminous corrosion resisting paint. 2 coats of the paint shall be given, and drying time between the 2 coats shall not be less than 5 hours. Also, its drying time after second coat shall not be more than 8 hours. Its finish shall be smooth, glossy and elastic.

The primer shall confirm to the following requirements:

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- Viscosity by standard tar viscometer, 4mm orifice at 25°C: 4 to 24
- Penetration at 25°C, 100g, 5sec in 1/100 cm : 20 to 50
- Water content percent (max) : 0.2

APPLICATION

SL. NO.	DESCRIPTION	ITEM OR AREA
1.	Bituminous Paint (Primer)	Concrete surface
2.	10mm Bitumastic Laying in two layers each shall not be more than 5mm thick	Over Bituminous Paint
3.	One layer, 5mm Acid, K-based Silicate Type mortar	#
4.	10 mm thick Acid proof tiling	Over K-based Silicate

- Tiles should be fixed on bitumastic surface with the help of 5mm K-based silicate mortar.



16.2 ACID RESISTANT BRICK LINING

A. MATERIAL

These bricks are made of raw materials such as clay or shale of suitable composition with low lime and iron content, feldspar, flint or sand and vitrified at high temperature in ceramic kilns. Bricks shall not absorb more than 2% of their own wt. when soaked in water. Compression strength: > 700 Kg/cm². Bricks shall not lose more than 1.5% at their own weight when tested for acid resistance.

Chemical compositions of bricks are

- a) Al₂O₃ 22-24%

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- b) SiO₂ 60-65%
- c) Fe₂ O₃ 1.0-2.0%
- d) Alkalies 10-12%

1) K-BASED SILICATE MORTAR

Acid Proof cement KSC is a potassium silicate based corrosion cement. Acid brick linings carried out with KSC cement are not subject to crystal formation in the pores of cement. Besides Bitumastic surface is joint-less, hence there is no danger of Acids percolating through the surface.

Characteristics of K-based Silicate mortar:



Colour	: White
Density (lbs/Cub. ft.)	: 130
Water Absorption	: 2-5 %
Tensile Strength (Psi)	: 400
Compressive strength (Psi)	: 2800
Bond Strength (Psi)	: 180
Coefficient of thermal expansion	: 6.0 x 10 ⁻⁶

2) BITUMASTIC MORTAR

It shall consist of an acid proof inorganic filler and blended bitumen. It shall be trowelled to concrete having total thickness of 10 mm.

Characteristics of Bituminous compounds:

Density (Kg/m ³)	: 2200
Water content by mass percent (max)	: 0.5
Flash point °C ,min.	: 35
Consistency	
c) Before setting (test after 1 hr) min.	: 100

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d) After setting (test after 24 hr) min. : 80

Mastic shall be heated to 150-300°C and shall be applied in 5 mm layers after surface is cleaned & dried.

3) BITUMINOUS PAINT(PRIMER)

This is generally of heavy grade bituminous corrosion resisting paint. 2 coats of the paint shall be given, and drying time between the 2 coats shall not be less than 5 hours. Also, its drying time after second coat shall not be more than 8 hours. Its finish shall be smooth, glossy and elastic.

The primer shall confirm to the following requirements:

Viscosity by standard tar viscometer, 4mm orifice at 25°C : 4 to 24



Penetration at 25°C, 100g, 5sec in 1/100 cm : 20 to 50



Water content percent (max) : 0.2

APPLICATION

SL. NO.	DESCRIPTION	ITEM OR AREA
.	Bituminous Paint (Primer)	Concrete surface
.	10mm Bitumastic Laying in two layers each shall not be more than 5 mm thick	Over Bituminous Paint
3.	One layer, 5mm Acid, K-based Silicate Type mortar	#
4.	One layer, 40mm Acid resistant Brick lining	Over K-based Silicate

#:- K-based Silicate mortar should be buttered on all sides of acid-resistant brick except the side facing the surface to be exposed to corrosives



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ANNEXURE-VI



ES-2517

TECHNICAL SPECIFICATION
FOR
WATER SUPPLY, DRAINAGE & SANITATION

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1.0 Scope

1.1 This Specification Covers

The supply, laying and installation of pipes / open surface drains for draining off rain / surface water, fire water, sewage, plant effluent / blow down / floor washings etc., with all fittings and fixtures including jointing.

The supply, laying and installation of pipes for supply of water with all fittings and fixtures including jointing.

The supply and installation of sanitary fixtures like water closets, urinals, wash basins, sinks etc., with all fittings and fixtures.

The supply and installation of toilet accessories like mirrors, shelves, towel rails, liquid soap containers etc., with all fittings and fixtures.



The supply and installation of overhead water tanks with all fittings and fixtures.

The supply and construction of ancillary works like manholes, drop connections, gully chambers, oil traps, soak pits etc., with all fittings and fixtures.

2.0 GENERAL REQUIREMENTS

2.1 The Contractor shall furnish all skilled and unskilled labour, plant, equipments, scaffolding, men, materials, etc., required for complete execution of the work in accordance with the drawings and as described herein and / or as directed by the Engineer.

2.2 The Contractor shall make his own arrangements for locating the coordinates and positions of all works and reduced levels (RL) at these locations based on two reference grid lines and one bench mark which will be furnished by the owner. The Contractor has to provide at site all the required survey instruments etc., to the satisfaction of the Engineer so that the work can be carried out accurately according to the specification and drawing.

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- 2.3 The Contractor shall make good to the satisfaction of the Engineer all cuttings / damages resulting from his operations during the installation.
- 2.4 Only tentative Plant layout shall be furnished by the Owner. Detailed working drawings showing the layout, installation and other details will be prepared by the Contractor and got approved from the Engineer.
- 2.5 The Contractor shall dispose of all unserviceable materials at least 50 m away from the plant boundary, unless otherwise directed by the Engineer. All serviceable material shall be stacked within a lead of 500 m as directed by the Engineer.
- 2.5 In case of any contradiction between the provisions stipulated in this module of technical specification and those of other modules like Excavation and Filling, Cast-in-situ Concrete and Allied works etc., the former shall govern.



All works shall be carried out by qualified / licensed plumbers.

3.0 CODES AND STANDARDS



- 3.1 All standards, specifications, acts, and Codes of practice referred to herein shall be the latest edition including all applicable official amendments and revisions.
- 3.2 In case of conflict between this specification and those (IS Standards, codes etc.) Referred to herein (in para 3.3) the former shall prevail.
- 3.3 Some of the relevant Indian Standards, Acts and Codes referred to herein are given below:

IS : 458 : Precast concrete pipes.



IS : 554 : Dimensions for pipe threads, where pressure tight joints are made on threads.

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- IS : 651 : Salt glazed stoneware pipes and fittings.
- IS : 771 : Glazed fire clay sanitary appliances.
(Part-1 to 7)
- IS : 774 : Flushing cisterns for water closets and urinals.
- IS : 775 : Cast iron brackets and supports for wash basins and sinks.
- IS : 778 : Copper alloy gate, globe and check valves for water works purposes.
- IS : 781 : Cast copper alloy screw down bib taps and stop valves for water services.
- IS : 782 : Caulking lead.
- IS : 783 : Code of practice for laying of concrete pipes.
- IS : 805 : Code of practice for use of steel in gravity water tanks.
- IS : 1172 : Code of basic requirements for water supply, drainage and sanitation.
- IS : 1239 : Mild steel tubes, tubular and other wrought steel fittings.
- IS : 1536 : Centrifugally cast (Spun) iron pressure pipes for water, gas and sewage.
- IS : 1703 : Copper alloy float valves.
- IS : 1726 : Cast iron manhole covers and frames.
- IS : 1729 : Sand cast iron spigot and socket, soil waste and ventilating pipes, fittings and accessories.
- IS : 1742 : Code of practice for building drainage.
- IS : 1795 : Pillar taps for water supply purposes.
- IS : 2065 : Code of practice for water supply in buildings.
- IS : 2326 : Automatic flushing cisterns for urinals.

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IS	:	2501	:	Solid drawn copper tubes for general engineering purposes.
IS	:	2548	:	Plastic seats and covers for water closets.
IS	:	2692	:	Ferrules for water services.
IS	:	2963	:	Copper alloy waste fittings for wash basins and sinks.
IS	:	3311	:	Waste plug and its accessories for sinks and wash basins.
IS	:	3438	:	Silvered glass mirrors for general purposes.
IS	:	3486	:	Cast iron spigot and socket drain pipes.
IS	:	3989	:	Centrifugally cast (spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS	:	4111 (Part-1 to 5)	:	Code of practice for ancillary structure in sewerage system.
IS	:	4127	:	Code of practice for laying of glazed stone-ware pipes.
IS	:	4764	:	Tolerance limits for sewage effluent discharged into inland- surface waters.
IS	:	4827	:	Electro plated coatings of nickel and chromium on copper and copper alloys.
IS	:	5219	:	Cast copper alloys traps.
IS	:	5329	:	Code of practice for sanitary pipe work above ground for buildings.
IS	:	5382	:	Rubber sealing rings for gas mains, water mains and sewers.
IS	:	5822	:	Code of practice for laying of welded steel pipes for water supply.
IS	:	6163	:	Centrifugally cast (spun) iron low pressure pipes for water, gas and sewage.

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- IS : 7231 : Plastic flushing cisterns for water closets and urinals.
- IS : 7740 : Code of practice for construction and maintenance of road gullies.
- IS : 8931 : Copper alloy fancy single taps combination tap assembly and stop valves for water services.
- IS : 8934 : Cast copper alloy fancy pillar taps for water services.
- IS : 9762 : Polyethylene floats for float valves.
- IS : 10446 : Glossary of terms for water supply and sanitation.
- IS : 10592 : Industrial emergency showers, eye and face fountains and combination units.
- IS : 12592 : Specification for precast concrete manhole covers and frames.
- SP : 35 : Hand book on water supply and drainage.

4.0 MATERIAL

- 4.1 All pipes, fittings, fixtures, appliances and accessories shall conform to the relevant Indian Standards as listed under Clause No. 3.0. These shall be obtained from an approved reputed manufacturer, and shall be approved, the Engineer. Wherever indicated by the Engineer, the Contractor shall submit samples of materials. These may be retained by him for subsequent comparison when bulk supplies are received at site. Ultimate choice of type lies completely with the Engineer.
- 4.2 The material brought to the site shall be stored in a separate secured enclosure, away from the building materials. Pipe threads, sockets and similar items shall be specially protected till final installation. Brass and other expensive items shall be kept under lock and key. Fragile items shall be checked thoroughly when received at the site and item found damaged shall not be retained at site.

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4.3 Chromium plating fittings and appliances shall be of grade-2. (10 micron thickness), conforming to IS: 4827.

4.4 **Pipes**

Unless otherwise specified, following types of pipes shall be used:

For water supply to buildings, fittings CPVC pipes conforming to IS 15778 shall be used.



For inlet connecting pipes to appliances / fittings, C.P. brass pipe of 15 mm N.B. with union of approved make shall be used. Standard length of 300 mm to 450 mm pipe shall be used to suit the site requirements.

For building sanitary work above ground, UPVC pipes, fittings and accessories conforming to IS: 13592/relevant IS Codes shall be used. Pipes shall be coated with coal-tar by hot dipping process for both inner and outer surfaces.

Glazed stoneware pipes used for sewer and drain shall conform to Grade A of IS: 651. RCC pipe used for sewer and drain shall conform to IS: 458. Class NP2 pipe shall generally be used. However, for road or railway crossing higher class of pipe or concrete encashment shall be provided to take care of higher load. For drain and sewer line work in bad or unstable ground condition and under building, centrifugally cast (Spun) iron pressure pipes conforming to IS: 1536 shall be used. Class LA pipe with spigot and socket ends shall be used. Pipes shall be coated with coal tar.

PVC rain water pipes shall be used for roof drainage.

4.5 **Above Ground Level**

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1) Galvanised mild steel pipes for water supply

For work above ground level, the galvanised mild steel pipes and fittings shall run on the surface of the walls, ceiling or in chase as specified or shown on the drawing. The fixing shall be done by means of standard pattern holder bat clamps, provided at no more than 90 cm and keeping the pipes about 1.5 cm clear of the wall. To conceal the pipes, chasing may be adopted or pipes fixed in the ducts or recess etc. Provided there is sufficient space to work on the pipes with the common tools. The pipes shall not ordinarily be buried in walls or solid floors. Under unavoidable situations, pipes may be buried for short stretch after providing adequate protection against damage. Union joints shall be provided for all required locations to facilitate maintenance.

Where directed by the Engineer, a M.S. tube sleeve shall be fixed at a place the pipe is passing through. In case the pipe is embedded, it should be painted with anti-corrosive bitumastic paints conforming to IS: 158. The pipes shall be oiled and rubbed over the white lead and a few turns of spun yarn wrapped round the screwed end of the pipe. The end shall then be screwed in the socket, tee etc., with the pipe wrench. All pipes and fittings shall be properly jointed and made complete water tight. Burr from the joint shall be removed after screwing.

The pipes and fittings shall be checked under working pressure. Any joint found leaking, shall be rectified and all leaking pipes removed and replaced. The pipes and fittings shall be tested to a hydraulic pressure of 6 kg/sq.cm. All pipes used for water supply should be thoroughly and efficiently disinfected before being taken into use. The method of disinfection shall be subject to the approval of the Engineer.

The storage tanks and downtake distribution pipes shall be disinfected together as specified under clause no. 13.2 of IS: 2065-1983, using disinfecting chemical.

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2) UPVC pipe above ground for Buildings Sanitary work



For sanitary pipe work above ground for Buildings, 1S:5329 shall be followed for general guidance. Proper ventilation shall be provided in the piping system. The single stack system shall not generally be provided.

Plain pipes shall be secured to the walls at all joints with M.S. holder bat clamps. The clamp shall be made from 1.6 mm thick M.S. sheet of 30 mm width, bent to the required shape and size so as to fit tightly on the socket of the pipe, when tightened with screw bolts. It shall be formed out of two semicircular pieces, hinged with 6 mm dia M.S. pin on one side and provided with flanged ends on the other side with holes to fit in the screw holt and nut, 40 mm long. The clamp shall be provided with a hook made out of 27.5 cm long, 10mm diameter M.S. bar, riveted to the ring at the centre of one semicircular piece. C.I. brackets can also be used. The clamps shall be fixed to the wall by embedding their hooks in cement concrete block 10 x 10 x 10 cm (1:2:4 mix) for which necessary holes shall be made in the wall at proper places. The clamps shall be kept about 25 mm clear of finished face of wall.

All soil pipes shall be carried up above the roof and shall have sand PVC terminal guard. The pipes above parapet shall be secured to the wall by means of clamps.

The pipes shall be fixed perfectly vertical or to the lines as directed. The spigot of the upper pipes shall be properly fitted in the socket of the lower pipe such that there is a uniform annular space for filling with the jointing material. The interior of the socket and exterior of the spigots shall be thoroughly cleaned and dried. The spigot end shall be inserted into the socket right up to the back of the socket and carefully jointed using solvent as per recommendation of manufacturer.

Floor trap shall be 'Nahni' or ordinary type and shall conform to IS:1729. The floor shall be suitably lowered to accommodate the trap and the top of the

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floor shall be properly sloped towards the trap for effective drainage. A chromium plated/galvanised grating shall be provided on the trap. The sunken floor slab shall be filled with light weight materials like cinder mixed with cement. Sunken slab shall be made watertight by means of Sika water proofing compound as recommended by the manufacturer.

Rain Water Downcomers

Rain water downcomers and fittings shall be standard PVC rainwater downcomers shall run along and be secured to walls, columns etc. Where desired by the Engineer, these may have to be installed in chases cut out in the structure. All pipes shall be well secured to the walls and supported by adequately strong brackets. The brackets may be wrought iron clevis type, lip-ring type or perforated strap iron type, as approved by the Engineer. Suitable spacer blocks shall be provided against the vertical surface on which the pipe is fixed.

All bends and junctions shall be supplied with water tight cleaning eyes. For improving the aesthetic appearance of the portion of building carrying rain water downcomers, the pipes may have to be concealed by encasing them with brick masonry, concrete, etc.

Galvanised M.S. pipes shall be joined by using standard sockets or by welding. For welding of pipes, IS:11906 shall be followed. After welding, the welded area shall be coated with zinc rich paint after proper cleaning and preparation of the surface. Joints between successive lengths of pipe can be by collars according to provision of IS:1742-1983. All rainwater downcomers shall be provided with roof drain head of the shape and type as shown on the drawing. Unless otherwise specified, dome type drain head shall be used.

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3) Khurras



The khurras shall be constructed before the brick masonry work in parapet wall is taken up, and it shall be 45x45cm in size, unless otherwise specified and be formed of cement concrete 1 :2:4 (1 cement: 2 sand: 4 graded stone aggregate of 20 mm nominal size).

A PVC sheet 1 mx1 mx400 micron shall be laid under khurras and then cement concrete shall be laid over it to a minimum thickness of 3cm with its top surface lower than the level of adjoining roof surface by not less than 50mm.

The concrete shall be laid to a size greater than the stipulated size of khurra in such a way that the adjoining terracing of brick tile overlaps the concrete on its 3 edges by not less than 7.5 cm. The concrete shall slope uniformly from the edges to the rainwater outlet. The concrete shall be continued at the same slope through the width of the wall into outlet opening to ensure a water tight joint.

The khurras and the sides of outlet shall then be rendered with 12 mm coat of cement plaster 1:3 (1 cement: 3 sand). This shall be done when the concrete is still green and shall be finished with a floating coat of neat cement. The sides of khurras and the sides of openings shall be well rounded. The size of finished outlet opening shall be 10cm wide by 20cm high or as directed by the Engineer.

Iron grating shall be provided at the outlet to prevent chocking. The grating shall be 20x25cm with an outer frame of 15mm x 3mm MS flat, to which 4 nos. - 10mm dia MS bars shall be welded in vertical direction, keeping an equal clear spacing of 2.5cm.

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4) Rainwater Spout

No spout shall be less than 80 mm in diameter. The spacing of spouts shall be arranged to suit the position of openings in the wall.



The spouts shall be of PVC, 60 cm long. These shall be perfectly sound, free from cracks, imperfections of glazing etc. These must be straight, cylindrical and of Standard nominal diameter, length and depth of socket. Full length of pipes shall be used on the work. These must be salt glazed and shall generally conform to IS: 651.

These shall be provided at the mouths of khurras and shall be fixed in cement mortar 1: 4 (1 cement: 4 sand) with the socket embedded in the masonry and the spigot end projecting outside. The masonry around the pipe and socket shall be thoroughly wetted and the hole shall be given a coat of cement mortar around. The pipe shall then be inserted and fixed with a surround of mortar. In case the hole is made much larger than the size of the pipe. Cement concrete 1: 2: 4l (1 cement: .2 sand: 4 graded. stone aggregate of 12.5 mm nominal size) shall be used to fill in the annular space. The spouts shall slope downward at a slope of 1 in 6. The projection outside the wall shall be uniform and not less than 40 cm. The entrance with the pipe shall be smoothly rounded to meet the internal bore of the pipe to facilitate easy flow. Care shall be taken to ensure that the vertical plane through the centre line of the spouts in a row shall be true to line.

4.6 Below Ground Level:

1) Trenches and other Excavation:

Except as mentioned hereunder, all work for earthwork shall be done as specified in relevant chapter of Excavation and Filling. The trenches shall be so dug that the pipe may be laid to the required alignment and at required depth. The cover shall be measured from top soil or other surface of the

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ground. Turf, top soil or other surface material shall be set aside, turf being carefully removed and stacked for use in reinstatement. The bed of the trench, if in soft or made up earth, shall be well watered and rammed before laying the pipes and the depressions, if any, shall be properly filled with earth and consolidated in 20 cm layers.

If the trench is extremely hard or rocky or loose stony soil, the trench shall be excavated at least 150 mm below the trench grade. Rocks, stone or other hard substances from the bottom of the trench shall be removed and the trench brought back to the required grade by filling with selected earth and compacted so as to provide smooth bedding for the pipe.

The last 7.5 cm. of excavation shall be trimmed and removed as separate operation immediately prior to the laying of the pipe on their foundations. The width of the trench shall be such as to provide not less than 20 cm clearance on either side of the pipe. Excavation in road shall be so arranged as to cause minimum obstruction to traffic.



2) Laying of Pipes:

In no case, pipes shall be rolled and dropped into the trench. After lowering, the pipes shall be arranged so that the spigot of one pipe is carefully centered into the socket of the next pipe and pushed to the distance that it can go.

The pipe shall be laid with socket facing the direction of flow of water. The connection to an existing sewer shall as far as possible be done at the manhole.

3) Filling of Trench



Filling of the trench shall not be commenced until the length of pipes therein has been tested and passed. Special care shall be taken to pack under and

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sides of the pipes thoroughly with selected material. At least 300 mm over the pipe shall also be filled with selected earth.



5.0 MANHOLES

5.1 Wherever applicable manhole should be suitably designed & constructed.

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ANNEXURE VII

QUALITY ASSURANCE PLAN



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QUALITY ASSURANCE PLAN



SL No	MATERIAL/ OPERATION	NAME OF TEST	FIEL D/ LAB.	TEST PROCEDURE	FREQUENCY OF CHECKING	EXTE NT OF CHEC KING	REFERENCE DOCUMENT
1.	Earthwork in excavation	Lines, levels & depth	Field	Measurement	As per decision of site engr.	100%	Specn.& approved drg.
2.	Concrete work						
	a) Course aggregate	i) % of soft or deleterious materials	Lab.	As per IS 2386 Part IX,1963	Once for each source/supply & shall be repeated in case source is changed	-do-	Specn.& IS 2386 (Pt.IX) & IS-383
		ii) Particle size distribution	Lab/ Field	As per IS 2386 (Pt.I)		-do-	IS 383, Specn.
	b)Fine aggregate	i) Silt content	Lab	Appendix -D of CPWD Specn.Vol.I	-do-	-do-	CPWD Specn.
		ii)Particle size distribution	Lab./ Field	IS 383	-do-	-do-	Specn. & IS 383
	c) Cement	i) Physical properties	Lab	As per IS 269 & 4031	-do-	-do-	IS 269,1489,4031 & test certificate
		ii) Chemical properties	-do-	As per IS 4032	-do-	-do-	IS 4032 & test certificate
	d) Reinforcing bars						
	i) Deformed bars	Physical properties & dimensions	Field /Lab	As per IS 1139	-do-	-do-	IS 1139& test certificate
	ii) Cold twisted bars	-do-	-do-	As per IS 1786	-do-	-do-	IS 1786& test certificate
	iii) Hard Drawn Steel Wire Fabric	-do-	-do-	As per IS 1566	-do-	-do-	IS 1566& test certificate
	iv) TMT bars	-do-	-do-	As per IS 1786	-do-	-do-	IS 1786& test certificate
	v)	Physical	Field	As per IS 456	ALL	-do-	IS 456 &

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	Placement, laps, hooks, spacers etc.						approved drawings
	e) Water	Chemical test	-do-	As per IS 3025-64	Single Test	-do-	IS 3025-1964
	f) Tests for concrete	i) Slump test	Field	As per IS 1199	For each batch of concreting	-do-	CPWD Specn. & IS 1199
		ii) Cube test at 7/28 days	Field/ Lab.	As per IS 516	No. of cubes to be decided as per given in IS 456/ Specn.	-do-	IS 456, IS 516
	g) Shuttering /Formwork Checking of levels, dimensions, unevenness, joints, cleanliness, oiling etc.	Physical	Field	Measurement	All	-do-	As per drawing, CPWD specifications & instruction of E.I.C
3.	Brick Work/Hollow Concrete Block work						
	a) Brick/ Hollow Concrete Block work	Physical properties & crushing strength	Field/ Lab.	As specified in Specn & IS 1077	Once for each source	100%	Specn. / IS 1077
	b) Mortar	Uniformity in mix	Field	As specified in IS 2250	As & when required	-do-	IS 2250
4.	Steel works using tubular, angles, plates, channels etc.						
	i) Structural steel & plates	Dimension, manufacturers, Specn. test certificates	Lab.	IS:226 & 2062	Once for each source/supply	100%	IS Codes & test certificates
	ii) Welding electrodes	-do-	-do-	IS:814 & 815	-do-	-do-	-do-
	iii) Welding	Quality of weld, weld reinforcement, contour etc.	Field	Visual	As per discretion of site engr.	-do-	IS: 823
	iv) Painting on steel works (synthetic enamel paint over 3	Cleaning off rust dirt, grease etc. of coats.	-do-	IS:123 1962	-do-	-do-	IS Code, Relevant Specn.

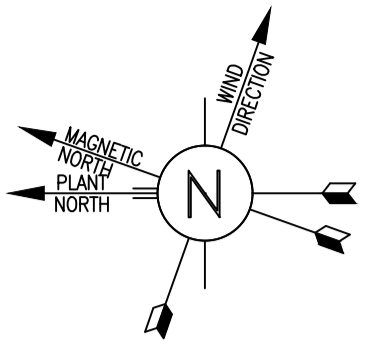
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	coats red oxide coat zinc primer)						
5.	Providing & laying water proofing on roof	Thickness, slope etc.	-do-	As per Specn. & IS 2115	-do-	-do-	-do-
6.	Flooring						
	i) Cement concrete floor	Physical	Field	As per IS 1443	All	-do-	IS 1443
	i) Glazed tiles	Physical	Field	As per IS 13630	All	-do-	IS 13630 & Manufacturer's certificate
7.	Pre-coated G.I sheet roofing laying & fixing.	Physical	-do-	As per IS 277 & 513	Once for each source/supply	-do-	IS code, specn. & Manufacturer's certificate
8.	Gypsum board false ceiling/ Prima board Armstrong false ceiling	Physical	-do-	IS 2095 & 2542	All	-do-	IS code, specn. & Manufacturer's certificate
9.	Doors/windows/ventilators						
	i) Glazing	Physical	-do-	IS 1081 & 2835	All	-do-	IS code, specn. & Manufacturer's certificate
	ii) Flush door shutters	Physical	-do-	IS 2095 & 2542	All	-do-	IS code, specn. & Manufacturer's certificate
	iii) Aluminium	Physical	-do-	IS 1948 & 1949	All	-do-	IS code, specn. & Manufacturer's certificate
	iv) Steel	Physical	-do-	IS 1038	All	-do-	IS code, specn. & Manufacturer's certificate
10	Plastering	Physical	-do-	As per specn.	All	-do-	Specn.
11	White washing, snowmen, distemper	Physical	-do-	IS 712, 428 & 5410	All	-do-	IS code & specn.

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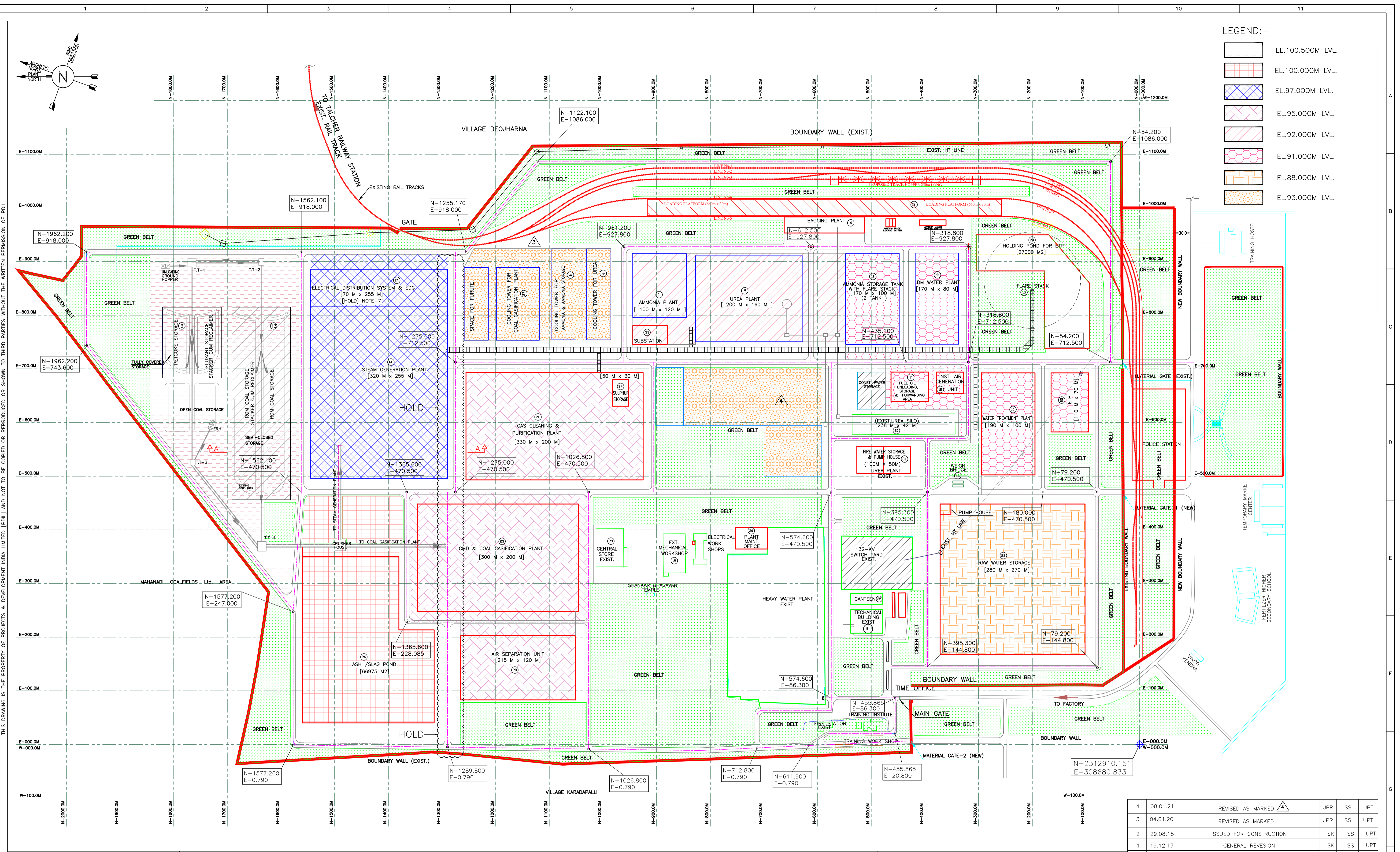
12	Toiletries & sanitary fixtures						
.	IWC, EWC, Urinals, washbasins, G.I pipes & fittings, C.I pipes & stoneware pipes etc.	Physical	-do-	IS 771, 775, 774, 1239, 2065, 781, 1729, 1726, 651, 412 7 etc.	All	-do-	IS code, specn. & Manufacturer's certificate

Note: Parameters/guidelines fixed for the quality control in accordance with the contract document, IS Codes/Technical Specification etc. are just the synopsis of the whole constructional activities in a bid to visualise the total involvement at a glance. Mere compliance of the QAP does not relieve the contractor from overall responsibility to render best quality of work in conformity with all the relevant documents and the best engineering practices. In order to minimise the size of QAP, only salient/important features have been taken into account and other small/minor involvement will be dealt with individually as per the provision of contract.



LEGEND:-

[Pattern]	EL.100.500M LVL.
[Pattern]	EL.100.000M LVL.
[Pattern]	EL.97.000M LVL.
[Pattern]	EL.95.000M LVL.
[Pattern]	EL.92.000M LVL.
[Pattern]	EL.91.000M LVL.
[Pattern]	EL.88.000M LVL.
[Pattern]	EL.93.000M LVL.



NOTE:-

- ALL DIMENSION ARE IN MM AND LEVELS ARE IN M. UNLESS NOTED OTHERWISE.
- THE DRAWING SHOULD NOT BE SCALED, ONLY FIGURE DIMENSION ARE TO BE FOLLOWED.
- THE RESPECTIVE RLS. SHALL BE RECKONED FROM THE PERMANENT BENCH MARK.

- FELLING OF TREES/CLEARING OF JUNGLES/SHRUBS SHALL NOT BE TAKEN UP IN THE AREA EARMARKED FOR THE GREEN BELT, EXCEPT ROADS WHERE LAND SHALL BE GRADED PROPERLY.
- NO EARTH FILLING BUT ONLY CUTTING AND GRADING SHALL BE DONE IN THE ASH POND AREA. BUND WALLS SHALL ALSO BE RETAINED.

LEGEND :-

[Pattern]	PROPOSED FACILITIES
[Pattern]	EXISTING FACILITIES
[Pattern]	NEW RAILWAY TRACKS
[Pattern]	ROAD FACILITIES (TO BE USED)
[Pattern]	GREEN BELT AREA

SECTION A-A

EL.100.500M LVL. EL.97.000M LVL. EL.95.000M LVL.

REV.	DATE	DESCRIPTION	PPD.	CKD.	APPD.
4	08.01.21	REVISED AS MARKED	JPR	SS	UPT
3	04.01.20	REVISED AS MARKED	JPR	SS	UPT
2	29.08.18	ISSUED FOR CONSTRUCTION	SK	SS	UPT
1	19.12.17	GENERAL REVISION	SK	SS	UPT
0	15.12.17	ISSUED FOR CONSTRUCTION	SK	SS	UPT

CLIENT : **M/s. TALCHER FERTILIZER LIMITED**

LOCATION : **TALCHER, ANGUL DISTRICT, ODISHA(INDIA)**

TITLE : **GENERAL LAND DEVELOPMENT PLAN**

SCALE : 1 : 2200

DRG. No. :- **PC150-0000-0205**

FILE :- **PC150-0000-0205-R4**

PROJECTS & DEVELOPMENT INDIA LTD. NOIDA

02.	TOPOGRAPHICAL & CONTOUR SURVEY DRAWING	SA/RCF/TALCHER/2017/TOPO-DWG-R2
01.	PLOT PLAN OF PROPOSED INTEGRATED COAL BASED FERTILIZER AND CHEMICAL COMPLEX	PC009-0000-0001_R6
S.NO.	REFERENCE DRAWINGS	NUMBERS

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		DOCUMENT NO.	REV	
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SECTION : VI – 6.0

PROJECT EXECUTION PLAN, PLANNING & SCHEDULE, INSPECTION

PLANT : ELECTRICAL DISTRIBUTION SYSTEM



**PROJECT : INTEGRATED COAL BASED FERTILISER
COMPLEX, AT TALCHER, ANGUL DISTRICT,
ODISHA**

0	26.03.21	26.03.21	Issued for Enquiry	SP	KJ	RRK
REV	REV DATE	EFF DATE	PURPOSE	PREPD	REVWD	APPD

	ELECTRICAL DISTRIBUTION SYSTEM	PC183/E/4006/SecVI-4.0	0	
	TALCHER FERTILIZERS LIMITED	DOCUMENT NO	REV	
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1.0. INTRODUCTION

The Joint Venture of four major Public Sector Units – **M/s Rashtriya Chemicals & Fertilizers Ltd. (RCF)**, **M/s GAIL (India) Ltd. (GAIL)**, **M/s Coal India Ltd. (CIL)** and **M/s Fertilizers Corporation of India Ltd. (FCIL)** has decided to build a world class Coal based fertilizer complex. The fertilizer complex will consist of Coal Gasification based Ammonia Synthesis Gas Plant and Urea Plant, and is to be built at Talcher, Angul District, Odisha (India).

To cater the requirement of electrical power for the entire fertiliser complex, TFL intends to set up “Electrical Distribution System” under one LSTK package.

Projects and Development India Limited (PDIL) has been retained as Consultant by TFL to provide services for the selection of LSTK CONTRACTOR.

LSTK CONTRACTOR is advised to visit and examine the site conditions and obtain for itself on its own responsibility all information that may be necessary for preparing the bid and entering into the Contract. Claims of any kind due to variation or ignorance of site conditions and environmental conditions will not be eligible in any circumstances.



1.1. General

This Lump-sum Turnkey package has been prepared as a Bidding Package to the extent enumerated in various sections and documents enclosed.

Detailed scopes of work and discipline-wise technical requirements are provided in respective sections of this Tender Document.

The Contractor will execute the project on Lump-sum Turnkey basis, in accordance with and supported by Process Engineering Procedures, Procurement Procedures, Construction Management Procedure, Project Controls and Computer System to be developed to affect the maximum efficiency of quality of the project. To achieve this goal and requirements of the Owner/PMC, Contractor will establish his project organization giving due consideration to the following aspects:

- Effective execution and timely completion of each phase of the project.
- Maintaining high quality in each phase of the project.
- Good relation and coordination between the Owner/PMC and the Contractor.
- Assignment of experienced resources and personnel for immediate and smooth launching of the project.

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1.2. Engineering

Contractor's scope of work includes detailed engineering, preparation of engineering drawings and datasheets, making use of standard specifications, standards, design guides and technical documents enclosed in this Tender Document. Technical requirements, technical documents, standard specifications, PMC standards and guides to be followed for different type of works shall be as provided in this Tender document.

Contractor to carry out the Detailed Engineering defined above. Commissioning of the project in totality is a part of Contractor's scope. Engineering required to be done by the Contractor may arise singularly or in combination due to Manufacturing, Fabrication, purchased items, Construction, Commissioning, Statutory requirements, Government regulations, Safety requirements, site conditions, resultant total procurement and Construction, Installation and Testing, Insulation, Painting and Commissioning, etc.

1.3. Procurement

Contractor's scope includes ordering, all import formalities, fabrication/purchase of equipment and materials, port clearance, packaging and transportation to site, stores management which includes preservation and storage of equipment and materials, uncovered storage. Items contemplated for fabrication at site to be submitted along with the bid although both these aspects would be covered under the Contractor's responsibility.

Vendor manuals relating to installation, operation and maintenance and test certificates should be necessarily sent along with equipment. Please also refer Final Documentation Submission requirement spelt out in this Tender Document, in this regard.



Before ordering, clearances for technical portion would be taken from Owner / PMC in respect of the Critical Equipments (Special Equipments) comprising of Mechanical Static and Rotary Equipments, Electrical and Instrumentation items. Any ordered items which do not confirm to the contractual requirement identified at any stage of the project shall be rejected. Replacement / modification and project delay arising out of this shall be to the Contractors account.

Whenever clearances are to be taken, it would be necessary to submit details of technically acceptable offer.

Procurement of spares shall be as per spare part philosophy detailed in the scope of supply. Commissioning spares are also in the Contractor's scope.

1.4. Construction and Installation

Contractor's scope covers detail engineering including barricading of the allocated area complying with statutory norms, construction, installation and commissioning of the unit as

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per P&IDs, datasheets, drawings, standards, specifications, codes, statutory and state regulation. Supply of construction materials, labour, labour supervision, tools, tackles, consumable materials and accessories not specifically mentioned herein but nevertheless necessary, as per the PMC for the construction, installation, testing and commissioning of the complete system including cranes or any other material handling equipment is also part of Contractors scope.

1.5. Commissioning

Contractor's scope covers supply of all initial fill such as lubricants, seal oils, chemicals, consumables, spares required for start-up, pre-commissioning and commissioning of the project. Contractor shall arrange necessary loading / unloading equipments for undertaking this activity. The scope also includes providing manpower (skilled as well as unskilled) and organisation for commissioning and is to be indicated along with the bid.



1.6. Quality Assurance

The desired quality is to be met for different activities at various stages of the project. The quality checks by Owner and PMC could be of audit type / involvement at all stages of project execution by the Contractor and details of the quality plans will be furnished along with the bid. Contractor is required to submit detailed Quality Control (QC) measures to be adopted by him for all stages/types of activities. A notice period of six weeks is to be given for imported items and one week for indigenous items for association with respect to witness QC steps by Owner / PMC. Detailed methodology is enclosed in Tender Document for compliance. Facilities at shops / site / Engineering office for carrying out quality checks by Owner/PMC shall be provided /organised by Contractor.

1.7. Statutory Approvals/State Regulations

Statutory regulations as required during pendency of the contract will be adhered to for engineering, preparation of drawings/documents, fabrication, manufacturing, purchased items, construction and commissioning. Documents as required will be generated and submitted for the approval of statutory authorities. Follow up and obtaining clearances shall be responsibility of the Contractor.

State regulations as and when applicable for different phases of the project shall be adhered to by the Contractor. Statutory approval from any authority as per statutory rules and regulations of Central/State Government shall be the Contractor's responsibility unless otherwise specified in bid documents. The application on behalf of Owner/PMC for submission to relevant authorities along with copies of required certificates complete in all respects shall be prepared and submitted by the Contractor well ahead of time so that the actual construction / commissioning of the work is not delayed for want of approval or inspection by concerned authorities. The inspection of the works by the authorities shall be arranged by the Contractor and necessary coordination and liaison work in this respect

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shall be the responsibility of the Contractor. Statutory fees paid, if any, for all inspections and approvals by such authorities shall be borne by Contractor.

Any changes/additions required to be made to meet the requirements of statutory authorities shall be carried out by the Contractor free of charge. The inspection and acceptance of the work by statutory authorities shall however, not absolve the Contractor from his responsibilities under this contract.

1.8. Project Management

The project management services will include Planning, Scheduling, Monitoring, Progress Reporting, Quality Assurance and Quality Control and Overall Project Management functions. Contractor shall nominate a Project Manager who will be responsible for the total scope of work under this contract and shall respond to Owner and PMC's Project Managers on all matters relating to this contract.

The Contractor is expected to execute the Work/Services under this contract on Task Force concept with a dedicated team of specialists who will be responsible and respond to the Project Manager.

The Task Force shall be so organized as to give effective management and control of various services to the Project Manager.



1.9. Organization

The organisation up to working level including period envisaged for different phases of the project engineering, ordering, follow up for manufacture of equipment, clearances, transportation, inspection of equipment and materials, warehousing, safety, construction, commissioning coordination with statutory authorities and government authorities and project management will be submitted along with the bid. Bio-data of key personnel will also be submitted with the offer.

1.10. Safety

All measures required for safe constructions are to be taken and the schemes are to be approved by Owner/PMC before commencement of works. Besides, all personnel employed on the job are to follow safety requirement of Owner/PMC and state regulations as applicable from time to time. A list of safety implements/equipment proposed to be used by the Contractor, are to be indicated along with the bid. At least one safety engineer in each shift, for the project, shall be provided by the Contractor.

Safety report generation for different situations as per rules and required by Owner/PMC are to be adhered to. Copy of safety practices to be followed during construction is enclosed in this Tender Document. Contractor shall comply with the provisions of this document. This document specifies broad guidelines on safe practices to be adhered to

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during construction activities. However, before commencing any job, specific hazards and its effects should be assessed and necessary corrective/preventive action should be taken by the Contractor. This document shall supplement the prevailing statutory requirements, which shall also be followed as applicable.

1.11. Sequence for Decisions

Along with bid submission, it is necessary for the Contractor to bring out variation, if any, in related data sheets, drawings, specifications, standards, codes, scope, any other contractual clauses and seek clarifications from PMC/Engineer-In-Charge. The decision of the PMC shall be final and binding on the bidder in such cases. For those such items, which arise during execution of the project, the stringent specification/standards will be applicable, and shall be binding on the Contractor. However, the decision of the PMC/Engineer-in-Charge shall be final and binding on the Contractor.

1.12. Vendor List

All items required for project are to be purchased through approved vendors of Owner/PMC, wherever such details are not available, vendor list to be proposed by Contractor and clearance to be obtained from Owner/PMC before initiating the ordering process.

1.13. Waste Disposal / Scrap etc.

All waste generated which could be surplus earth after use and or surplus construction materials will be disposed off from time to time as directed by Owner/PMC.



1.14. Environmental Management System

Bidders should comply with the latest relevant elements of the International Standard for environmental protection, as applicable to their scope of work.

2.0. PROJECT MANAGEMENT AND EXECUTION

2.1. Project Management

Plot plan, detailed technical requirements along with the detailed scope of work and overall proposed implementation schedule is issued by Owner / PMC. These will form the basis for formulation of the **Overall Project Master Schedule** of the plant by Contractor. The Contractor is required to organise his services in a systematic manner to ensure execution and completion of the unit as per the schedule. The bidder is required to submit along with his bid the methodology/procedure proposed by him for this unit together with the organisational set up proposed and bio-data of key personnel.

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In order to achieve uniformity in execution of various activities of the project, PMC has developed engineering design basis and project procedures/methodologies to be adopted by the executing agency. The Contractor is required to carry out detailed engineering, procurement, tendering, construction supervision and management, planning scheduling, monitoring, reviewing, reporting, and overall project management activities. All activities to be performed and services to be rendered by the Contractor under this contract shall be monitored by Owner / PMC and will be subject to periodic reviews by PMC. The Contractor shall facilitate such reviews/monitoring by Owner / PMC.

Immediately after the award of job, a Kick-Off Meeting will be held to finalise and establish the modalities and procedures to be adopted for execution of the contract based on the enquiry document, commitments made by Contractor and subsequent agreements reached between Owner/PMC and Contractor during negotiations. The Kick-Off Meeting will be attended by key members of Owner/PMC and Contractor. This will address all necessary details and arrangement between Owner/PMC and the Contractor.

The Contractor's service for Engineering, Procurement, Tendering, Construction, Supervision and Management, Planning, Scheduling, Monitoring, Reporting, and Overall Project Management shall meet the requirements given in this section.

English language and Metric Units shall be used in all documents, drawings, reports, correspondences etc. under this contract.



2.2. Detailed Engineering Services:

The Contractor shall provide the detailed engineering services for the project as mentioned in this bid document furnished by the Owner/PMC. The services shall cover the detailed engineering required for execution and completion of the project along with the utilities to be provided inside the battery limit of the Plant.

All critical drawings / documents to be prepared by Contractor/sub-contractors/vendors as per given in the bid document for review and approval by Owner / PMC. Obtaining all such approvals shall be the responsibility of the Contractor and the same is included in his scope of work. Such review and approval by Owner/PMC shall, however, not relieve the Contractor of his responsibilities.

For achieving the project schedule, it may be necessary in some cases to prepare the drawings in stages and release it for construction so as to take up simultaneous execution of detail engineering and construction. Any revision involved for the above is included in the scope of work of the Contractor. Also any change required to meet site conditions/statutory requirements shall have to be carried by Contractor at no extra cost.

The Contractor is required to organise a Task Force of dedicated specialists from each discipline under a Project Engineering Manager who will be assisted by engineering Coordinator. An engineering schedule will be prepared and submitted to Owner/PMC for

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approval. This approved schedule shall be used for all engineering activities. The engineering coordinator shall coordinate all design and engineering activities and interact with purchase, inspection, expediting, C&T, tendering, planning, construction and project groups. His responsibilities shall include.

(a) Engineering coordination for procurement involving:

- Preparation of Material Requisitions (MRs).
- Technical evaluation of offers received (which may involve technical discussions with vendors and concerned specialists may have to be deputed to vendors works or to Owner/PMC's offices as per requirements) and preparation of recommendations.
- Preparation of Technical Purchase Requisition (PRs) on selection of vendor.
- Review/approval of vendor drawings/documents. (This may call for arranging specialist visits to vendor's works for timely approvals of critical items.)



(b) Engineering coordination for sub-contractors involving:

- Preparation of schedule of quantities and specifications for various contracts.
- Technical evaluation and recommendation of offers received. This may involve arranging technical discussions with Tenderers at Owner/PMC's office if called for due to job requirements.
- Preparation of technical-agreed variations for incorporation in contracts for the selected Contractor.

In any case, Contractor has to take owner approval for sub-contractors list prior to scrutiny and award.

(c) Engineering coordination for construction involving:

- Timely issue of approved construction drawings including drawings duly approved by Owner/PMC as per requirements.
- Providing/arranging clarification on drawings and specifications wherever called for including specialists visits to site.
- Making regular periodic visits to project site for review of site requirements in respect of engineering activities.
- Attending/arranging for discussions with statutory authorities such as Chief Electrical Inspector, Chief Inspector of Boiler, Tariff Advisory Committee, etc. to arrive at

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design basis/documents acceptable to them wherever required for obtaining statutory approvals and any other local approvals.

(d) Monitoring progress of engineering activities and advising Project Manager on shortfalls and corrective actions needed. He will also attend the review meetings.

Detailed engineering and construction shall be based on sound engineering practices. List of applicable codes, standards and mandatory rules to be used in design is also mentioned in bid document.

Drawings/Documents/MRs etc., which are to be generated by Contractor shall be numbered as per the Documents Numbering Procedure of Owner/PMC.

Head Office engineering support of Contractor shall be provided to site during construction including deployment of engineering specialists for field engineering as and when required by Contractor.

2.3. Procurement



The procurement services to be provided by the Contractor shall cover the purchasing, inspection, expediting, custom clearance and transportation activities

(a) Purchase

The purchase activities will cover all equipments and materials required for completion of the project. The purchase group shall consist of adequate number of experienced and qualified Purchase Officers commensurate with the number of material requisitions to be handled and the time schedule for ordering. A procurement schedule will be prepared and submitted to Owner/PMC for approval. This approved schedule will be followed for all procurement activities.

Purchasing activities shall be coordinated by an experienced purchase coordinator who shall be responsible for:

- Coordinating with engineering group regarding preparation of material requisitions (MRs), evaluation and clarifications on offers of vendors, technical discussions, negotiations with vendors, technical recommendations preparation of purchase requisitions to form part of purchase requisitions selected vendors purchase order.
- Coordination for processing of change orders as required during execution of the project on account of additions/modifications as well as transit losses/damages.
- Before ordering, clearance for technical portion for rotating, instrumentation and electrical items as indicated in technical details would be taken from PMC.

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- Preparation and issue of status reports on purchasing activities.
- Attending review meetings with Owner/PMC on all purchase activities.

(b) Inspection and Expediting

The Contractor is required to organise a proper inspection and expediting system so as to ensure timely delivery of all the items/equipment meeting the specified quality criteria. This function has to be carried out by appropriate deployment of qualified personnel who have wide experience in their respective fields. Owner/PMC will reserve the right to inspect items deemed necessary by them without any additional cost to Contractor/sub-contractor/vendor /third party.



Expediting is one of the vital activity of successful and efficient procurement system which enables timely execution on the project. Such expediting has to be carried out by deployment of expediting coordinator located at Contractor’s Head Office who would be assisted by expeditors located in various regional offices. To enable this function to be very effective and fruitful, following functions are to be carried out as a minimum.

Expediting Coordinator

Expediting Coordinator located at the Contractor’s HO will liaison with various departments such as purchase, projects, engineering, transportation etc. on one hand and regional inspection/expediting offices and vendors on the other. The basic functions of such expediting coordinator would be:



- Maintain effective communication link between various departments of the Contractor including his regional offices and vendors on whom the orders are placed.
- Status maintenance of all the orders.
- Analyzing the order status in detail after identifying the critical order and initiation of suitable remedial measures.
- Acting as an effective instrument in final delivery of the item within CDD.
- Preparation of order close out reports of each order.
- Expediting coordinator shall be a person who is highly communicative and has sound technical knowledge; he must be highly analytical, alert, quick in gathering up-to-date information of the various orders.

Responsibility of Expediting Coordinator

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- Attending periodical review meetings with Contractor's project department and Owner/PMC.
- Distribution of Fax of Intent/Letter of Intent and status maintenance.
- Liaison with regional offices to obtain order to generate acknowledgement of Fax of Intent/Letter of Intent.
- Intimate Owner/PMC of reservations (if any) from the vendor in purchase order acceptance.
- Distribution of POs / PRs to vendors and regions.
- Expediting of vendor's drawings and other related documents.
- Expediting of approval of drawing by respective engineering department and timely return of the same to the vendor.
- Ensure receipt of periodical expediting reports and preparation of monthly status report against each order as per the requirement of Owner/PMC.
- Identification of critical orders/issues and initiate of remedial action.
- Expediting of decision on deviation sought by the vendor.
- Follow up actions with various concerned departments regarding all the issues discussed in the review meetings.
- Prompt despatch of material after inspection with the assistance of transportation department.
- Follow up of despatch particulars after despatch.
- Ensure preparation of order close out report for each order giving complete details of the order including ordered quality, contractual delivery date (CDD).
- Date of completion, delay, if any and reasons for delay, status of final documents etc.
- Ensure receipt/distribution of vendor documents including final documents as per PR.
- Preparation of final procurement closing report. The order close out reports shall be accompanied with two sets of complete documents in respect of each order bound/put together in a folder comprising of: purchase order, purchase requisition, change orders (if any), inspection certificates, material test certificates, final vendor drawings (if applicable), operation/maintenance manuals, any other document as specified in PR.

Expeditor

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Expeditor's responsibility commences from the time he receives the intimation of placement of TOI/LOI/order on vendor located in his region till the time he furnishes the despatch particulars of the item under a particular PO. During this process expeditor shall monitor and maintain all activities of the vendors such as:

- Vendor's understanding of the order.
- Submission of design drawing documents for approval.
- Sub-ordering, planning and scheduling.
- Manufacturing testing and despatch.
- Delays, power cuts, strike lock out etc.
- Submission of final documents as per PR.

Above functions may be possible only by frequent visits to vendor's office and shops including their sub-vendor's establishments as the case may be. Expeditor shall be able to visualise the problems in advance and suggest timely corrective measure. In nutshell, expeditor is not a mere progress reporter but a vital catalyst for successful completion of the job. Expeditor's responsibilities are as below:

- Ensure order acknowledgement from the vendor.
- Communicate the person concerned the reason for vendor's inability to accept the order (if so).
- Progress reporting of various orders located in the region.
- Communication with the vendors whenever he finds lack of efforts on their part.
- Raise alarm report at an appropriate time on possible serious delay or vendor's inability in meeting with scheduled date of delivery and also to suggest action plan.
- Liaise with inspection department for timely inspection, including third party inspection/statutory inspection as specified/required.
- Liaise with engineering department for approval of drawing, acceptance of deviation etc. through the expediting coordinator.
- Liaise with transportation department for sound and quick despatch of material.

(c) Inspection Quality Assurance System

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The objective of the quality assurance scheme of the Contractor shall be to ensure the conformity of equipment, material, site construction (if any) to various standards, specifications, drawings and technical requirements that are being mutually agreed between the Contractor and Owner/PMC. Quality Assurance System should clearly indicate the organisational approach for quality control and quality assurance of the various equipment/construction activities (if any) and also provide a verifiable evidence of the Contractor having carried out all the activities laid down in the bid document and the procedure. Such conformity to quality level shall be ensured by controlling the quality level of purchased items at vendor's/sub-vendor's shop/site and shall cover from source surveillance to final inspection. The Contractor to submit a detailed inspection and testing plan for various shop/site activities as a part of his Procurement Manual which shall be duly approved by Owner/PMC. The Procurement Manual shall as a minimum include:

In house Inspection Programs



- Inspection procedures consistent with mandatory codes.
- Procedures for material identification and transportation.
- Certification of non-destructive testing.

Inspection responsibility shall include but not be limited to the following:

- Single or multiple visits to the vendor's shop/site as per the requirement.
- Pre-inspection liaison meeting with the vendor for vendors correct understanding of the inspection requirements.
- Approval of quality assurance/quality control plan procedure clearly indicating stages of inspection with specific reference to witness and review.
- Ensure submission of quality control procedure and approval of the same for critical sub-orders.
- Inspection of various equipment/items as per relevant codes, specifications/drawings including witnessing of final acceptance test at vendors works/site.
- Maintenance of inspection reports periodically highlighting hold, deviation etc.

As indicated for expediting coordinator, Contractor should nominate an inspection coordinator with similar responsibility who will liaise various inspection offices/vendors for proper coordination.

Inspection through an Approved Third Party Inspection Agency

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Inspection requirements shall be fulfilled through Owner/PMC approved Third Party Inspection Agency. The payments to be made to the Third Party Inspection Agency shall be the responsibility of the Contractor. Further, the responsibility for inspection/testing as per specification approved documents and agreed Quality Assurance procedure and plans shall be that of the Contractor. Inspection activities of the Third Party Inspection Agency shall be coordinated by the Inspection Coordinator of Contractor.

(d) Customs Clearance and Transportation

The Contractor is required to organise a custom clearance and transportation (C&T) system to ensure prompt clearance of imported equipments from customs and transportation of equipments/materials to project site from ports/vendors works. This function shall be carried out by deployment of qualified and experienced personnel. C&T functions shall include, but not be limited to the following:

Appointment of Contractors



- Clearing forwarding of imported equipments/materials.
- Collection and transportation of bulk materials by road from vendor's works.
- Transportation of consignments from port to site by road.
- Handling of consignments at project site.
- Transportation of general cargo and over dimensioned consignments by road/rail wherever applicable.
- Clearing and handling of air consignments, if applicable.
- Any other contracts relating to C&T services.

Supervision of Contractors

Supervision, monitoring and coordination of above contracts for import clearance and transportation as detailed below by Contractor. EC (Essentiality certificate) shall be provided by Owner to main Contractor of Indian origin. Essentiality certificate is not applicable to foreign Contractor.

Import Clearances

- Monitoring and coordination with clearing agents, customs, ports, steamer agents, airlines, railways and transport agencies for clearance of imported consignments.
- Registration of contracts with custom under project imports.

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- Control of payment of import duty to customs, payment of port dues, etc.
- Conducting surveys with various agencies for imported consignments landed in damaged condition and corrective action for timely replacement of items.

Despatch of Indigenous Project Goods

- Coordination with inspection/expediting group and all indigenous suppliers for expeditious despatch of consignments.
- Monitoring movement of consignments from vendors works to project sites.
- Collection, transportation and delivery of bulk-material to project site.

(e) Monitoring Movement of Consignments

Total monitoring of movement of all consignments dispatched to project site from various points of despatch. A chaser has to be deployed from Contractor, for transportation of all ODC Consignments as well as important consignments (imported and indigenous) as and when advised by Owner/PMC.

(f) Reporting



Preparing and issuing Weekly, Fortnightly and Monthly Status Reports on clearance of imported equipments/materials and movement of equipments/materials from various despatch points to project site.

Monthly Reports on Over/Short Rejected/Damaged (OSRD) items. It shall be Contractor's responsibility to arrange for timely replacement of OSRD items.

(g) Tendering

Tendering activities of the Contractor shall be properly organised to ensure award of various contracts in line with the project schedule. The tendering group shall consist of sufficient number of contract engineers/officers who are having adequate professional experience and qualifications.

Contractor shall prepare a Tender schedule for carrying out different works such as civil and structural equipment erection, piping, electrical, instrumentation, painting etc. All tendering activities shall be carried out in accordance with this approved tender schedule. The Contractor shall deploy a contract coordinator for coordination of tendering activities. The contract coordinator shall be responsible for:

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- Coordinating with the Resident Construction Manager during execution of the contracts regarding clarifications on contract terms and conditions as required.
- Preparation and issue of status reports on contracting activities.
- Attending review meeting with Owner/PMC on all contracting activities.
- Preparation of tender documents, issue of enquiry to approved Contractors through receipt of bids, techno-commercial evaluation of offers for award of contract will be carried out by Contractor.

All major tenders will be handled by the Contractor from his Head Office. However, tenders for certain minor construction will be handled by Contractor's site office.



The Contractor is required to institute and maintain a proper planning, scheduling and monitoring system and employ professionally qualified and experienced planning engineers for the project. The system shall have latest state of the art technique. To this effect, Contractor shall implement this system through the Prima Vera Project Planner. The system developed should be capable to support and enforce proper control mechanism in the project. It should be based on hierarchical breakdown of works with elaborate level of detailing and control. The levels of controls should be such that it supports and foster controls at activity level, function level and management level with greater emphasis on target, scope and commitment at various stages of contract for accountability and action planning, such multi-level/ multi-tier system of planning, scheduling and monitoring, supports, effective information generation, assimilation, summarisation and reporting in proper and adequate manner.

The system shall be predictive type and should constitute pre-warning mechanism to diagnose and anticipate the problem well in advance and provide preventive features/measures. It is required that work breakdown structure should consist of details of systems, work packages, functions, work items and activities from monitoring point of view at micro level and summarisation at higher levels. It is expected that the work breakdown structure coding system or methodology to be followed shall be informed/discussed with the successful bidder during the kick-off meeting.

2.4. Kick-Off Meeting

On award of job, the Contractor is required to submit the following documents which will be discussed during the kick-off meeting to establish planning requirements, inputs and outputs for overall schedule, monitoring and progress reporting.

- List of work package/areas.
- List of critical drawings.
- Breakdown of work packages to work items level.

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- Input requirements of each work item/activity.
- Schedule start and finish dates of all milestone/activities in line with overall schedule of the project.
- Procedure for Project Planning, Scheduling, Monitoring & Control System including all reporting formats.
- Progress Measurement Methodology and Unit, Function, Discipline and Deliverable wise weightages breakdown. Overall system-wise, discipline-wise weightages for each item/activity.
- Procedure/presentation on proposed Bulk material control system
- Three month Front-End Schedule within a week of award.

In this kick-off meeting, it will be endeavoured to reach complete understanding with Contractor on activities, inputs and logic to establish planning documents for monitoring. Venue of the kick-off meeting to be held between the successful Bidder, PMC and the Owner, shall be either at PMC Office or Owner Office.



2.5. Early Planning Document / Look Ahead Schedule

Immediately after the award of contract and pending finalisation of overall project schedule, detailed activity chart/network, functional schedules etc., the Contractor in consultation with PMC shall prepare a look ahead schedule as a guideline for the activities to be performed during the relevant periods.

2.6. Overall Project Schedule

The Contractor shall submit within 30 days of Fax of Intent / Award of Work, the Work Breakdown Structure (Plant wise / Facility wise) showing project work load, that is, preparation of tenders, material requisitions, construction drawings equipments etc. alongwith a sufficiently detailed overall project schedule in the activity network form, clearly indicating the major milestones, inter relationship/interdependencies between various activities such as process, engineering, procurement tendering, manufacture, delivery, construction etc. together with computer analysis of critical path and floats as well as quantum of work for major activities.

The time and the date of completion of the works as stipulated in the CONTRACTOR's proposal and accepted by the OWNER shall be deemed to be of utmost importance. The CONTRACTOR shall so organise his resources and perform his work as to complete it not later than the date agreed to.

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The CONTRACTOR shall submit The detailed Primavera Level 4 Project Master Schedule within thirty (30) days or as specified elsewhere after effective date of the CONTRACT.

The Primavera Level 4 Project Master Schedule shall be for OWNER / PMC review and be based on a Proposal Schedule as attachment to the CONTRACT. Such Proposal schedule shall show the execution periods for (i) Engineering, (ii) Procurement & Delivery of Equipment and Materials, (iii) Construction & Erection and (iv) Commissioning, Testing.

Bidding consortium shall be contractually obliged to issue a Primavera Level 4 Project Master Schedule, provided that such schedule shall not (i) accelerate the OWNER obligations (to be agreed upon prior to Contract award) (ii) change the agreed GUARANTEED COMPLETION DATE (date to be agreed upon prior to Contract award)

The above Primavera Level 4 Project Master Schedule shall be periodically updated, & reviewed and reports shall be submitted by the CONTRACTOR as directed by the OWNER / PMC.

The schedule will be reviewed and approved by Owner/PMC and the comments if any shall be incorporated in the network issued for implementation within two weeks from receipt of comments. The network thus finalised shall form part of the Contract and will become the basis for developing further detailed activity network. This schedule shall not be revised without the prior permission from the Owner/PMC during the entire period of contract. The changes made during revision of the contract shall be approved by Owner/PMC.

2.7. Detailed Activity Network



The Contractor should develop Detailed Activity Networks for various systems of the project, based on approved Overall Master Project Schedule. Such networks would be computerised for further monitoring and reporting.

2.8. Functional Schedules

The Contractor should prepare resource-based detailed functional schedules in line with detailed activity networks for functional monitoring, scheduling and control. This should clearly reflect strategies and philosophy of execution. Owner/PMC reserves the right to check the functional schedule and status of activities at anytime and at any location of performance/execution. Further, the functional schedules shall be submitted by the Contractor on demand by the Owner/PMC.

2.9. Progress Measurement Methodology

The Contractor is required to submit during the Kick-Off Meeting, the detail Methodology of Progress Measurement of Engineering, Procurement, Manufacturing, Delivery,

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Computation of total Service/Physical Progress at the unit-wise level and on the overall basis. The progress basis shall be physical realisation of work such as in terms of deliverables and construction quantity/volume accomplished. The amalgamation of such output across the project to compute overall progress shall be suitably established with proper rational and norms and maintained throughout the project. Owner/PMC reserves the right to modify the methodology in part or in full.

2.10. Vendor Scheduling and Monitoring

The Contractor shall establish schedules for Pre-Ordering and Post Ordering for follow up. The vendor monitoring preferably should be on logical networks and commitments at least on critical items in order to monitor them on regular basis for effective control. Owner/PMC may demand such follow up procedure and logical networks for various Critical Equipment at any time during the course of order execution. The manufacturing schedule shall be established and agreed with the vendors and acceptance shall be brought to the notice of Owner/PMC in time.

2.11. Construction Network

The Contractor shall prepare and submit a Detailed Construction Network with full consideration of logistics, construction studies and method for Owner/PMC approval. The Contractor shall describe the resources required and special construction equipments, Tools and tackles to be mobilized. The network shall be developed subsequent of substantial progress of engineering and ordering with fairly known construction workload and quantities.

2.12. Construction Worksheets



The Contractor shall further detail out the construction network into area-wise details in terms of work, quantity and schedule, to firm up basis for area control. The construction schedule should be worked out based on work front generation criteria which will call for availability of input like drawings, materials and access for each/group of activity to be performed. It may be in the form of resource loaded bar chart with 'S' curve. Owner/PMC reserves the right to access the same.

2.13. Construction Contractor Schedule

The Contractor shall agree upon the construction schedules with sub-contractors for proper mobilisation, monitoring and control. Owner/PMC reserves the right to ask for such programme and status of any time as may be required.

2.14. Computerisation

Contractor should follow proper computerised control for the following project modules:

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- Activity network
- Engineering (Residual)
- Purchasing, delivery and expediting
- Tendering
- Construction planning and control
- Materials control at head office.
- Material allocation and control at field office
- Proper warehousing control
- Project documents and construction drawings

The above distinct but integrated components of project should be monitored as deliverable and quantum level. To perform such elaborate level of input-output control at each deliverable, the packages used should forecast resources based on recovery plan in dynamic manner for adequate control.

As indicated earlier, Project Schedules as above shall be developed/evolved using the Latest Version of the Primavera (P6) Project Planner Software Package.

2.15. Project Review Meetings



Contractor shall present programme and status at various review meetings as required.

Monthly Review Meeting

Level of participation	:	Project and planning of PMC, OWNER and Contractor
Agenda	:	Monthly Programme v/s Progress Status/Statistics Major hold ups/Slippage Completion outlook Assistance required Areas of concern and critical issue Recovery Action Plan
Venue	:	Owner / PMC Office or As Mutually Agreed Venue

Weekly Review Meeting

Level of participation	:	Contractor / PMC's site in-charge / Project Manager and Job Engineers
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Agenda : Weekly programme v/s actual achieved in week
Programme for next week
Purchase requisition status report
Recovery actions and hold up analysis,
Safety related incidents and action taken for the same
Man-Power status

Venue : Site office or As Mutually Agreed Venue



2.16. Progress Reporting

The Contractor shall submit the following Progress Reports on a regular basis for Owner / PMC review.

Monthly Progress Report

This report shall be submitted on a monthly basis within seven calendar days from cut-off date, or as agreed upon, covering overall scenario of the project. The report shall include, but not limited, to the following:

- Executive summary or summary of major events/activities.
- Schedule v/s actual percentage progress and progress curves for engineering, ordering, manufacturing, delivery, contracting, construction, commissioning, overall.
- Areas of concern/problem/hold-ups, impact; recovery action plans/catch-up plans.
- Activities executed achievements during months and targets for the following month.
- Analysis of critical activities and impact on overall completion.
- Chronological achievements of key events indicating schedules and actual date.
- Annexure giving status summary for drawings material requisitions, equipment and materials delivery, contracting and construction.
- Resource requirement deployment status.
- Statutory requirements / compliance status
- Change order status.
- Invoice status.
- Construction photographs.
- Updated Project Schedule

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Weekly Reports

This report will be prepared for Head Office and construction site in summarized fashion and submitted on every Tuesday taking status as of Sunday by the Contractor on weekly basis and will cover following items:

- Activities completed (engineering, procurement, contracting, construction. etc.)
- Programme for subsequent week.
- Resource deployed – man and machine.
- Quantities and productivity achieved in key areas of work.
- Progress on procurement activities including material requisition status reports.
- Constraints, if any.



The report/information may be transmitted preferably through fax to Owner / PMC HO.

Daily Reports

- Important activities for the day at site.
- Engineering Deliverables Status
- Material/equipments receipts for the day.
- Labour deployment report.

2.17. Material Control

It is essential that the Contractor follow an integrated material control system for the project. In the system, material identification in the drawing office, procurement and allocation, are all channelized and controlled in an orderly manner. The Contractor should follow a system for material identification like system-wise or area-wise/zone-wise, and should give construction orientation to material control. The Contractor, right from the beginning, at the drawing office stage will start identifying materials system-wise or area-wise. The system will be based upon backing of material from the material take off stage through material requisitioning, placement of purchase order, manufacturing at vendor's shop upto receipt at site for making the material available for performing planned and sequential construction work.

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At the construction site, the Contractor will develop and implement a system of inspection, receipt and effective utilisation of materials received by re-examining the work front availability and priority between and amongst various systems and areas.

In the case of multiple agencies carrying out construction at site, the Contractor must adopt methodology of allocation and de-allocation and timely issue of the materials thereby preventing possible idle storage of items at the Contractor's level. Contractor must follow proper warehousing procedure at project store to maintain various planned and unplanned issues and dynamic stock status records. Through periodic reviews, the Contractor will have a system of generating hold up reports well in advance to identify exception on material availability and to track such material by the expeditery through a systematic follow up procedure from the vendors.

Owner/PMC may introduce checkpoints at procurement, allocation and construction stages to know the development, status and behaviour of the system and the Contractor shall submit the following reports on monthly basis: bulk material status report, and material hold up/shortage report.



2.18. Project Time Control Methodology

2.18.1. The time for completion of the complete scope of work shall be strictly as per the time schedule given in the tender document.

2.18.2. The CONTRACTOR shall furnish the following documents along with the bid:

- (a) An overall schedule in the form of network, clearly indicating all important milestones in design, engineering, fabrication, procurement construction, testing, commissioning, etc. for the plant commensurate with the overall time schedule.
- (b) Resource deployment schedule indicating mobilisation of all critical resources including manpower and machinery for the smooth execution of the job at engineering offices, fabrication shops and construction site. The resource schedule shall also contain various construction aids envisaged to be deployed for execution.
- (c) Organisation structure for effective project management and control, clearly indicating the responsibility centre as well as bio-data of the key personnel, who are permanent employees of the Contractor.

2.18.3. Within 30 days of issue of fax/letter of intent, the Contractor shall finalise the following as detailed earlier:

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(a) Overall Project Schedule

Overall project schedule in line with the agreed milestone and detailed to adequate work breakdown structure level covering all phases of the work such as detailed engineering, procurement, manufacturing, shipment, tendering and field erection. This schedule shall also include the interface activities to be provided by the Owner/Engineer-in-Charge and the dates by which such facilities are needed. Contractor shall get the schedule reviewed by Owner/Engineer-in-Charge and the agreed schedule shall form part of the Contract monitoring document based on which performance would be reported and evaluated. This document shall be signed by both the parties. The Owner/Engineer-in-Charge shall also review the weightage allotted to various activities and method of reporting to be adopted by the Contractor. During the progress of the contract if in the opinion of Owner/Engineer-in-Charge, desired progress as physically/sequentially is not maintained, it would be obligatory on the Contractor to re-programme the work schedule in order to accommodate the backlog and/or provide work front to other agency, without any obligation to the Owner/PMC.

(b) Functional Schedules

- **Engineering Schedule**

This shall indicate list of drawings, specification and sketches to be prepared discipline wise for each plant and scheduled date of issue of each document.

- **Ordering, Manufacturing & Delivery Schedule**



This will be in the form of bar chart and shall indicate item-wise all the major activities regarding ordering, shop fabrication/manufacturing and delivery of materials.

- **Construction Schedule**

This will be in the form of a detailed bar chart showing all the construction activities (civil structural, piping, equipment erection, electrical, instrumentation, insulation, painting, etc.) at site with their durations and workload and highlighting the inputs namely drawings, materials availability, etc., compatible with the related functional schedule. The Contractor shall provide on request key construction net work of any work module for critical review and control.

- **Resource Deployment Schedule**

A detailed deployment schedule indicating manpower, machinery, construction, equipment in line with the overall project schedule

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- **Pre-commissioning and Commissioning Schedule**

Contractor shall develop this schedule in the form of a bar chart and submit the same to OWNER / PMC for review.

- **Any other document required for monitoring.**



2.18.4. In line with the construction schedule, the Contractor shall submit a monthly programme for site activities and the target set in shall be strictly adhered to. In all matters concerning the extent of targets set out in the monthly programme and the degree of achievement, the decision of PMC shall be final and binding. The monthly programme shall be further broken into weekly programmes. At the end of each week, a report shall be submitted by the Contractor indicating the achievement during the week against the targets, reason for shortfall if any and the construction programme for the following week. Contractor shall also attend weekly/monthly review meeting conducted by PMC or by his representative to review project status.

2.18.5. The Contractor shall regularly submit a detailed progress report in respect of:

- Release of drawings
- Sub-ordering of materials
- Manufacturing
- Delivery of equipment/material status report
- Construction
- Other features like mobilisation, safety etc.
- Report indicating the critical activities governing the timely completion of the project and actions to overcome the same to be submitted every month.

This report will be issued every month on an agreed cut off date and shall include the following brief description of the progress achieved during the month. Reason for short fall if any and action plan to make up short-fall.

- Scheduled and actual percentage progress discipline-wise/system-wise as well as overall physical progress.
- Job completion trend in the form of updated overall schedule.
- Progress photograph highlighting major achievement.



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- 2.18.6. The Contractor at any point of time of operating would be permitted to revise the accepted schedule/control documents with the Owner/Engineer-in-Charge without changing the contractual completion date.
- 2.18.7. The review of the performance of work would be made at different levels of management and Contractor is expected to ensure proper participation for effective reviewing and action plan.
- 2.18.8. The Contractor should ensure availability of professionally qualified planning engineer both at HO and site deemed adequate by the Owner/Engineer-in-Charge.
- 2.18.9. The Contractor at his own cost should maintain a control room at site highlighting all the features, schedule and achievements of the project.
- 2.18.10. Weighted percentage of each discipline/group of work shall be mutually agreed to between the Contractor and Owner/ Engineer-in-Charge after the award of contract to facilitate compilation of progress.

3.0. CONSTRUCTION, CONSTRUCTION SUPERVISION AND MANAGEMENT

3.1. Construction

- 3.1.1. The Contractor will carry out the construction works in accordance with all relevant codes, standards, specifications, his documents and drawings, and based on the most efficient use of local resources. The Contractor will act as principal employer on the labour employed for construction activities and will follow Indian Labour Act, and all statutory regulations in this regard. The Contractor will have total responsibilities for the following:
- Construction, erection and installation of all equipment, machinery, piping and materials supplied by the Contractor.
 - Site supervision, planning and coordination at site.
- 3.1.2. Major categories of construction work performed by the Contractor will comprise of but not limited to the following:
- Civil work: Aboveground structure work; refractory, brick and castable work.
 - Civil foundation work shall be done by the bidder.
 - Machinery: Installation of machinery and equipment; assembling of large size equipment, if any

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- Piping Work: Prefabrication of piping, installation of piping; welding work of piping; non-destructive test for welded parts.
- Electrical Work: Installation of transformer, cubicles and electrical equipment; power cable and control cable wiring; installation of lighting fixtures and lighting wiring; installation of communication system and wiring; installation and wiring work for fire-alarm system; grounding work for equipment and structures.
- Instrument Work: Installation of local panel, all field devices like transmitters, control valves and other instruments/equipments; installation of cable duct and cable laying etc.; cable wiring work; air piping and tubing work; instrument pressure-piping work.
- Painting/Insulation Work: Painting of equipment, piping, impulse piping and steel structures; insulation of equipment and piping
- Safety work during construction period.
- Test and inspection work.



3.1.3. The Contractor is required to organise and mobilise construction management services in a systematic and sequential manner to ensure that the plant installation is carried out in accordance with the approved engineering drawings, specifications, standards, QA/QC procedures etc. and its mechanical completion is achieved within targeted time schedule. For this purpose, the Contractor shall deploy a construction management team headed by a Resident Construction Manager (RCM) at site.

The construction management team shall include engineers/specialists in QA/QC, project control (planning, scheduling, monitoring), contracts, construction supervision, progress measurement/billing, safety, warehousing, purchasing etc.

Construction supervision, coordination and management activities shall be carried out by Contractor in accordance with the approved construction procedures by PMC. Contractor will prepare construction schedules based on the overall project schedule of the plant and submit to Owner/PMC for approval. Monitoring and control of the construction activities will be carried out as per the approved construction schedule and procedure.

A construction management team headed by a Resident Construction Manager will be deployed at site by Contractor. The Contractor shall ensure delegation of adequate and sufficient power to his RCM for effective and smooth functioning of the field management. HO support shall be provided to the RCM at site during construction as and when required on all matters of project execution including the following:

- Field engineering

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- Vendor specialists required during construction
- Rectification/replacement of defective supplies, if any, noticed during construction
- Inspection/expediting of replacement orders/field purchase order for ordered items placed by field purchase
- Expediting replacement of imported items found short/damaged.

3.1.4. The Contractor shall establish and maintain a material testing laboratory for carrying on field tests during execution of contracts under different disciplines by Sub-contractors, at no extra cost to owner. Also, all material handling equipment shall be subjected by the Contractor to required load test initially and then periodically to ensure safe/stable operation including witnessing and maintaining records of such tests.

3.1.5. The construction organisation will include the following for effective execution, monitoring and control: planning, scheduling, monitoring reporting, construction supervision, quality assurance and quality control, warehouse management and material control, field engineering/purchase, safety personnel administration.



(a) Quality Assurance and Quality Control (QA/QC):

QA/QC personnel will be responsible for ensuring quality of construction carried out by different Sub-contractors in accordance with the approved QA/QC procedures and management of material testing laboratory.

(b) Warehouse Management and Material Control:

This discipline will be responsible for carrying out the warehouse management and material control in accordance with the warehousing procedure and material control procedure. The material control plan and warehousing procedure shall be Contractor for Owner/ PMC's review/approval. The activities of the contractor will include:

- Transport Liaison, filing of insurance claims and follow up.
- Receipt, handling, identification, inspection, and acceptance of materials including free issue materials to be supplied by owner.
- Documentation for control and accounting of materials.
- Materials control and issue
- Inventory checks
- Field requisition and purchase
- Spare and tools

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- Material appropriation and handing over
- Security
- Taking with suppliers on short supplied items and placing replacement orders for lost/damaged items.
- Intimating HO regarding short, lost, damaged items and taking up with suppliers and taking replacement action when applicable.
- Perform material reconciliation and identification of surplus material and its handing over to the Owner after certification by the PMC.
- Contractor will generate and issue following reports: fortnightly statement of consignments in transit; daily report of material received; report on over, short, reject, and damage receipts against each consignment on receipt at warehouse; weekly status of consignments, material receipt report; monthly status of field purchase; monthly status of excess, shortage rejected and damage settlement.



(c) Field Engineering:

This discipline will be responsible for controlling and issue of technical drawings and documents, preparation of field sketches, field modifications, checking/preparation of as-built drawings, technical assistance for field purchase and field tendering etc. Specialist engineers from Vendor HO will also be deployed at site as per requirements.

- Field tendering will be responsible for carrying out field tendering activities if required.
- Field purchase contractor will be responsible for carrying out field purchase activities if required. The bulk of procurement action will be done from HO. Field purchase items are restricted to those required for running and maintenance of the field offices, items required for field, items required to expedite construction work and items found short, missing or damaged against the main order when received at the site.

(d) Safety:

It is the responsibility of the Contractor to ensure that safe construction procedures are complied with. They will also ensure that adequate first aid medical facilities are available for emergency purpose and that safety procedures as per the approved safety procedure are followed by the different Contractors. To assist in the development of an effective safety programme, a safety checklist for various jobs shall be developed and the same shall be reviewed by the Contractors Site Incharge.

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The responsibilities will include the following: coordination and supervision of the details of the job safety programme; initiation and supervision of the use of accident report and investigation form; preparation of periodic accident summaries; tallying safety inspection of the job site and submission of summary inspection report to site PMC in charge.



3.2. Quality Assurance/Quality Control

All work/services to be performed by the Contractor under this contract shall be of specified/approved quality and Contractor shall have a quality assurance/quality control (QA/QC) system during the performance of various activities such as engineering, procurement, tendering, construction etc. Review/approval of activities by Owner/PMC shall not however dilute the responsibility of Contractor for maintaining quality.

(a) QA/QC Procedure:

Contractor shall submit the QA/QC procedure to be adopted for engineering procurement and construction activities of plant for review and approval to Owner/PMC. The QA/QC procedure shall cover all activities to be performed by Contractor. Some important activities and procedures to be evolved are listed below:

- **General:**
Document control, coordination, non-conformance report of Sub-contractors, output identification and traceability, QA system review
- **Procurement/Inspection:**
Incoming material control, welding qualification and repair, manufacturing or fabrication process control, applicable non-destructive examination, coating/lining, preservation, post-weld heat treatment wherever applicable, packaging and despatch control, transportation, inspection/test plans for all specific and mandatory tests (as per drawings and codes) with clear indication of witness, verification and hold points.
- **Construction:**
Pre-construction activities, job construction, welding qualification and repair, inspection/test plans for all specified tests (as per drawing and codes) with clear indication of witness, verification and hold points. Contractor shall prepare construction QA plans for review of the Owner/PMC and the same shall cover as minimum the areas as under, and shall confirm their compliance to approved codes/standards/specifications, etc.
- **Site Preparation:**
Tie-ins, structures, incorporation of all witness tests/hold points of construction work, clean-up testing, instrumentation installation and construction.



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(b) As a part of Construction and Quality Assurance, the Contractor shall also comply with the following activities:



- Stage-wise inspection of quality of work as per approved QA plan and contract specifications.
- Develop welding procedures and welders qualification procedures for their work.
- Ensure compliance of various statutory rules, regulations and safety measures and to arrange and co-ordinate site inspection, testing etc. as required under local statutory rules and regulations prevalent in India.
- Take all necessary precautions to protect construction work and material from damage by climate, outside elements and construction activities.
- Ensure that materials used are in accordance with drawings/project specification.
- Review safety procedures prepared by the Contractor for compliance with applicable codes, regulations and Owner requirements.
- Prepare schemes for heavy/critical equipment's erection/lifts/rigging before and submit the same for PMC review/approval.
- Ensure alignment (hot/cold) of all critical rotary equipment/machinery and their upkeep/maintenance as per suppliers' recommendations.
- Perform housekeeping activities, which include maintaining sanitary facilities, sweeping clean up, removal of excess materials/temporary facilities, scaffolding, as necessary.
- Conduct periodic quality/technical audits for ensuring quality and conformance with the contract.
- To take immediate appropriate corrective actions as and when such discrepancy arises to fulfil quality, safety obligations.

(c) QA/QC procedure shall also include quality plans, mostly in tabular formats defining the specific quality practices and flow of every identifiable activity of a discipline. All disciplines concerned with the performance of work are to be covered. These quality plans should indicate the following:

- For Design and Engineering: Activity description; preparation, checking, review and approval requirements; code of conformance (applicable standard specification number); applicable procedure number; QA data/records produced.

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- For Procurement and Construction: Activity description; procedure number, inspection and test plan number, conformance code, testing and inspection code
- (d) QA/QC procedure and quality plans will be discussed during kick-off meeting. Hold, witness and verification points and Owner/PMC review/audit requirements will be finalised between Contractor and Owner/PMC.
- (e) During the performance of the contract, the Contractor shall:
- Implement approved quality assurance programme including but not limited to:
 - (i) Performance of internal quality audits, preparation of audit reports and submission for review of PMC. Contractor shall evolve a comprehensive system of planned and documented audit to verify whether various performed activities comply with detailed procedures, specifications, guidelines etc. and to determine the effectiveness of quality system. Scope of such internal audits shall be furnished to PMC for review. Verification documents shall be generated during audit and submitted periodically to PMC for review. Throughout all stages of the scope of contract, the Contractors procedures, documents, activities, products and services and those of his Sub-contractor's shall be subject to Owner/PMC review/approval. Such surveillance and audit are optional and shall not relieve the Contractor of his contractual obligations and liabilities.
 - (ii) Generation of QA records (mostly inspection and test plans) as per quality plan and submission for review by Owner/PMC. The Contractor shall submit all quality records (generated during activity execution) and audit results on well laid formats/performance for Owner/PMC review. The rights of such review are reserved by Owner/PMC. Owner/PMC may review it in full, parts or selectively. However, complete correctness of the QA records shall be the sole responsibility of the Contractor irrespective of its review by Owner/PMC.
 - Facilitate Owner/PMC in the quality audit at works.
 - Certify QA Programme documents of Contractors and submit to Owner/PMC for review.
 - Carry out audits/inspection at Contractors works as per approved QA programme and submit the reports for review by Owner/PMC
 - Get similar QA system implemented at his Sub-contractor's works/office. QA records from the Contractor shall be reviewed and certified for compliance by the Contractor before submitting to Owner/PMC for information.

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- Carry out audits at Contractors' office/works and submit the report to Owner/PMC for information.
- Ensure that all personnel shall be assigned tasks commensurate with their qualification. Specialized workmen shall be qualified and certified.
- Handle non-conformance brought out by internal and external sources as follows:
 - (i) Non-conformance brought out by Contractor's own review/audit shall be resolved by Contractor himself. One level higher than those responsible to carry-out the activity shall resolve the non-conformance. Such resolution shall be in full knowledge of Departmental Manager. Corrective action shall be initiated at the earliest. Report of such resolution shall be submitted to Owner/PMC for information.
 - (ii) Non-conformance brought out by Owner/PMC through any of the following shall be resolved by the Contractor. Such corrective actions shall be submitted to Owner/PMC for review. However, corrective action shall be initiated at the earliest for : technical reviews, QA review and surveillance, inspection, external audit (Owner / PMC)

3.3. Construction Equipment

The Contractor is required to organize and mobilize the construction equipment and other tools tackles in a sequential manner to ensure that plant installation is carried out in a mechanized manner and its mechanical completion is achieved within targeted time schedule. The Contractor shall without prejudice to his responsibility to execute and complete the work strictly as per the specifications and other laid down procedures by mechanizing the construction activities to the maximum extent by deploying all necessary construction equipment/machinery of adequate capacities and numbers. For this purpose, the Contractor shall deploy a rigging team headed by a rigging foreman reporting to Area Engineer responsible for equipment erection.

Area Engineer should be well conversant with various erection techniques and shall be responsible for preparing erection schemes in accordance with the approved procedures and based on crane manuals suiting to plan layout. Area Engineer will have to foresee various other constructive activities in the surroundings while planning erection schedules including safety aspects of man and machinery also.

Contractor will prepare erection schedule based on the overall project schedule of the plant in phased manner with erection schemes of various equipments, vessels and submit to Owner/PMC for approval, monitoring and control of erection schedule. Erection activities will be carried out as per the approved construction procedures.

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For efficient working and maintenance of construction aids, Contractor shall establish and maintain crane yard/workshop equipped with regular maintenance facility for various construction aids for carrying out routine field maintenance during performance for the contract. Temporary approach road, wherever required for the movement of the crane and other vehicles for equipment erection and transportation of material shall be properly planned and be made by the Contractor for quick mobilisation of the transportation system. The proper padding for the crane movement shall be done to avoid any delays of erection schedule. Weekly/fortnightly maintenances shall be planned in such a way that it should not hamper the erection schedule.

Contractor shall ensure the timely augmentation of the plant, equipment and machinery depend upon the exigencies of the requirement to meet the overall project schedule. During performances of the work, Contractor must ensure that structures, materials or equipments are adequately braced by guys, struts or otherwise approved means which shall be supplied and installed by the Contractor as required till the erection works is satisfactorily completed. Such guys, shoring, bracing, strutting, planking supports etc. shall not interfere with the work of other agencies and shall not damage or cause distortion to other works executed by him or other agencies. Contractor to submit the construction equipment schedule along with the bid.



3.4. Construction Manpower

The Contractor is required to organise and mobilise construction staff in a sequential manner to ensure that plant installation is carried out in accordance with the S curve defined with other chapter of the Bid package. Mobilisation of construction staff should be such that 'S' curve based on the time schedule and progress achieved in the phased manner should match with the overall project time schedule. For this purpose, the Contractor shall clearly indicate in his construction methodology that work shall be done departmentally or by engaging such Sub-contractor or the combination of both.

Contractor will prepare detailed methodology for the work to be carried out departmental as well as by Sub-contractor clearly defining the scope and responsibility of main Contractor and Sub-contractor.

In case, Contractor proposes to engage Sub-contractor for the erection of various activities, he must enter into an agreement of Memorandum of Understanding and same shall be furnished along with their credential with the bid. Sub-contractor's credential will be evaluated along with the offer. Contractor shall not be permitted to change the Sub-contractor after the award of work under any circumstances. Non-compliances of the above will be strictly dealt with relevant provisions of the contract.

During the execution of works at site, if the principal Contractor engages Sub-contractors for execution of works at site as per approval obtained from Owner/PMC in line with contract provisions and in the event Sub-contractor complains in writing to the Owner with regard to the non-payment of their dues from the principal contractor for the works

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executed by them and site (excluding final payments and payments due after termination of Sub-contractors' services by the main contractor), Owner reserves their right to make such payment to the Sub-contractors based on approved measurement with due notice to the principal Contractor. Owner shall release such payments to Sub-contractor at the cost and risk of the main Contractor in order to ensure smart execution of work at site.

The above such payment made by Owner to the Sub-contractor shall be adjusted in the running account bills or any other payment due to the concerned principal contractor. Contractor to submit the construction manpower schedule.

All Sub-contractors will be managed by the main Contractor construction staff who will perform the duties of construction management and will administer, coordinate, and inspect the work of the Sub-contractor and be responsible for the quality.

The contractor will establish the prerequisite for successful construction of sub-contractor work. However, by deploying the Sub-contractors as approved by Owner/PMC for any discipline, does not absolve the principal Contractor for his total responsibility under the subject contract

The Contractor to ensure that in case of Sub-contract failure to execute the works as per standards/specifications/drawings and negligence and disobedience in carrying out any order or instruction of Owner / PMC will be viewed very seriously and dealt with appropriately in accordance with provisions of the contract. Contractor to submit the construction manpower schedule along with the bid

4.0. QA SYSTEM / INSPECTION REQUIREMENTS FOR BOUGHT OUT ITEMS & DURING CONSTRUCTION



4.1. General

Contractors are required to follow a well-documented quality assurance and quality control system covering all phases of project viz. engineering, procurement, installation, testing and commissioning. Similarly, Contractors are required to develop their own resources for inspection of all bought-out items supported by third party inspection services for specific cases. Supervision of construction activities is the responsibility of turnkey contractor; Owner/PMC role during construction phase is for quality surveillance.

4.2. Specification for Turn-Key Bidder's Quality Assurance System

(a) Introduction

This specification establishes the quality assurance requirements to be met by the turnkey bidder during execution of contracted services. in case of any conflict between the requirements of this specification and other documents such as technical specifications,

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contract conditions etc., the contractor shall notify Owner/PMC of all such conflicts for final resolution.

(b) Scope of Work by Contractor

Prior to the award of contract, the following documents shall be submitted along with the bid for evaluation:



- Quality policy
- Quality objective
- Company quality manual
- Project quality plans
- Copy of certificate of approval of quality management system

After the award of contract, within four weeks after the award of the contract, the Contractor shall participate in the pre-start meeting with Owner/PMC to finalize 'Project Quality Plans' as regards to the following:

- Standard practices specified by the Contractor
- Hold, witness and verification point
- Owner/PMC's review/audit requirements

During job execution, implement approved project quality plan including but not limited to:



- Performance of internal quality audits, preparation of audit reports and submission for Owner/PMC's review.
- Generation of QA records as per quality plan and submission for Owner/PMC's review.
 - Records of management review of quality system
 - Contract review records
 - Design review, verification and validator's records
 - Assessment records of acceptable vendors/sub-vendors
 - Records of nonconformity
 - Records of external quality audit
 - Records of training
 - Inspection reports
 - Test data/inspection and test plans
 - Qualification reports
 - Material review reports

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- Calibration data
- Quality cost report
- Schedule control and progress reports
- Facilitate Owner/PMC in the quality audit at his works.
- Certify QA Programme documents of sub-contractor and submission for review to Owner/PMC.
- Carry out audits/inspection at sub-contractor's works as per approved QA programme and submit the reports for Owner/PMC's review.

(c) Quality Assurance System Requirement



- Requirements stipulated in this specification shall be fulfilled by the Contractor/Sub-contractor. All other features of QA System shall be as per Contractor's standards.
- The Contractor shall ensure that the quality system is clearly understood and faithfully implemented at all levels in his organisation.
- The Contractor shall develop quality consciousness' among all personnel working for the contract.
- Non-conformances brought out by Contractors/Sub-contractors' own internal review/audit shall be resolved by Contractors'/Sub-contractors, themselves. One level higher than those responsible to carry out the activity shall resolve the non-conformances. Such resolution shall be in full knowledge of Departmental Manager. Corrective action shall be initiated at the earliest. Report of such resolution shall be submitted to Owner/PMC for information.
- Non-conformances brought out by Owner/PMC through any of the following: technical reviews, QA reviews and surveillance, inspection, external audit (Owner/PMC), post construction quality audit (by Owner/PMC) to be carried out immediately after declaration of mechanical completion by the Contractor. Non-conformances brought out due to the above, shall be resolved by the Contractor/Sub-contractor. Such corrective actions shall be submitted to Owner/PMC for review. However, corrective action shall be initiated at the earliest.
- The Contractor shall evolve a comprehensive system of planned and documented audit to verify whether various performed activities comply with detailed procedures, specifications, guidelines etc. and to determine the effectiveness of quality system. Scope of such internal audits shall be furnished to Owner/PMC for review. Verifiable documents shall be generated during audit and submitted periodically to Owner/PMC for review. Audits shall be carried out by independent engineers not responsible for execution of the activity to be audited.

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- Throughout all stages of the scope of contract, the Contractor's procedures, documents, activities, products and services and those of his Sub-contractors' shall be subjected to quality surveillance and audit by Owner/PMC. Such surveillance and audit are optional and shall not relieve the Contractor of his contractual obligations and liabilities.
- The Contractor shall submit all quality records (generated during activity execution) and audit results on well laid formats/proforma for Owner/PMC's review. The rights of such review are reserved by Owner/PMC. Owner/PMC may review it in full, parts or selectively. However, completes correctness of the QA records shall be the sole responsibility of the Contractor irrespective of its review by Owner/PMC.
- The Contractor shall get similar QA system implemented at his Subcontractors' works/office. QA records from the Subcontractor shall be reviewed and certified for compliance by the Contractor before submitting to Owner/PMC for information.
- Contractor shall carry out audits at Subcontractors, office/works and shall submit the report to Owner/PMC for information.
- All personnel shall be assigned tasks commensurate with their qualification. Specialized operators shall be qualified and certified. The Contractor shall have a system for identifying personnel training needs in line with the latest ISO guidelines.
- Immediately after submitting written declaration of mechanical completion by the Contractor, Owner/PMC will carry out post-construction quality audit. Contractor shall extend all help and cooperation to carry out this audit including providing all necessary resources to Owner/PMC and shall implement all corrective measures, based on the post-construction quality audit findings and observations at no cost to the Owner/PMC.
- A pre-startup safety review (PSSR) checklist is a tool used by a PSSR team during a safety review of a new facility before commissioning. This checklist helps ensure that a facility will be safe for employees and that equipment will operate according to design specifications. This may be added here to ensure safety aspect before pre-commissioning. All the points in the PSSR has to be complied by LSTK contractor before start up of the unit.



4.3. Inspection Coordination Methodology for Turnkey Package

- 4.3.1. All equipment and materials are to be procured from vendors listed in the approved Vendor List enclosed in this Bid, or from other reputed vendors after obtaining specific approval of the Owner/PMC. In this regard, no difference is made between the equipment and materials purchased by the contractor directly or by his contracted agencies.
- 4.3.2. After finalisation of purchase order, a detailed QA/QC plan shall be developed by the vendor, duly reviewed by the Contractor and shall be submitted for approval of the

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Owner/PMC. It is envisaged that QA/QC plans for the critical Items shall be reviewed/approved by the Owner/PMC and for the balance items QA/QC plans shall be submitted for records. The management of quality control system is to be developed generally based on the categorisation of various equipment and materials. Preliminary categorisation of various items involved is enclosed. For items not included here, categorisation shall be decided during detailed engineering and Owner/PMC may change inspection category based on final information and quantities. For indigenous items, Contractor shall employ an approved third party inspection agency to carry out inspection on his behalf, whose involvement must be brought out in the detailed QA/QC plans. For imported items, contractor should engage Owner/PMC approved Third Party Inspector (TPI). Each stage of inspection by the TPI, must define whether it is a hold point, witness point, verification point or internal inspection point by the vendor. Contractor shall make independent QA Plans through the approved Third Party Agency which shall be having a confirmation of meeting the minimum inspection requirements spelt out. All inspection stages where Owner/PMC desires to participate (which shall be preferably only for critical items) shall be marked on the QA/QC plan and these stages must necessarily be attended by the Contractor in addition to the other stages being attended by him. In case the QA/QC plans are not submitted in sufficient detail, the Contractor may be asked to re-submit the plans.



- 4.3.3. The personnel to be deployed by the third party inspection agency must have adequate qualification and experience for the type of work involved and the owner may ask for approval of the personnel employed for the job and his replacement, if required.
- 4.3.4. The Contractor shall submit a detailed vendor's inspection schedule for the coming two months at the beginning of each month as well as notify owner's involvement at the appropriate inspection stage, giving a clear notice period of 15 days. The contractor shall submit monthly inspection and expediting reports of the inspection agency regularly to the Owner/PMC.
- 4.3.5. PMC's inspector shall witness the test on a mutually agreed date according to contractor's inspection notification, wherever applicable.
- 4.3.6. Submission of category-wise inspection plan by Contractor at PMC HO for review. It is envisaged that the QA/QC plans shall be submitted to the PMC in accordance with the clauses as defined above.
- 4.3.7. After finalisation of the vendor, the copy of PO or technical specification for sub-ordered items along with QAP will be submitted by Contractor to PMC covering the location where the sub-ordered items are manufactured. The QAP is to be duly approved by the PMC.
- 4.3.8. Contractor will be totally responsible for furnishing the complete and correct technical document/specifications to his sub-vendor. It is responsibility of the contractor to ensure that relevant specifications indicated in the tender documents are incorporated in the sub-

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order/sub-order specification. Each PO shall categorically indicate involvement of various agencies for inspection.

- 4.3.9. Contractor shall forward the approved copy of relevant drawings/documents to the TPI before giving inspection call. The final inspection will be done by the TPI, based upon drawings/documents reviewed by TPI/PMC in Code 'AP' (Approved) wherever applicable.
- 4.3.10. Contractor will ensure presence of their inspection engineer at sub-vendor's works during inspection by TPI or Owner/PMC inspection engineer (wherever applicable).
- 4.3.11. Contractor shall expedite to ensure delivery of all the materials as per CDD.
- 4.3.12. All correspondence by contractor to the PMC for submission of documents and inspection calls shall also be intimated to Owner.

END

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SECTION : VI - 5.0

CONSTRUCTION/ERECTION, PRE-COMMISSIONING AND COMMISSIONING

PLANT: ELECTRICAL DISTRIBUTION SYSTEM

PROJECT: INTEGRATED COAL BASED FERTILISER COMPLEX AT TALCHER, ANGUL DISTRICT, ODISHA (INDIA)

0	26.03.2021	Issued for Enquiry	JKY	JKY/RRK	RRK
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2	General Scope of Works and Services Pre-commissioning	
3	Basic Plan for Temporary Services	
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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.

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- 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 Deleted
- 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:

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- 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 Functional 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 Obtaining all necessary statutory clearances
- 2.6 Any other activity required to complete the job in all respect as per NIT.
- 2.7 When OWNER is satisfied that Pre-Commissioning activities of the plant has been achieved, OWNER shall issue certificate of Pre-Commissioning Completion to LSTK CONTRACTOR in accordance with the CONTRACT.

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. 415V Feeder (250 A) 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.

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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 PRE-COMMISSIONING

CONTRACTOR shall be responsible for completing the design, engineering, procurement, inspection and expediting, arranging for transportation of EQUIPMENT, construction and testing and all statutory clearance for making PLANT ready COMMISSIONING.

PRE-COMMISSIONING " shall mean completion of erection, Site Testing, Interlock & operation check, obtaining all statutory clearances / approvals required for charging of PLANT and to such an extent that PLANT is ready for commissioning. This shall happen when:

- A. 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.
- B. Site Acceptance Test of ECMS
- C. The EQUIPMENT are installed, aligned and grouted (wherever applicable) in accordance with drawings, specifications as per finally approved Drawings/Documents and in accordance with all applicable codes, and laws.
- D. Instruments, control system, instrument cable, safety interlock are installed, inspected and such non-operating checks are made as to ensure operability in the manner.
- E. 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.
- F. Pipe support system installed as per drawings.
- G. Painting is completed. EQUIPMENT /MACHINERY, piping duly marked and labelled.
- H. Safety equipments, systems are installed and checked for operations. Effluent management and treatment systems are installed and operational.
- I. All Emergency & Instrument power system are checked and operating.
- J. Performance Test of HVAC System and DG Set
- K. Obtained all statutory clearance/approvals like Central Electricity Authority (CEA), Electrical Inspector etc. Including all liasioning work.
- L. The PLANT is ready to be charged.
- M. Liquidation of all punch list applicable for achieving pre-commissioning . Balance items of punch list, if any, shall be liquidated as mutually agreed
- N. Temporary constructions facilities are removed to extent necessary to permit start of commissioning of Plant

CONTRACTOR shall provide experienced personnel as required for carrying out the PRE-COMMISSIONING activities.

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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.

5.0 COMMISSIONING

5.1 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. LSTK Contractor shall associate OWNER's engineers and operating staff with the commissioning work.

CONTRACTOR shall be responsible for COMMISSIONING after PRE-COMMISSIONING activities 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 engineers as required to commission the SYSTEM

COMMISSIONING " shall mean safe & successful energisation of PLANT, functional & operational check and PLANT is ready to be in operation to take care of entire fertiliser complex.

This shall happen when:



- A. Sequential Energisation starting from 220 KV GIS to 240 V AC
- B. Commissioning & Load Test of of UPS, DC Sytem etc.
- C. Operation of ECMS
- D. Operation of complete CCTV System
- E. Functional & operational check



FUNCTIONAL & OPERATIONAL CHECK' shall mean all 'functional & operational checks required for to determine and demonstrate capacity, efficiency and operating characteristics as specified in the CONTRACT documents.

This activity shall be performed for PLANT for continuous Minimum 2 Weeks without any System Failure.

NOTE:

Detail CONTRACTOR'S scope of work in relation with the construction / erection, and pre-commissioning, commissioning from the point of scope of execution as well as performing way are described in detail in the following Sub-Annexes of Sections 5.0 as given below.

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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

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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 functional and operational checks after commissioning 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 painting works as per Annex 7 – 2G, titled painting Specification/work.
9. 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

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- 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.
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.

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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.



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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 | Painting work (For detail refer TS-2001) |

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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.

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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.

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- 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.

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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**

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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 / 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.

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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

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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 CONTRACTOR'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.

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- 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

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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.

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- 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.

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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.

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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.

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- 26.9 The discovery of any unregistered pipes, drains, cables, etc., shall be promptly reported to and dealt 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

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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

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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.

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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 :

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- ◆ 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**

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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 fignent 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 :

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- ◆ 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.

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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.

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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.

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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.

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- 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.

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- 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

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- 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.

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- 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.

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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 filler 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 °C joints to be preheated.

5.10 **Welding Procedure Qualification**

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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 radiographed.

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.

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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.

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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.



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- 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.



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4.1.5 After erection at site, the belt conveyors and related equipment shall be tested for satisfactory operation for mechanical completion.

4.2 Deleted

4.3 **COMMISSIONING AND GUARANTEE TEST**

4.3.1 After issue of Pre-commissioning certificates by Owner, LSTK CONTRACTOR & OWNER shall mutually decide the date of commissioning of the equipment.

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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 Motors
- 2.2 Control panels
- 2.3 Transformer

Note : Installation of all accessories, tanks, levelling and fixing in place are also considered.

2.4 **GIS / 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



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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.

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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.**

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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.

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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.



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- 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.

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- 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 consultation 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**

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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.

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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.

3.0 LOCAL PANELS

LSTK CONTRACTOR shall install local panels, consisting of, but not limited to:

- 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.
- Install and connect air supply and air signal piping and tubing to 'from panels.
- Install cabling and connect alarm horns.
- Identification / tagging of all equipment, terminals, cables and tubing which is not installed by panel vendor. Tag plates to be installed by LSTK CONTRACTOR.
- Installation of brackets / supports for cable, etc. and installation material as required to complete the installation.

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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 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.

6.2 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.

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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

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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.

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- 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 Deleted



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

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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 more details LSTK CONTRACTOR shall follow **Electrical design philosophy elsewhere mentioned in ITB.**

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13.0 **Miscellaneous**

LSTK CONTRACTOR shall remove all waste and debris from the SITE.

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ANNEXURE- 7 – 2G

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 cured 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:

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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:

- Instructions for storage to avoid exposure as well as extremes of temperature.
- Surface preparation prior to painting.
- Mixing and thinning.
- 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

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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° 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,

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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/Cm² 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,

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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.

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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

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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 5⁰C (depending on local condition)
- The metal temperature is less than 3⁰C 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.

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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.

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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;

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- 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.

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- 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	Blast cleaning	P2 : ONE coat of two	P2 : 60	Total dry	Total dry

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Ref No.	Application	Surface Preparation	Generic Coating System	Minimum DFT	Remarks	
	work with operating temp. Up to 90 ^o C (Steel structures, Piping support, uninsulated CS piping, flanges, valves, stairways, walkways etc. except grating).	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
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.	
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	Blast cleaning to near white metal grade 2	F9 : Two coats of Inorganic Co-polymer based coating With an	F9 : 2 x 150 microns	Total dry film thickness of paint system: 300 microns.	

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Ref No.	Application	Surface Preparation	Generic Coating System	Minimum DFT	Remarks	
	operating temp. Over 200° C.	½, of Swedish Standards SIS-05-5900 (Latest).	Inert Multipolymer Matrix.			
07	Uninsulated CS equipment with operating temp. Up to 90° 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° C to 200°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°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 operating temp. Up to 90° 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	
11	Insulated CS equipment with operating temp.	Blast cleaning to near white metal grade 2	F8 : Two coats of high temperature epoxy phenolic (novolac)	F8 : 2 x 125 microns	Total dry film thickness of paint system: 250 microns	

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Ref No.	Application	Surface Preparation	Generic Coating System	Minimum DFT	Remarks	
	From 91°C to 200°C, to be treated at Manufacturer's shop.	½, of Swedish Standards SIS-05-5900 (Latest).				
12	Insulated CS equipment with operating temp. Over 200°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°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°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 air cooler heads not galvanized with operating temperature up to 90°C, 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	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

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Ref No.	Application	Surface Preparation	Generic Coating System	Minimum DFT	Remarks	
			polyurethane			
		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° C TO 200°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 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 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
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.	P1 : 60 microns F1 : 120 - 200 microns F5 : 60 microns	Total dry film thickness of paint system: 240 microns as per C4 – High	Total dry film thickness of paint system: 320 microns as per C5 – High

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Ref No.	Application	Surface Preparation	Generic Coating System	Minimum DFT	Remarks	
			F5 : Two-pack aliphatic Isocyanate cured acrylic finish paint		Durability	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 1/2, 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°C to 240°C treated at Manufacturer's shop	Blast cleaning to near white metal grade 2 1/2, 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°C treated at Manufacturer's shop	Blast cleaning to near white metal grade 2 1/2, 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
b)	Surfaces (CS) with operating temperature upto 91°C TO 200°C, treated	Blast cleaning to near white metal grade 2 1/2, of Swedish Standards SIS-	P1 : One coat of Ethyl Silicate zinc rich with solvent Primer meeting SSPC Paint 20 level 1	P1 : 75 microns F3 : 2 x 25 microns	Total dry film thickness of paint system: 125 microns.	

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Ref No.	Application	Surface Preparation	Generic Coating System	Minimum DFT	Remarks
	at manufacturer's shop.	05-5900 (Latest).	F3 : Two coats of single pack special Oleouresinous based heat resistant ready mixed Aluminium Paint.	for each coat	
c)	Surface (CS) with operating temp. Over 200°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 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 (1-¼ 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, roof of CS tanks, with operating temp. Upto 110°C	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	F2 : Two coats of two pack amine adduct cured Phenolic (Novolac) epoxy (immersion grade)	F2 : 2 x 150 microns for each coat	Total dry film thickness of paint system: 300 microns.
25	For underside (soil side) of the tank bottom (CS) below only of the fixed tanks,	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-	F7 : Two coats of Tar Free Epoxy paint suitably pigmented OR	F7 : 2 x 200 microns OR	Total dry film thickness of paint system: 400 microns. OR

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Ref No.	Application	Surface Preparation	Generic Coating System	Minimum DFT	Remarks
	bottom & shell shall be treated as follows:	05-5900 (Latest).	F8 : Two coats of high temperature epoxy phenolic (novolac)	F8 : 2 x 150 microns	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

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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.

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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.



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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

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		Hard dry < 4 hrs. @ 30 Deg. C
Storage life	:	12 months under sealed conditions

TAR FREE EPOXY – F7 (Coal Tar is Banned Globally being Carcenogenic)

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 inorganic 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:

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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 Jensions & 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

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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).

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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

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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 / 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 / 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.

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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):

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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.

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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.

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- 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.

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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

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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.

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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.

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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
Construction manager
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**.

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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 form, 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

Refer Section VI-3.1, 3.2.2



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ANNEXURE-7-6

Minimum Qualification & Exp. Of Key Supervisory Construction Personnel

<u>SL. NO.</u>	<u>CATEGORY</u>	<u>QUALIFICATION & EXPERIENCE</u>
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	Deleted	
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.

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For and on behalf of

Stamp & Signature :

Name :

Designation :



Date :



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ANNEXURE-7-7

Deployment Schedule of Supervisory Personnel

SL. N O.	DESCRIPTION	DEPLOYMENT SCHEDULE																											
		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																												
2.3.3	MECHANICAL EQPT/ ROTARY EQPT.																												
2.3.4	PIPING																												
(i)	ENGINEERS																												
2.3.5	ELECTRICAL																												
(i)	ENGINEERS																												

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For and on behalf of :



.....

Stamp & Signature :

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Designation :

Date :

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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 be deployed at site	Period of retention at site

For and on behalf of

Stamp & Signature :

Name :

Designation :

Date :

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SECTION : VI-6.0

DRAWINGS AND DOCUMENTS

PLANT: ELECTRICAL DISTRIBUTION SYSTEM

**PROJECT: INTEGRATED COAL BASED FERTILISER COMPLEX
AT TALCHER, ANGUL DISTRICT, ODISHA (INDIA)**

0	26.03.2021	26.03.2021	Issued for Enquiry	RK	SKB	SKB
REV	REV DATE	EFF DATE	PURPOSE	PREPD	REVWD	APPD



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3.0	Procedure	7
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LIST OF ATTACHMENTS

Attachment Number	Description	Number of Sheets

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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 LSTK Contractor 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 LSTK Contractor under the contract is the key to the timely completion of the plants. The LSTK 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 LSTK 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 LSTK 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 LSTK Contractor of responsibility to conform to drawings, standards, specification, codes and contractual requirements / obligations.

The LSTK Contractor shall prepare the drawing numbering procedure and submit to Owner/ PMC for approval. Each Drawing submitted by the LSTK 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:
200 Series for Mechanical etc.

LSTK Contractor to note that the number corresponds to Electrical Distribution System and shall be prefixed to all related documents/deliverables which shall be indicated to successful bidder.

For Details of the Drawing and Documents submission and tools to be used for generating these documents, LSTK contractor is requested to refer Part- B of Section : VI-6..0 of the NIT.

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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 LSTK Contractor/duly approved engineering sub-contractor appointed by the LSTK Contractor. Document received without vetting will be returned.

The review by the PMC/Owner shall not be construed by the LSTK 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 LSTK 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 LSTK 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 LSTK 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 LSTK Contractor's account.

2.0 CATEGORY OF DOCUMENTS

Category	Description	Action by Owner/ PMC
1	Records/ Information	LSTK 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 LSTK Contractor of any comments (deviations from the contract) at any time and the LSTK contractor is liable to respond to satisfy that the work being done is in accordance with the contract; deviations, if any

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		will be bidder's risk and cost.
2	Review	<p>Owner/PMC will review and advise the LSTK Contractor of any Comments on Contractor's Drawings / documents within specified schedule (ie 2 weeks), from date of receipt in PMC office of LSTK 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 LSTK Contractor in accordance with approved drawings / documents schedule as indicated in ITB. In case of any non-conformity to the above by LSTK 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.</p>

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 LSTK 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 LSTK Contractor at any stage of the project will be rectified/ replaced by LSTK 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.

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As Built Drawings:



LSTK 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 / LSTK 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.

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4.0 LIST OF DRAWINGS & DOCUMENTS

S. No	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
A.	ELECTRICAL				
1.0	Load List indicating rated and absorbed power of loads and duty type (Continuous / Standby / Intermittent) at different voltages including emergency loads.	Y	-	Y	Y
2.0	Load Data indicating normal, peak, starting and construction power requirement at various voltage levels.	Y	-	Y	Y
3.0	Single line distribution diagram (power, lighting, DC supply and UPS supply) including protection and metering details giving rating of each equipment.	Y	Y	-	Y
4.0	Filled in Specification Sheets and Technical Particulars, provided in the NIT	Y	Y	-	Y
5.0	Specification Sheets and Technical Particulars of Electrical Equipment	N	Y	-	Y
6.0	General arrangement and foundation drawings of all equipment.	N	-	Y	Y
7.0	Equipment layout in Switchyard gantry, GIS Substation, Sub Station, MCC room, and plant area showing location of all electrical equipment.	N	Y	-	Y
8.0	Cable schedule.	N	Y	-	Y
9.0	Cable rack / trench / pipe layout.	N	Y	-	Y
10.0	Power Layout.	N	Y	-	Y
11.0	Schematic diagram for all control panel & switch boards.	N	Y	-	Y
12.0	Feeder Details of all switch boards / GIS	N	Y	-	Y
13.0	Interconnection & Terminal connection diagram	N	-	Y	Y
14.0	List of controls, interlocks, indication & metering at various locations for all drives.	N	-	Y	Y
15.0	Characteristic curves for motor/ relays etc.	N	-	Y	Y
16.0	Sizing Calculations for Electrical System and Equipment.	N	Y	-	Y
17.0	Electrical System Study Report	N	Y	-	Y

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	(both hard as well as editable working files with complete library / back-up)				
18.0	Design calculations (for system design and equipment sizing, earthing, lighting, cables, bus ducts etc.)	N	Y	-	Y
19.0	Earthing and lightning protection layout	N	Y	-	Y
20.0	Lighting layout and Distribution diagram	N	Y	-	Y
21.0	Drawings and documents asked for each equipment as per respective Technical Specifications	N	Y	-	Y
22.0	Control & operation write up/Block logic diagrams.	N	Y	-	Y
23.0	Catalogues for all bought out items	N	-	Y	Y
24.0	Bill of Materials covering all electrical equipment and installation materials	N	-	Y	Y
25.0	Installation operation and maintenance(Manual)	N	-	-	Y
26.0	Relay Co-ordination and settings	N	-	Y	Y
27.0	Spare Parts list	N	-	Y	Y
28.0	Test Certificates (Type Test, Routine Test)	N	-	Y	Y
29.0	Guarantee Certificates	N	-	Y	Y
30.0	Quality Assurance Plan & Formats	N	Y	-	Y
31.0	Erection Drawings & Details	N	Y	-	Y
32.0	Construction & Commissioning specification and procedure for all equipment.	N	-	Y	Y
33.0	Any other drawings & data as required for satisfactory installation, operation & maintenance.	N	Y	Y	Y



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B	EOT Crane				
1	Data sheets – completely filled		Y		Y
2	Information to be supplied by manufacturer / Vendor		Y		Y
3	General arrangement Drg. showing various details & all principal dimensions of the assembled unit, horizontals and vertical clearances and approaches.		Y		Y
4	List of spare parts with individual part Nos. and prices.		Y		Y
5	Descriptive literature / catalogue		Y		Y
6	Detailed manufacturing programme Time-Bar Chart.		Y		Y
7	Individual structural drgs. For main girders and End-carriages.		Y		Y
8	Mechanical calculations (Brakes, Gear boxes, gears, pinions coupling, Bearing, Rope-drum, Wire-rope etc.		Y		Y
9	Civil load data drawing, Cross-sectional detailed drawings of sub-assemblies part nos., materials of construction and heat treatment details wherever applicable :		Y		Y
10	a) General Assembly Drg. Showing the complete mechanical details.		Y		Y
11	Crane rail & end stops fixing arrangement.		Y		Y
12	Material test certificates (including the originals) of load bearing parts e.g.		Y		Y
13	Crane rail & end stops fixing arrangement.		Y		Y
14	Material test certificates (including the originals) of load bearing parts e.g.		Y		Y
15	Test certificates of motors (including the originals)		Y		Y
16	Certificates of No load, load, over load deflection Test duly witnessed by the Inspector		Y		Y
17	Operation & Maintenance Manual (including the lubrication schedule also.)		Y		Y
18	Drg. Showing the supporting arrangement of flexible cable with main bridge and trolley.		Y		Y

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C	HVAC System				
1	List of drawings / documents including drawing number, revision number and Description & approval status.		Y		Y
2	Specification sheets - Completely filled in agreed proforma.		Y		Y
3	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.		Y		Y
4	List of spares for 2 years normal maintenance in PDIL proforma.		Y		Y
5	Description of Lubrication and sealing system (if any).		Y		Y
6	Manufacturing schedule.		Y		Y
7	Cross-Sectional drawing of AC Plant and auxiliaries alongwith Bill of Materials.		Y		Y
8	Parts catalogue complete with reference drawing numbers & sketches etc.		Y		Y
9	Instruction manuals for erection, installation, operation and maintenance of AC Plant and accessories.		Y		Y
10	Material test certificates and Inspection & performance test report alongwith despatch clearance certificates from inspector.		Y		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, if any.		Y		Y
13	Drivers specification and Drg.		Y		Y

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D.	CIVIL & STRUCTURALS				
1.0	Job Procedure/Method statement	N	Y	-	Y
2.0	Design basis	N	Y	-	Y
3.0	Overall foundation layout drawings	N	Y	-	Y
4.0	Drawings & design calculations Equipment foundations	N	Y	-	Y
5.0	Drawings & design calculations for Steel/RCC structures foundations	N	Y	-	Y
6.0	Drawings & design calculations for Steel/RCC structures	N	Y	-	Y
7.0	Drawings & design calculations for major Steel/RCC structures/foundations viz. cooling towers, derrick str for flare stack, compressors & machine foundations etc.	N	Y	-	Y
8.0	Structural layout drawings: Showing key plan wise Structural Sectional drawings, platforms, Ladders, Walkways & Staircases	N	Y	-	Y
9.0	construction drawings for structures	N	Y	Y	Y
10.0	Fabrication drawings for steel structures	N	-	Y	-
11.0	Drawings of compressor shed & analyser shed	N	Y	-	Y
12.0	Control room/ MCC buildings: Architectural drawings Finishing schedule	N	Y	-	Y
13.0	Building detail drawings for Control room and MCC building	N	Y	-	Y
14.0	Drainage/ Sewage layout drawings	N	Y	-	Y
15.0	Road / paving drawings	N	Y	-	Y
16.0	Standards for steel structures	N	-	Y	-
17.0	Standards for concrete construction	N	-	Y	-
18.0	Standards for general civil	N	-	Y	-

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E.	PIPING				
1.0	Piping Layout drg.	N	Y	Y	Y
2.0	Quality control procedure & plan for piping system.	N	Y	-	Y
3.0	Filled in Valve Data Sheet.	N	Y	-	Y
4.0	Design data and layout.	N	Y	-	Y
5.1	Design basis	N	Y	-	Y
5.2	Piping material specification	N	Y	-	Y
6.0	Issued for construction (IFC) Drawing.	N	-	Y	Y
6.1	Piping GA DRGS.	N	-	Y	Y
6.2	Piping supports, operating platforms drg.	N	-	Y	Y
7.0	Valves	N	Y	-	-
8.0	Design calculation / Documents.	N	-	Y	-
8.1	Support and load data	N	Y	-	-
9.0	Vendor Drawings	N	Y	Y	Y
9.1	Valves	N	-	Y	-
10.0	As Built Drgs	N	-	-	-
10.1	Piping GAD's	N	-	Y	Y
10.3	All inspection, testing & NDT Records.	N	-	Y	-
F.	GENERAL				
1.0	Master Time Schedule/Network (PERT Network/ Bar chart) showing all the activities	Y	-	Y	Y
2.0	Complete Recommended Spare Part List	Y	-	Y	Y
3.0	List of all construction equipments, tool-tackles & man power resources proposed	Y	-	Y	Y
4.0	Description and Catalogues of Auxiliary items	N	-	Y	Y

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SECTION : VI – 7.0

SPARE PARTS

PLANT : ELECTRICAL DISTRIBUTION SYSTEM

**PROJECT : INTEGRATED COAL BASED FERTILISER
COMPLEX, AT TALCHER, ANGUL DISTRICT,
ODISHA**

0	26.03.2021	26.03.2021	Issued for Enquiry	RK	SKB	SKB
REV	REV DATE	EFF DATE	PURPOSE	PREPD	REVWD	APPD



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CONTENTS

Section Number	Description	Sheet Number
1.0	Spare parts for Commissioning	
2.0	Mandatory spare parts	
2.1	Centrifugal Compressor (for air / HVAC services, if applicable)	
2.2	Screw Compressor (for air / HVAC services, if applicable)	
2.3	Centrifugal Fan (FD / ID Fan)	
2.4	Centrifugal Pump	
2.5	Reciprocating Pump	
2.6	EOT Cranes	
2.7	Fire Fighting	
2.8	Electrical Items	
3.0	Vendor recommended spare parts	
4.0	Maintenance Tools and Tackles	

LIST OF ATTACHMENTS

Attachment Number	Description	Number of Sheets

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1.0 SPARE PARTS FOR COMMISSIONING

- 1.1 LSTK Contractor shall supply free of cost all spares and consumables covering pre-commissioning, commissioning, testing, and till handing over of the Electrical Distribution System .
- 1.2 Supply of Mandatory Spares/Insurance spares for Electrical/Mechanical and other plant machinery shall be under LSTK Scope.
- 1.3 Supply of spares and consumables post handing over of the plant shall be under Owner's scope.
- 1.4 LSTK Contractor shall submit/provide recommended 2 years O&M spares (other than Mandatory spares) list with budgetary offers valid for 2 years from the date of submission of offer for TFL /Owners consideration..

2.0 MANDATORY / INSURANCE SPARE PARTS



LSTK Contractor shall supply mandatory spare parts of the plant as detailed below.

- a) Centrifugal Compressor (for air / HVAC services, if applicable)
- b) Screw Compressor (for air / HVAC services, if applicable)
- c) Centrifugal Fan (FD / ID Fan)
- d) Centrifugal Pump
- e) Reciprocating Pump
- f) EOT cranes
- g) Electrical items
- h) Fire& Safety.

2.1 Centrifugal Compressor (for air / HVAC services, if applicable)

The mandatory spares to be supplied for each working train /unit shall be as under .
No spares considered for standby unit.

S. 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 bearing (each type)	2 sets
1.4	Complete Set of Seals/ Mechanical seals for process media (each type)	2 set
1.5	Complete Set of oil seals	200%
1.6	Complete Set of 'O' rings, gaskets, sealing rings, Oil seals for compressor each type	200%
2.0	GEAR BOX	
2.1	Complete set of bearing each type	2 sets
2.2	Set of spare wheels with shaft	1 set
2.3	Oil seals, gaskets	200%
3.0	COOLERS (Inter cooler / after cooler spares)	
3.1	Tubes for cooler	1 set of total tubes bundle
3.2	Gaskets/ end gaskets, O-rings for coolers & press. Vessels	200 %
3.3	Tube Plugs	5% of tube holes



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S. No.	DESCRIPTION	QUANTITY
4.0	LUBE OIL SYSTEM	
4.1	Complete set of Lube Oil Pumps with drive	1 set
4.2	Spares for lube oil pump :	
	a) Set of bearings	1 set
	b) Set of seal	200 %
4.3	Lube oil filter cartridges	4 sets
4.4	Set of Couplings	2 Set
5.0	ACCESSORIES	1 set
5.1	Spare permanent filters in gas/ air line	2 sets
6.0	INSTRUMENTATION	
	As per Instrumentation specification enclosed with enquiry / order specification.	

2.2 Screw Compressor (for air / HVAC services, if applicable)

The mandatory spares to be supplied for each working train /unit shall be as under. No spares considered for standby unit

S. 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 Bearings each type	2 set
1.4	Mechanical seal	1 set
1.5	Set of 'O' rings, gaskets, Oil seals sealing rings etc.for compressor	200 %
2.0	OIL SYSTEM	
2.1	Complete set of Lube Oil Pumps with drive as applicable	1 set
2.2	Spares for lube oil pump :	
	a) Set of bearings	1 set
	b) Set of seal	200 %
2.3	Lube oil filter cartridges	4 sets
2.4	Set of Couplings	2 Set
3.0	GEAR BOX	
3.1	Complete set of bearing each type	2 sets
3.2	Set of spare wheels with shaft	1 set
3.3	Oil seals, gaskets	200%
4.0	ACCESSORIES	
4.1	Spare permanent filters in gas/ air line	2 sets
5.0	INSTRUMENTATION	
	As per Instrumentation specification	

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2.3 Centrifugal Fan (FD / ID Fan)

The mandatory spares to be supplied for each working train /unit shall be as under. No spares considered for standby unit

S. No.	DESCRIPTION	QUANTITY
1.0	Completely dynamically balanced rotor assembly including impeller, wheel, key etc.	1 Set
2.0	Shaft sleeve	1 Set
3.0	Bearings	2 Set
4.0	Stuffing box packing rings sets (DE/ NDE)	200 %
5.0	Complete set of all Gasket & 'O' rings	200 %
6.0	Complete mechanical seal , if applicable	1 set
8.0	Coupling bushes	2 Set
9.0	Complete coupling with elements	1 Set.
10.0	All type of Fasteners	200%

2.4 Centrifugal Pump



S. 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	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.	Mech. Seal where applicable	1 no.	1 no.	2 nos.	2 nos.
9.	'O' Rings / Springs for Mech. Seal	2 set	2 sets	3 sets	4 sets
10.	Mechanical Seal Faces	1 set	2 sets	3 sets	4 sets
11.	Constant level Oiler	2 sets	2 sets	2 sets	2 sets
12.	Deflectors	2 sets	2 sets	3 sets	3 sets
13.	Complete coupling	1 No.	1 No.	1 No.	1 No.
14.	Flexible elements, Bushes, Pins for Coupling	1 set	1 set	2 sets	2 sets
15.	All type of Bearings	1 set	2 sets	2 sets	2 sets
16.	Gaskets & 'O' Rings	2 sets	3 sets	4 sets	6 sets
17.	Labyrinths	2 sets	3 sets	4 sets	5 sets
18.	Throat Bushing	1 No.	2 Nos.	3 Nos.	4 Nos.
19.	Throttle Bushing	1 No.	2 Nos.	3 Nos.	4 Nos.

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S. No.	DESCRIPTION	QUANTITY			
		No. of Pumps working			
		1	2	3	4
20	Oil Seals	2 sets	3 sets	4 sets	6 sets
22	Leak-off valve-gaskets, 'O' Rings and springs	2 sets	3 sets	4 sets	5 sets
23	Spares for gear box (bearings, gears and seals)	1 set	1 set	1 set	1 set
24	All type of Bearings and Oil filter elements for variable hydraulic Turbo coupling (if applicable).	1 set	2 sets	2 sets	2 sets
25	All type of Fasteners	200%	200%	200%	200%

2.5 Reciprocating Pump

S. 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 bolts complete with nuts	4 Nos.	4 Nos.	6 Nos.	6 Nos.
7.	Crank shaft	1 No.	1 No.	1 No.	1 No.
8.	Lube oil pump (w/o motor)	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
12.	Complete set of coupling with fasteners	1 set	1 set	1 set	1 set
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.	Suction valve & seat	1 set	2 sets	3 sets	4 sets
6.	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)				
1.	Oil seals	2 set	1 set	2 sets	2 sets
2.	Lube oil pump	1 No.	1 No.	1 No.	1 No.

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S. No.	DESCRIPTION	QUANTITY			
		No. of Pumps working			
		1	2	3	4
3.	Spare parts for lube oil pump-gears, bushes, gaskets etc	1 set	1 set	2 sets	2 sets
D	LUBE OIL COOLERS (IF APPLICABLE)				
1.	Complete Set of gaskets, o-rings if any	2 sets	2 sets	4 sets	4 sets
2.	Set of tube bundles	100%	200%	300%	400%

2.6 EOT Cranes :



Sl. No.	DESCRIPTION	QUANTITY
1.	Wire rope for main hoist	1 set
2.	Wire rope for Auxiliary hoist	1 set
3.	Rope guide for main Hoist	1 set
4.	Rope guide for Auxiliary Hoist	1 set
5.	Brake linings of each type	2 sets
6.	Gear sets	2 sets
7.	All type of Bearings	2 sets
8.	All type of Seal, Gaskets , O-rings	2 sets

NOTE:

- 'Set' means complete replacement of particular part in one machine.
- The quotation should contain sectional drawing showing location & part no. (For exact identification) & material specification



2.7 Fire Fighting

S. No.	Description	Quantity (% of total installation qty. or as specified)
1	Hose box, RRL hose with couplings, jet nozzle with branch pipe, hose reel with nozzle, hydrant valve, landing valve	5% per item.
2	Monitor per type & capacity	1 no.
3	Portable fire extinguisher per type & capacity (up to 10 kg)	1%
4	Wheel mounted fire extinguisher per type & capacity (greater than 10 kg)	1 no.



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2.8 Electrical Items:

Sr. 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.	Control Cards	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.	Batteries	5 cells
K.	Isolator switch of each type	1 No.
L.	Ventilation Fan each type	2 Nos.
M.	PCBs of each type	1 No.
N.	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.	Buchholz relay	1 No.
N.	Analog type OTI	1 No.



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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	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
4.0	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 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



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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	1No.		
DD.	Alarm buzzer	1 No.		
EE.	Lamp Complete assembly of each colour & voltage	10%		
FF.	Current transducers of each rating	20%		
GG.	Voltage transducers of each rating	20%		
HH.	Power Transducers of each rating	20%		
II.	Bus-Bar Support Insulators	1 Set		
JJ.	Surge Arrestors	1 No.		
KK.	Inspection Glass	3 Nos.		
LL.	Sprouts	1 Set		
MM.	Panel Space Heaters with Thermostat	2 Nos.		
NN.	Alarm Annunciator of each type	1 No.		
OO.	Interpanel insulation barriers	20% Minimum 1 No.		
PP.	Earthing Trolley	1 No.		
QQ.	Maintenance Trolley for breaker of all rating	1 No.		
RR.	Set of gaskets for all ratings & type	1 Set		
SS.	Panel shutter assembly	2 No.		
TT.	Removable bus bar shrouds	1 Set		
UU.	Bus bar mounted power fix contacts	1 Set		
5.0	Each LT (415V) Switchboard (PMCC/PCC/MCC/ASDB/DCDB/UPSDB)			
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.		

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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.



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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
6.0 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, if necessary, for dismantling and maintenance	1 Set
7.0 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
8.0 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.
9.0 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.
10.0 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)



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B.	Terminal block of each type	5 Nos.
C.	Heat resistance toughened glass cover of each type	5 Nos.
D.	Fuse holder of each type	5 Nos.
E.	Fuse of each Type	5 Nos.
F.	Allen keys of different sizes as applicable	2 Sets
11.0 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.



12.0 Each Battery Bank		
A.	Complete cells of each type	4 Sets
B.	Float guide	2 Nos.
C.	Cell lid	2 Nos.
D.	Level indicators	2 Nos.
E.	Vent plugs	2 Nos.
F.	Inter cell connectors with nuts, bolts and washers	2 Sets
G.	P.V.C. Spill Trays	2 Sets
H.	Terminal Post	2 Sets
13.0 Local Control Station		
A.	Trip – neutral – close switch	20%

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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%		
14.0	Junction Box			
A..	Junction Box of each type	10 Nos.		
15.0	Electricals for Overhead Cranes & Hoists (per crane/hoist)			
A.	Bearings of each type & no.	1 Set		
B.	Contactors of various ratings	1 Set		
C.	Complete set of contactors 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		
16.0	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.	Software for parameter setting each type	1 Set		
17.0	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.		
18.0	Each ANNUNCIATOR PANEL			
A.	Hooters	1 No.		



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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%		
19.0	DG Set of each rating (DG power board spares shall be as per switchgear spares)			
A	O Ring of various types & sizes	1 Set		
B	Bearing of various types & sizes	1 Set		
C	Gaskets of various types & sizes	1 Set		
D	Lube oil filter, air filters etc.	1 Set each		
E	Solenoids of various types & sizes	1 No.		
F	Electrical actuator of various types & sizes	1 No.		
G	Circuit breaker arcing & fixed contact assembly	1 No.		
H	Excitations system diodes	1 Set		
I	Fuses of all ratings	1 No.		
J	AVR Protection relays	1 No.		
K	Instrumentation items like pressure/temp switches, gauges etc.	1 No. Each		
L	Battery cells for protection and control supplies	1 No.		
M	PLC Spares for logic and monitoring	1 Set of each type		
N	Any other spare part not covered but required	1 No.		
20.0	NIFPS			
A	Fitted nitrogen cylinder	1 No.		
B	Fire detectors of each type	3 Nos.		
C	Heat sensor assembly of each type	1 Set		
D	PNRBV of each type	1 Set		
E	Limit switch for fire detector of each type	2 Sets		
F	Thermostat of each type	2 Sets		
G	Heating element of each type	2 Sets		
H	Fire survival cable sufficient for one system	1 Set		
21.0	220 KV GIS			
A	SF6 Gas pressure relief devices	1 No.		
B	Pressure gauges along with coupling device	1 No.		
C	Rubber Gaskets, "o" Rings and seals for SF6 gas	1 No. of each type		
D	Molecular filter for SF6 gas	1 No.		
E	Density Monitors for SF6 gas	1 No.		
F	All types of Control Valves for SF6 gas	1 No. of each type		
G	SF6 gas %age ** of total gas requirement	20%**		
H	Enclosures, Insulators & bus bar to replace one section of each phase of bus bar compartment	1 No. Each		
I	Cable termination enclosure for feeder bay module	1 No.		
J	Cable termination enclosure for transformer bay module	1 No.		

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22.0	33 KV GIS	
A	SF6 Gas pressure relief devices	1 No.
B	Pressure gauges along with coupling device	1 No.
C	Rubber Gaskets, "o" Rings and seals for SF6 gas	1 No. of each type.
D	Molecular filter for SF6 gas	1 No.
E	Density Monitors for SF6 gas	1 No. of each type.
F	All types of Control Valves for SF6 gas	120%**
G	SF6 gas %age ** of total gas requirement	1 No. Each
H	Enclosures, Insulators & bus bar to replace one section of each phase of bus bar compartment	1 No.
I	Cable termination enclosure for feeder bay module	1 No.
J	Cable termination enclosure for transformer bay module	1 No.
25.0	Spares for GIS Circuit Breaker	
25.1	245kV C.B.	
A	Single pole, 1600A, interrupting chamber complete with all necessary apparatus.	1 No
B	Rubber gaskets, 'O' rings and seals	1 Set
C	Trip coils with resistor.	3 Nos.
D	Closing coils with resistor	3 Nos.
E	Molecular filter.	3 No. of each type
F	Density/pressure monitoring systems	1 No
G	Relays, Power contactors, push buttons, timers & MCB etc.	1 Set of each type
H	Closing assembly/ valve	1 No
I	Trip assembly/ valve	1 No
J	Pressure switches	1 No. of each type
K	Auxiliary switch assembly	1 No
L	Operation Counter	1 No
M	Rupture disc/diaphragm	1 No. of each type
N	Single pole, 1600A, operating mechanism, complete with all necessary connecting apparatus.	1 Set
O	All types of coupling for SF6 gas	1 No. of each type
25.2	36kV C.B.	
A	Single pole, 3150A, interrupting chamber complete with all necessary apparatus.	1 Set
B	Single pole, 2000A, interrupting chamber complete with all necessary apparatus.	1 Set
C	Rubber gaskets, 'O' rings and seals	1 Set of each type
D	Trip coils with resistor.	3 No.
E	Closing coils with resistor	3 No.
F	Molecular filter.	3 No. Each
G	Density/pressure monitoring systems	1 No
H	Relays, Power contactors, push buttons, timers & MCB etc.	1 Set of each type
I	Closing assembly/ valve	1 No.
J	Trip assembly/ valve	1 No.
K	Pressure switches	1 No. of each type
L	Auxiliary switch assembly	1 No.
M	Operation Counter	1 No.
N	Rupture disc/diaphragm	1 No. of each type
O	Single pole, 3150A, operating mechanism, complete with all necessary connecting apparatus.	1 No.

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P	Single pole, 1600A, operating mechanism, complete with all necessary connecting apparatus.	1 No
Q	All types of coupling for SF6 gas	1 No. of each type
26.0	Spares for Isolator and Earth Switch	
26.1	245kV Isolator and E/S	
A	Single ph., 1600A Disconnecting Switch internal parts, complete with all necessary gaskets, mounting hardware, etc.	1 Set.
B	Three ph., 1600A Disconnecting Switch operating mechanism, complete with all necessary connecting apparatus.	1 Set
C	Single ph., 1600A Grounding Switch internal parts, complete with all necessary gaskets, mounting hardware etc.	1 Set
D	Three ph., 1600A Grounding Switch operating mechanism, complete with all necessary connecting apparatus.	1 Set
E	Single phase, 1600A, high speed fault making grounding switch, Internal parts complete with all necessary gaskets mounting hardware etc.	1 Set
F	Three phase, 1600A, high speed fault making grounding switch operating mechanism complete with all necessary gaskets connecting apparatus.	1 Set
G	Windscope / Observing window	1 No
26.2	36kV Isolator and E/S	
A	Single ph., 2000A Disconnecting Switch internal parts, complete with all necessary gaskets, mounting hardware, etc.	1 Set
B	Three ph., 2000A Disconnecting Switch operating mechanism, complete with all necessary connecting apparatus.	1 Set
C	Single ph., 2000A Grounding Switch internal parts, complete with all necessary gaskets, mounting hardware etc	1 Set
D	Three ph., 2000A Grounding Switch operating mechanism, complete with all necessary connecting apparatus.	1 Set
E	Single phase, 3150A, grounding switch, Internal parts complete with all necessary gaskets mounting hardware etc.	1 Set
F	Three phase, 3150A, grounding switch operating mechanism complete with all necessary gaskets connecting apparatus.	1 Set
27.0	Spares for Current Transformer	
A	220kV, 1-phase CT ratio 1600-800/1-1-1-1A, complete with all gaskets and mounting hardware.	1 No
B	220kV, 1-phase CT ratio 800-400/1-1-1-1A, complete with all gaskets and mounting hardware.	5 No
C	33kV, 1-phase CT ratio 2000/1-1-1A, complete with all gaskets and mounting hardware	2 No
D	33kV, 1-phase CT ratio 800-400/1-1-1A, complete with all gaskets and mounting hardware	4 No
28.0	Spares for Voltage Transformer/ PT	
A	220kV, 1-phase VT ratio 245kV/√3 / 110V/√3-110V/√3-110V/√3 complete with all gaskets and mounting hardware	3 No
B	33kV, 1-phase VT ratio 36kV/√3 / 110V/√3-110V/√3-110V/√3 complete with all gaskets and mounting hardware	3 No

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29.0	Spares for Surge Arrestor	3 No
A	216kV, complete GIS type LA including insulating Base with Surge counter & accessories	3 No
B	30kV, complete GIS type LA including insulating Base with Surge counter & accessories	3 No
C	216kV, Surge counter/monitor	3 No
D	30kV, Surge counter/monitor	3 No
30.0	ECMS	
A.	Digital input module	3 Nos.
B.	Digital output module	3 Nos.
C.	Analog input module	3 Nos.
D.	Power supply module	2 Nos.
E.	Remote I/O adaptor	2 Nos.
F.	Network interface module	2 Nos.
G.	I/O chassis	2 Nos.
H.	RIO / communication Module	2 Nos.
I.	Battery for processor	2 Nos.
J.	Fuses (assorted)	10%
K.	Voltage transducers (each type)	5 Nos.
L.	Current transducers (each type)	5 Nos.
M.	Temperature transducers (each type)	2 Nos.
N.	Kilowatt transducers (each type)	2 Nos.
O.	Frequency transducers (each type)	2 Nos.



- 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.
- 5) 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.

3.0 VENDOR'S RECOMMENDED SPARE PARTS

Contractor shall submit list of recommended spare parts of specialised items not covered under Mandatory spares, along with itemised price. Owner will review and decide the recommended spares required for the project.

General Notes:

- 1) The above spares do not include installed spares / commissioning spares. The above shall be Mandatory spares only.
- 2) Set means complete replacement of particular part in one machine/equipment/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, LSTK Contractor to quote in next higher rounded figure

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- 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 mandatory 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) LSTK Contractor to supply all commissioning spares for all necessary equipment's for smooth & trouble free operation of complete system.**

LSTK Contractor to supply all mandatory spares parts as per the list for all necessary equipment's for smooth & trouble free operation of complete system.

Item-wise Price List to be furnished by LSTK Contractor with validity of 2 Years for 2 years Bidder's recommended Operational Spares (other than mandatory spares) for smooth & trouble free operation of complete system. However these prices shall not be part of LSTK bid.

4.0 MAINTENANCE TOOLS AND TACKLES

The Contractor shall include all necessary maintenance tools required for maintenance of the Static equipment/Boiler supplied by him. The tools included by the Contractor shall cover all minimum maintenance tools considered necessary by the Contractor. A comprehensive list of maintenance tools shall be furnished. For some of the equipment/systems, requirement of maintenance tools and tackles has been specified in Data Sheets. Contractor shall necessarily supply these tools in addition to other tools and tackles as required.

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SECTION : VI – 8.0

INFORMATION REQUIRED IN TECHNICAL PROPOSAL



PLANT : ELECTRICAL DISTRIBUTION SYSTEM

PROJECT : INTEGRATED COAL BASED FERTILISER COMPLEX, AT TALCHER, ANGUL DISTRICT, ODISHA

0	26.03.2021	26.03.2021	Issued for Enquiry	RK	SKB	SKB
REV	REV DATE	EFF DATE	PURPOSE	PREPD	REVWD	APPD

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- 1.0 INFORMATION REQUIRED IN THE TECHNICAL PROPOSAL**
- 1.1 General**
- 1.1.1 Drawings and Documents to be submitted in Technical Bid shall be in line with Section VI-6.0 as well details stipulated under design philosophy for respective equipment/ facility.
- 1.1.2 Construction Power and Construction Water requirement (Month-wise).
- 1.1.3 Master Time Schedule in latest version of Primavera showing all the activities from date of receipt of LOI/ FOI and till handing over of complete installation.
- 1.1.4 An Implementation Plan showing man-power deployment schedule during various stages of implementation period, including peak requirements. LSTK Contractor 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 LSTK Contractor.
- 1.1.5 Project Plan showing Project Organisation, Project team, Project services offered by the LSTK Contractor at home office and at site. A time schedule for the complete project in the form of a Bar Chart and Network indicating the time allocated for various activities.
- 1.1.6 Quality Assurance & Quality Control procedure to be followed by LSTK Contractor for the implementation of this project.
- 1.1.7 List of all construction equipments, testing equipments, special tool tackles, tool-tackles proposed to be used (Month-wise).
- 1.1.8 Detailed Month-wise manpower Deployment Schedule alongwith experience of personnel proposed to be deployed.
- 1.1.9 List of Recommended Spare part for 2 Years Operation & Maintenance (other than mandatory/insurance Spares). Complete list of itemised spare part for all Mechanical, Electrical items considered for this project. Refer Section VI-7.0
- 1.2 Information to be furnished : General**
- 1.2.1 Plant Battery Limit termination point details.
- 1.2.2 Location of Main Receiving Substation and Offsite & Utilities Main Substation clearly marked in the Battery Limit of Electrical Distribution System .
- 1.3 Information to be furnished in respect of EOT Cranes**
- 1.4 Information to be furnished in respect of Electrical**
- 1.4.1 Single Line Power Distribution Diagram for Complete electrics included in his offer up to incomers, bus-couplers of GIS, switchboards, PCCs, PMCCs, MCCs, Distribution Boards, MLDBs indicating maximum Load on each bus-section etc. for both MRSS and OUSS separately,
- 1.4.2 Load List indicating rated and absorbed power of loads in kW indicating voltage, rpm, speed variation requirement, type of starting/ control, duty type (Continuous/ Intermittent/ Standby) with type of power supply (Normal/ Emergency/ Critical).
- 1.4.3 Layout of equipment proposed in Substations (MRSS, OUSS) , Electrical Rooms and other premises for installing of facilities (electrical, ECMS) proposed by him to meet stipulations in NIT.
- 1.4.4 Emergency Power Requirement and the list of equipments connected to it.

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- 1.4.5 Duly filled-in Specification Sheets and Technical Particulars of major Electrical Equipment like 220 kV GIS, 33 kV GIS, Transformers, HV Switchboards, ECMS, DG Set, etc. but not limited to.
- 1.4.6 Water Requirement (Fire Fighting System, Service water, Make-up Water)
- 1.4.7 Any other utility required.
- 1.4.8 Architectural Drawing of ECMS.

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SECTION : VI - 9.0

SITE WORKING AND SAFETY CONDITIONS

PLANT: ELECTRICAL DISTRIBUTION SYSTEM

**PROJECT: INTEGRATED COAL BASED FERTILISER COMPLEX
AT TALCHER, ANGUL DISTRICT, ODISHA (INDIA)**

0	26.03.21	Issued for Enquiry	JKY	JKY/GC	GC
REV	REV ATE	PURPOSE	PREPD	REVWD	APPD





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1.0 SITE LOCATION

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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 conduct will be sufficient cause for removal of such person from the site.

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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.

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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.

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- 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.

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- 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.

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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

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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.

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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.

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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.

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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 engines, 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:
- Hoardings slopping inwards should be erected around the building.
 - Protective nettings should be hung around the building to prevent materials falling outside the periphery shelter
 - 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.

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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/ Monetary 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 violations; 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.

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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

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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

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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.

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SECTION : VI - 10.0

VENDOR LIST

PLANT : ELECTRICAL DISTRIBUTION SYSTEM



**PROJECT : INTEGRATED COAL BASED FERTILISER
COMPLEX, AT TALCHER, ANGUL DISTRICT,
ODISHA**

0	26.03.2021	26.03.2021	Issued for Enquiry	RK	SKB	SKB
REV	REV DATE	EFF DATE	PURPOSE	PREPD	REVWD	APPD

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CONTENTS

SECTION NUMBER	DESCRIPTION
1.0	Electrical
2.0	Piping
3.0	Rotating Equipments
4.0	Civil



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Bidder shall select sub vendors from the vendor list as specified below. 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.



Vendor shall have well proven record for the specified services and shall be subjected to owner/consultant approval.

1.0	ELECTRICAL
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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
220 kV GIS		
1.	GE T&D India Limited (Formerly known as Alstom T&D Ltd)	India
2.	ABB Power Products and System India Ltd	India
3.	Siemens Ltd.	India
4.	Hyosung T&D India Pvt Ltd	India
5.	Toshiba Transmission & Distribution System India Pvt Ltd	India
33 kV GIS		
1.	ABB Power Products and System India Ltd	India
2.	Siemens Ltd.	India
3.	Schneider Electric	India
Transformers – 20 MVA and above		
1.	GE T&D India Limited (Formerly known as Alstom T&D Ltd)	India
2.	ABB Limited	India
3.	BHEL (ELECTRICAL MACHINES DIVN.)	India
4.	CG Power and Industrial Solution Limited (Formerly known as Crompton Greaves Ltd)	India
5.	Siemens Ltd.	India
6.	Toshiba Transmission & Distribution System India Pvt Ltd	India

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Transformers –Below 20 MVA		
1.	GE T&D India Limited (Formerly known as Alstom T&D Ltd)	India
2.	ABB Limited	India
3.	BHEL (ELECTRICAL MACHINES DIVN.)	India
4.	CG Power and Industrial Solution Limited (Formerly known as Crompton Greaves Ltd)	India
5.	Siemens Ltd.	India
6.	Toshiba Transmission & Distribution System India Pvt Ltd	India
7.	Bharat Bijlee Ltd	India
8.	Kirloskar Electric Company Ltd.	India
9.	Voltamp Transformers Ltd.	India
Lighting Transformers		
1.	GE T&D India Limited (Formerly known as Alstom T&D Ltd)	India
2.	ABB Limited	India
3.	BHEL (ELECTRICAL MACHINES DIVN.)	India
4.	CG Power and Industrial Solution Limited (Formerly known as Crompton Greaves Ltd)	India
5.	Siemens Ltd.	India
6.	Toshiba Transmission & Distribution System India Pvt Ltd	India
7.	Bharat Bijlee Ltd	India
8.	Kirloskar Electric Company Ltd.	India
9.	Voltamp Transformers Ltd.	India
10.	IMP Power Ltd.	India
11.	Indcoil Transformers Pvt. Ltd.	India
12.	Kalpa Electrical Pvt. Ltd.	India
13.	Mehru Electricals (Formerly Automatic Electric Limited)	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 Ltd	India
2.	Crompton Greaves Ltd	India
3.	Siemens Ltd	India

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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
6.	Crompton Greaves Ltd	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

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16.	Schneider	India
Control & Relay Panel		
1.	Alstom Limited (Areva T&D)	India
2.	ABB Ltd.	India
3.	Elecmech Corporation	India
4.	Larsen & Toubro Ltd. (El. Products Divn)	India
5.	Siemens Ltd.	India
6.	Schneider	India
Protective Relays- Numerical & Auxiliary (other than BMR)		
1.	Alstom Limited (Areva T & D)	India
2.	Asea Brown Boveri Ltd.	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 Ltd.	India
3.	BHEL (Electrical Machines Divn.)	India
4.	Siemens Ltd.	India
5.	Schneider	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		

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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.	Asea Brown Boveri Ltd.	India
2.	GE Power Controls India Pvt. Ltd.	India
3.	Havells India Ltd.	India
4.	Kaycee Industries Ltd	India
5.	Larsen & Toubro Ltd.(EI.Products Divn)	India
6.	Siemens Ltd.	India
7.	Schneider Electric	India
Current Transformers (220 kV)		
1.	GE T&D India Limited (Formerly known as Alstom T&D Ltd)	India
2.	ABB Power Products and System India Ltd	India
3.	Siemens Ltd.	India
4.	Hyosung T&D India Pvt Ltd	India
5.	Toshiba Transmission & Distribution System India Pvt Ltd	India
6.	Mehru Electricals (Formerly Automatic Electric Limited)	India
Potential Transformers (220 kV)		
1.	GE T&D India Limited (Formerly known as Alstom T&D Ltd)	India
2.	ABB Power Products and System India Ltd	India
3.	Siemens Ltd.	India

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4.	Hyosung T&D India Pvt Ltd	India
5.	Toshiba Transmission & Distribution System India Pvt Ltd	India
6.	Mehru Electricals (Formerly Automatic Electric Limited)	India
7.	Asea Brown Boveri Ltd.	India
8.	BHEL (ELECTRICAL MACHINES DIVN.)	India
9.	CG Power and Industrial Solution Limited	India
10.	Mehru Electricals (Formerly Automatic Electric Limited)	India
Current Transformers (11 kV & 3.3 kV)		
1.	Anant Powertech	India
2.	Asea Brown Boveri Ltd.	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.	Asea Brown Boveri Ltd.	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)		

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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 & Systems Pvt. Ltd. (Only For Multifunctional Meter)	India
4.	Meco Instruments	India
5.	Mehru Electricals (Formerly Automatic Electric Limited)	India
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.	Spaceage Switchgears Limited	India
6.	United Electric Co. (Delhi) Pvt. Ltd.	India
7.	Powergear 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

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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	India
Induction Motors – LV (415 V) (Safe Area)		
1.	Asea Brown Boveri Ltd	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.	Asea Brown Boveri Ltd	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

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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

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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	India
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

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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 Termination Kit / 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

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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.	Indmark Formtech Pvt. Ltd.	India
4.	Jamna Metal Company	India
5.	Kanade Anand Udyog Pvt. Ltd.	India
6.	Maheshwari Electrical Mfrs. (P) Ltd.	India
7.	Metalite Industries	India
8.	Parekh Engineering Company	India
9.	Premier Power Products (Calcutta) Pvt. Ltd.	India
10.	Rukmani Electricals & Components Pvt Ltd	India
11.	Sadhana Engineering Corporation	India
12.	Slotco Steel products Pvt. Ltd.	India
13.	Sree Atreya Enterprises	India
14.	Stealite Engg Co	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

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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. (Formerly CEAG Flame)	India
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

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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.	Asea Brown Boveri Ltd.	India
Earthing & Lightning Protection Material – (Al) Wire/Strip		
1.	Anand Electric Trading Co.	India

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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.	Meghdyot 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

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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. (IsmaI 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	India
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
Diesel Generator Set		
1.	Caterpillar	India
2.	Cummins India Limited	India
3.	Garden Reach Shipbuilders & Engineers Ltd.	India
4.	Wartsilla India Ltd.	India
5.	Jakson Engineers Ltd	India
6.	Kirloskar Oil Engines	India
Fuse		
1.	Larsen & Toubro Ltd. (El. Products Divn.)	India
2.	Siemens Ltd.	India
3.	Alstom Power	India
4.	Havells India Ltd.	India

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Contactor / Relay /		
1.	Larsen & Toubro Ltd. (El. Products Divn.)	India
2.	Siemens Ltd.	India

Timer		
1.	ABB India Limited	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

FRP Cable Trays		
1.	Enercon	India
2.	Ercon Composites (Upto 600 Mm Wide)	India
3.	Kemrock	India
4.	Satyam Industries	India
5.	Sintex Industries Ltd.	India
6.	Sumip Composites Pvt Ltd.	India



High Masts		
1.	Bajaj Electricals Limited	India
2.	Philips India Ltd.	India

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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
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

Electrical Control& Monitoring System		
1.	Rockwell Automation India Pvt. Ltd.	India
2.	Siemens Ltd.	India
3.	ABB India Ltd.	India
4.	Honeywell Automation	India
5.	Emerson Process Management Asia Pacific Pvt Ltd	Singapore
6.	Emerson Process Management India Pvt Ltd	India

CCTV		
1.	Honeywell Automation	India
2.	Bosch India	India
3.	Samsung India	India
4.	C P Plus	India
5.	Yokogawa Limited	India



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NETWORK EQUIPMENT		
1.	Active Switching & Routing	CISCO
2.	Active Other Components	Allied Telsys RAD Xycel
3.	Passive Cabling Components	Lucent AMP Systemax Molex R&M
4.	Industrial Grade Ethernet Switch	Hirschmann Sixnet
5.	LCD Projector	Hitachi Canon HP



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2.0	MECHANICAL – PIPING
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CS WELDED PIPES TO API 5L SPIRAL LONG. WELDED		
Sl.No	Vendor's Name	Country
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	PHOCEEENNE	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

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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.
FITTINGS: CS/AS/SS SEAMLESS & FORGED		
1	AMFORGE INDUSTRIES	INDIA
2	ANIL METAL CORPORATION	INDIA

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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/Seamless -upto 24", Welded upto 48")	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

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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
50	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

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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

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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) 1/2" 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 1/2-2, <=300# FOR SIZE 2-6")	INDIA
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

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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.
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

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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" (Upto 300#), 4" (Upto 900#) & Forged: Upto 2" (800#))	INDIA
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

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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
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

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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
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
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		

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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 (1/2" 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

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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

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3.0	ROTATING EQUIPMENTS	
COOLING WATER PUMPS (HORIZONTAL)		
1.	A.R WILFLEY INDIA PVT. LTD	INDIA
2.	FLOWMORE LTD (FORMALLY FLOWMORE PVT. LTD.)	INDIA
3.	JYOTI LIMITED	INDIA
4.	KIRLOSKAR BROTHERS LTD.	INDIA
5.	MATHER & PLATT (INDIA) LTD. (A SUBSIDIARY OF WILO SE GERMAN)	INDIA
6.	SAM TURBO INDUSTRY PRIVATE LTD.	INDIA
7.	KSB AG	GERMANY
8.	MITSUBISHI HEAVY INDUSTRIES LTD	JAPAN
9.	SHIN NIPPON MACHINERY CO. LTD	JAPAN
10.	TORISHIMA PUMP MFG. CO. LTD	JAPAN
11.	FLOWSERVE (IDP)	U.K
COOLING WATER PUMPS (VERTICAL)		
1.	A.R WILFLEY INDIA PVT. LTD	INDIA
2.	FLOWMORE LTD (FORMALLY FLOWMORE PVT. LTD.)	INDIA
3.	JYOTI LIMITED	INDIA
4.	KIRLOSKAR BROTHERS LTD.	INDIA
5.	MATHER & PLATT (INDIA) LTD. (A SUBSIDIARY OF WILO SE GERMAN)	INDIA
6.	KSB AG	GERMANY
7.	MITSUBISHI HEAVY INDUSTRIES LTD	JAPAN
8.	SHIN NIPPON MACHINERY CO. LTD	JAPAN
9.	TORISHIMA PUMP MFG. CO. LTD	JAPAN
10.	FLOWSERVE (IDP)	U.K
PUMPS FOR UTILITY SERVICES		
1.	AKAY INDUSTRIES PVT. LIMITED	INDIA
2.	FLOWMORE LTD. (FORMALLY FLOWMORE PVT. LTD.)	INDIA
3.	FLOWSERVE INDIA CONTROL LTD.	INDIA
4.	KIRLOSKAR BROTHERS LIMITED	INDIA
5.	KIRLOSKAR EBARA PUMPS LIMITED	INDIA
6.	KISHORE PUMPS LTD	INDIA
7.	MICROFINISH PUMPS PVT. LTD	INDIA
8.	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
FANS & BLOWERS		
1.	ABB FLAKT INDIA LTD.	INDIA

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2.	AEROTO BOLDROCCHI INDIA PVT. LTD.	INDIA
3.	AEROVENT PROJECT PVT LTD	INDIA
4.	DRAFT INDIA PVT LTD	INDIA
5.	MAX FLOW FANS MANUFACTURING PVT LTD	INDIA
6.	SWAM PNEUMATICS	INDIA
7.	BHEL	INDIA
8.	TLT ENGINEERING INDIA PVT. LTD	INDIA
9.	ILLONOIS BLOWERS INC	U.S.A
COUPLINGS (miscellaneous non critical equipment)		
1.	ELECON ENGG. CO. LTD	INDIA
2.	FENNER INDIA LTD.	INDIA
3.	HI-CLIFF	INDIA
4.	RATHI TRANSPower PVT. LTD	INDIA
5.	RATHI TURBOFLEX PVT. LTD	INDIA
AIR CONDITIONING SYSTEM		
MAKE OF CHILLER UNIT / AC PACKAGE :		
1	YORK	INDIA
2	TRANE	INDIA
3	CARRIER	INDIA
4	BLUE STAR	INDIA
5	VOLTAS	INDIA
AIR CONDITIONING SYSTEM (EPC VENDORS)		
1	BLUE STAR	INDIA
2	VOLTAS LTD.	INDIA
3	ADVANCE VENTILATION PVT LTD	INDIA
4	VERTIV ENERGY PRIVATE LIMITED	INDIA
5	S K SYSTEMS PVT LTD	INDIA
EOT CRANE		
1	TECHNOCRAFT	INDIA
2	UNICON TECHNOLOGIES PVT LTD.	INDIA
3	UNIQUE INDUSTRIAL HANADLERS PVT. LTD	INDIA
4	ELECTROMECH MATERIAL HANDLING SYSTEM.	INDIA
5	CENTURY CRANE PVT. LTD.	INDIA
6	GRIP ENGG.	INDIA
7	SAFEX INDUSTRIES LTD	INDIA
8	BRADY & MORIRIS ENGINEERING	INDIA
9	MEEKA MACHINERY PVT LTD	INDIA



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GENERAL NOTES:

- i. Only 'First' Quality materials shall be used.
- ii. Bidder shall select sub vendors from the vendor list as specified below. 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. Vendor shall have well proven record for the specified services and shall be subjected to owner/consultant approval.
- iii. OWNER / CONSULTANT reserve the right to choose any of the approved make / vendor as per this list. Make of the item not indicated and any other make for the specified item shall be subject to owner's / consultant's approval.
- iv. Specifications of manufacturer's items shall be checked against tender item / specifications before selecting any product or brand name. In case of any discrepancy, tender item / specifications shall prevail, and any such brand of item shall not be used which is not conforming to tender specifications even if it is listed in this vendor list.
- v. In case of non-availability of any material among approved vendors / makes in a particular site / region, alternate vendor / make conforming to IS / BS etc. Shall be used subject to approval by OWNER / CONSULTANT.
- vi. Contractor shall get the the material sample approved by EIC as per the Vendor list before procurement.



SL. NO.	ITEM	NAME
1.0	<u>FLOOR FINISHING</u>	
1.1	CEMENT TILES (FLOOR/WALL)	a) EUROCON b) ALTRA TILE PVT. LTD. c) DAZZLE
1.2	TERRAZZO TILES	A) NITCO

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		B) HINDUSTAN TILES
1.3	CERAMIC TILES	a. SOMANY CERAMICS b. H&R JOHNSON CERAMICS c. KAJARIA CERAMICS d. ORIENT CERAMICS
1.4	HEAVY DUTY FLOOR TILES	A) BHARAT TILES B) RESTILE CERAMICS C) PELICAN CERAMIC INDUS. D) PAVIT E) SONA TILES
1.5	INDUSTRIAL FLOOR HARDENER ADMIXTURE	a) PIDILITE INDUSTRIES b) SIKA c) CICO.
1.6	PVC ROLLS	A) PREMIER VINYL B) ARMSRONG INARCO C) RMG POLYVINYL
1.7	PVC TILES	A) ARMSTRONG
1.8	PVC TILES/ROLL ANTISTATIC	A) PREMIER VINYL B) RMG POLYVINYL C) ARMSTRONG
1.9	ACID RESISTANT TILES(BATTERY ROOM)	A) H&R JOHNSON OR APVD. EQUIV.
1.10	MOSSAIC TILE	A) ITALIS B) SPECIFIC GLASS MUSSAIC INDIA LTD.
2.0	WOODWORK	
2.1	FLUSH DOOR	A) GREEN B) CENTURY DOORS C) KITPLY PRODUCTS
2.2	PLY WOOD/BLOCK BOARD	A) CENTURY B) KITPLY PRODUCTS C) GREEN PLY
2.3	PARTICLE BOARD (EXTRA GRADE)	A) BHUTAN BOARD B) NOVAPAN INDIA LTD.
2.4	MDF BOARD/MD PARTICLE BOARD (EXTRA GRADE)	A) NUCHEM LTD. B) MANGALAM TIMBER PRODUCTS LTD. C) WESTERN BIO SYSTEMS LTD.

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2.5	DECORATIVE LAMINATES	A) CENTURY B) GREENPLY INDUS. LTD. C) MERINO D) ARCHID
2.6	MARINE PLYWOOD	A) CENTURY B) GREENPLY INDUS. LTD. C) MERINO D) ARCHID
2.7.0	DOORS & WINDOWS FITTINGS	
2.7.1	MORTICE LOCKS WITH HANDLES	A) GODREJ & BOYCE B) EVERITE AGENCIES (P) LTD. C) DOORSET
2.7.2	CYLINDRICAL PIN TUMBLER LOCK WITH KNOBS	A) GODREJ & BOYCE B) EVERITE AGENCIES (P) LTD. C) DOORSET
2.7.3	HYDRAULIC DOOR CLOSER (OVER HEAD/ FLOOR)	A) OZONE B) EVERRITE AGENCIES (P) LTD. C) HARDWYN
2.7.4	MISC. DOOR FITTINGS HINGLE, TOWER BOLTS, LATCHES, SOPPER, STAYS, ALDROPS ETC.	A) EVERITE AGENCIES (P) LTD. B) EBCO DINSUTRIES D) OZONE E) HARDWYN
2.7.5	THREE WAY BOLTING LOCKING DEVICE HANDLE	A) SRIMA SALES & SERVICES B) DHIMAN INDUSTRIES
2.7.6	PANIC BAR LATCH (FOR EMERGENCY DOOR)	A) SRIMA SALES & SERVICE
2.7.7	UPVC WINDOWS	A) FENESTA B) ENCRAFT C) WINDOW MAGIC
2.7.8	FASTENERS	A) HILTI INDIA PVT. LTD. B) FISCHER
3.0	STEEL / ALUMINIUM DOORS, WINDOWS & VENTILATOR	
3.1	PRESSED STEEL DOORS WINDOWS & SECTION DOORS WINDOWS/ROLLING SHUTTER	A) RAYMUS ENGINEERS B) DHIMAN STEEL C) RDG ENGINEERING D) SUPER STEEL WINDOW CO. E) SKS STEEL INDUS.
3.2	ALMUNIUM / DOORS/ WINDOWS SECTIONS	A) JINDAL ALUMINIUM LTD. B) HINDALCO INDUSTRIES C) INDAL
3.3	FIRE-PROOF DOORS(APPROVED)	A) NAVAIR INTERNATIONAL B) RDG ENGINEERING
3.4	PVC DOORS / WINDOWS	A) SINTEX OR APPVD EQUIV.
3.5	PVC WATER TANKS	A) SINTEX OR APPVD EQUIV.
4.0	PLASTERING	
4.1	WATERPROOFING/ COMPOUND	A) STRUCTURAL WATER PROOFING

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	IN CEMENT PLASTER	CO. (P) LTD. B) PIDILITE INDUSTRIES C) SIKA D) KRISHNA CONCHEM
5.0	ROOF TREATMENT (WATER PROOFING)	
5.1	BRICK BAT COBA	A) INDIA WATER PROOFING CO. B) OVERSEAS WATERPROOFING CORPN.
5.2	ACRYLIC BASED CEMENTATIOUS PRIMER COATING FOR ROOF WATERPROOFING	A) STRUCTURAL WATER PROOFING CO. (P) LTD. B) SIKA QUALCRETE LTD. C) PIDILITE INDUSTRIES D) KRISHNA CONCHEM
5.3	APP MODIFIED POLYMERIC WASTER PROOFING MEMBRANE	A) PIDILITE INDUSTRIES LTD. B) SIKA
5.4	PU BASED WATERPROOFING	A) PIDILITE INDUSTRIES LTD. B) SIKA C) BASF D) FOSROC
6.0	PAINTING WORKS	
6.1	PLASTIC EMULSION (INTERIOR/EXTERIOR)	A) ICI INDIA LTD. B) BERGER PAINTS LTD. C) ASIAN PAINTS LTD. D) SHALIMAR PAINTS E) KANSAI NEROLAC PAINTS LTD. F) M/s. Johnson & Nicholson
6.2	DRY OILBOUND DISTEMBER	A) ASIAN PAINTS LTD. B) KANSAI NEROLAC PAINTS LTD.
6.3	INDUSTRIAL / EPOXY/ ALIPHATIC ACRYLATE/ SYNTHETIC ENAMEL PAINTS	A) ICI/AKZO NOBEL INDIA B) BERGER PAINTS LTD. C) ASIAN PAINTS LTD. D) SHALIMAR PAINTS E) INTERNATIONAL MARINE COATINGS PVT. LTD. F) KANSAI NEROLAC PAINTS LTD. G) BOMBAY PAINT H) KRISHNA CONCHEM
6.4	WATERPROOFING CEMENT PAINT	A) KILLICK NIXON LTD. B) RAJDOOT PAINTS
6.5	WOOD MELAMINE POLISH	A) ASIAN PAINTS B) SHALIMAR PAINTS C) WEMBLY PAINTS

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6.6	WATERPROOFING TRANSPARENT EXTERIOR WALL COATING (OVER PAINTED SURFACE)	A) PIDILITE INDUSTRIES B) SIKA C) KRISHNA CONCHEM
6.7	FIRE PROOF COATING	A) NAVAIR INTERNATIONAL OR APPVD. EQUIV.
7.0	ROOFING SHEETS & ACCESSORIES	
7.1	ASBESTOS SHEETS	A) ETERNIT EVEREST LTD. B) CHARMINAR INDUSTRIES C) VISAKA
7.2	C.G.I. SHEETS	A) ISPAT INDUSTRIES LTD. B) STEEL AUTHORITY OF INDIA C) TATA STEEL D) JINDAL
7.3	PRECOATED G.I. PROFILE SHEETS FOR ROOFING & WALL CLADDING	A) ISPAT INDUSTRIES LTD. B) LLOYD INSULATION (I) LTD. C) STEEL AUTHORITY OF INDIA D) TATA STEEL E) JINDAL
7.4	ALUMINIUM SHEET (PLAIN/PROFILE)	A) INDIAN ALUMINIUM CO. LTD. OR APPROVED EQUIVALENT
7.5	FIBRE GLASS SHEETS & PANELS (MACHINE MOULDED)	A) SIMBA FRP (P) LTD. B) GE INDIA C) DUROPLAST
7.6	PROOFING J/L HOOKS, BOLTS & OTHER ACCESSORIES (POLYMER COATED)	A) KATALIST CONSULTANT (P) LTD. B) ADVANCED MACHINE
8.0	SANITARY PLUMBING FITTINGS & FIXTURES	
8.1	SANITARY FITTINGS (W.C. WASH BASIN, URINAL ETC.)	A) HINDUSTAN SANITARY WARE & INDUS. LTD. B) PARRYWARE SANITARY WARE C) MADHUSUDAN CERAMICS D) NYCER CERAMICS
8.2	PLUMBING FITTINGS & FIXTURES	A) JAGUAR B) CERA C) HINDWARE
8.3	GLASS/MIRROR (SHEET/ FLOAT/ TOUGHENED/ LAMINATION)	A) GUJARAT GUARDIAN LTD. B) SAINT GOBAIN C) ASAHI FLOAT
8.4	GI PIPES	A) JINDAL B) SURYA C) PRAKASH D) SWASTIK

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9.0	FALSE CEILING, FALSE FLOORING & UNDERDECK INSULATION	
9.1	FLASE CEILING / WALL CLADDING (ALUMINIUM STRIP/ TRAY TYPE)	A) INTERARCH BUILDING PRODUCTS (P) LTD. B) HUNTER DOUGLAS C) MASCOT OVERSEAS
9.2	FALSE FLOORING	A) MULTI INTERIORS PVT. LTD. B) BESTLOCK SYSTEM & CONCEPTS C) LLOYD INDUSULATION (I) LTD. D) UNITED INSULATION E) A.R. & BROTHERS
9.3	UNDERDECK/WALL HEAT INSULATION	A) BAKELITE HYLAM LTD. B) U.P. TWIGA F.G. LTD. C) LLOYD INDULATION (I) LTD. D) SUPEREME E) PIDILITE
9.4	OVERDECK HEAT INSULATION	A) LLOYD INSULATION (I) LTD. B) BEST PLASTRONICS LTD. C) PIDILITE INDUSTRIES LTD
9.5	GYPSUM BOARD TILES (FIBRE GLASS REINFORCED)/ PRIMA BOARD ARMSTRONG FALSE CEILING	A) SAINT GOBAIN
10.0	SPECIALITY PRODUCTS (CEMENT ADDITIVES/ ADMIXTURES / CORROSION INHIBITORS / SBR LATEX & ACRYLIC POLYMERS / EPOXY LATEX POLYMERS / FOOD GRADE EPOXY SURFACE TREATMENT/ EPOXY & CEMENTITIOUS GROUT/ EPOXY BONDING AGENTS & ANCHORS / SEALING / COATING	A) PIDILITE INDUSTRIES B) SIKA C) KRISHNA CONCHEM D) FOSROC E) BASF
10.1	EPOXY FLOOR COATING (BATTERY ROOM ETC)	A) SIKA B) FAIRMATE C) CIPY POLYURETHANE D) KRISHNA CONCHEM
10.2	EPOXY PHENOLIC CHEMICAL RESISTANT COATING & MORTAR(SCREED) FOR FLOOR & WALLS	A) KRISHNA CONCHEM B) SIKA C) FOSROC D) BASF E) CIPY POLYURETHANE

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10.3	CONCRETE REPAIR & REHABILITATION PRODUCTS	A) KRISHNA CONCHEM B) SIKA C) FOSROC D) BASF E) PIDILITE
10.4	PREMIXED CEMENTITIOUS MORTARS & MICROCONCRETE	A) KRISHNA CONCHEM B) SIKA C) FOSROC D) BASF E) PIDILITE
10.5	GLASS/CARBON FIBRE WRAPPING FIBRE / LAMINATE / EPOXY	A) KRISHNA CONCHEM B) SIKA C) FOSROC D) BASF
10.6	CORROSION PROTECTION ANODES & CAPLETS	A) KRISHNA CONCHEM B) SIKA C) FOSROC D) BASF
11.0	MISCELLANEOUS ITEMS	
11.1	WOOD PRESERVATIVE	A) ASCU HICKSON LTD.
11.2	WALL SURFACE TEXTURED COATING	A) JOTUN B) SPECTRUM PAINTS C) BAKELITE HYLAM D) OIKOS
11.3	EXTERNAL ACRYLIC WALL COATINGS	A) KRISHNA CONCHEM B) SIKA C) FOSROC D) BASF E) PIDILITE F) ASIAN G) BERGER
11.4	PVC PLUMBING FITTINGS	a) SUPREME b) POLYPAC c) ASTROL
11.5	REINFORCED FIBRE GLASS WATERPROOFING FELT	A) SIKA B) U.P. TWIGA F.G. LTD.
11.6	ANTI TERMITE TREATMENT	A) PCI OR APPRVD EQUIV.
11.7	MATERIAL TEST HOUSE	A) IIT MADRAS B) GOVT APPROVED AGENCY
12.0	CEMENT	A) ACC B) J K CEMENT C) BINANI CEMENT D) JP CEMENT

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		E) GUJARAT AMBUJA F) ULTRA TECH CEMENT G) BIRLA CORPN. LTD. H) GRASIM I) SHREE
12.1	SULPHUR RESISTANT CEMENT	A) SAURASHTRA CEMENT LTD. B) SHREE DIGVIJAY CEMENT
13.0	RCC DESIGN MIX	AP GOVT APPROVED AGENCY
14.0	WRAPPING COATING (I/C TAPE & PRIMER) IWL OR APPROVED EQUIPMENT	A) IWL OR APPROVED EQUIVALENT
15.0	FIRE PROOFING MATERIAL	A) CAFCO B) CARBOLINE
16.0	STRUCTURAL STEEL / CS PLATE	HEAVY SECTIONS MORE THAN 150 MM A) SAIL B) TATA STEEL C) RINL LIGHT SECTIONS LESS THAN 150 MM D) JINDAL E) ESSAR F) ISPAT INDUSTRIES
16.1	MS PIPES (HAND RAIL APPLICATION)	a) SURYA b) PRAKASH c) JINDAL
17.0	TMT BAR / REBAR	A) SAIL B) TATA STEEL C) RINL D) SHYAM STEEL INDUSTRIES LIMITED E) ELECTROSTEEL STEELS LTD F) SHRI RATHI STEEL LTD. G) SRMB SRIJAN PRIVATE LIMITED
18.0	GRATINGS/HANDRAILS	A) INDIANA GRATINGS B) WESTCOAST ENGINEERING C) GREATWELD GRATING D) KANADE ANAND UDYOG
19.0	WELDING ELECTRODE	A) ADOR B) ESAB C) D & H D) HANOVAR

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NOTE:

1. Bidder to note that above vendor list enclosed with the NIT shall only be followed by bidder. Any additional vendor list furnished by bidder along with bid shall not be considered.
2. LSTK contractor shall evaluate and decide present financial, performance credential and Shop loading conditions of the above vendors before placement of enquiry/orders.
3. Make of the equipment/machinery/item, not indicated shall be subject to Owner's / Consultant's approval.
4. Vendor List shall be prepared by Bidder for equipment/machinery/item not covered in above Vendor List. While submitting the additional vendor list, bidder has to ensure the following points.
 - As it is not possible to ascertain credentials of all the added vendors by Bidders by Owner, with regard to the additional vendors proposed by Bidder, following prequalification criteria, with respect to Past Performance / Experience for any Equipment/item shall be applicable:

The Vendor during the last 15 (fifteen) years, should have designed, manufactured (under third party inspection agencies like Lloyds Register/TUV/BVIS) and supplied at least TWO similar Plant Equipment or Machinery or Item for similar duties and operating conditions and same should be operating satisfactorily after installation for at least TWO years.

The LSTK Bidders should satisfy themselves that sufficient documentary proof is submitted such as:

- a. Copy of Purchase Orders with full technical details of the equipment
- b. Certificate from user regarding satisfactory performance.
- c. Accreditation from third party inspection agencies like Lloyds Register, TUV, BVIS.
- d. Availability of After Sales Service and Spares in India.
- e. Availability of ASME Certification and its validity.

All documents (PTR) shall be in English language only.

The LSTK Bidder shall certify suitability of such vendors as per above..

Vendor for these equipment/machinery/item shall be finalized during detail engineering stage upon mutually agreed condition between bidder & Owner/Consultant.