



# **RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD**

**Cooling Water System Package  
for  
Kota Super Thermal Power Station  
Unit # 5 (1 x 210 MW)  
Kota, Rajasthan, India**

[ DOC. No. FCE-1117155-ME-DOC-SPC-3000-033 ]

**VOLUME I  
COMMERCIAL & GENERAL CONDITIONS**

**FICHTNER** Consulting Engineers (India) Private Limited  
Chennai-Bengaluru, India



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**VOLUME I**  
**SECTION 1.0**  
**INVITATION FOR BIDS (IFB)**



## RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD. (RRVUNL)

Office of Dy. Chief Engineer(TD), Room  
no. 502, 5th floor, Dreamax Plaza,  
Sahkar Marg, Jaipur- 302005

### DETAILED INVITATION FOR BIDS (IFB)

(DOMESTIC COMPETITIVE BIDDING)

FOR

Cooling Water System Package for KSTPS Kota, Rajasthan

#### 1.0 INVITATION OF BIDS

##### INTRODUCTION

Online e-Bid are invited by as Dy. Chief Engineer(TD), Rajasthan Rajya Vidyut Utpadan Nigam, Room no. 502, 5th floor, Dreamax Plaza, Sahkar Marg, Jaipur-302005, from eligible and qualified Bidders to bid for supply & installation of Cooling Water System, all Electrical Systems, all Mechanical system, Complete Control & Instrumentation and Complete Civil, Structural & Architectural works on single turnkey EPC basis for KSTPS Kota Unit# 5 with the brief scope of work mentioned herein after.

#### 2.0 BRIEF SCOPE OF WORK

Design, Engineering, Procurement, Supply, Fabrication, Insurance, Transportation of all equipment / materials to work site, Storage, construction and erection of all civil and structural, mechanical, electrical and instrumentation works, assembly and Installation, obtaining all necessary statutory approvals, Testing, Mechanical Completion, Pre-Commissioning, Commissioning, Sustained load test & Performance Guarantee Test Run (PGTR) for the entire plant including total Project Management and handing over of the Cooling Water System and facilities under contractor scope of work.

The scope of the work shall be on single bidder responsibility basis, covering the complete scope of work specified under the tender documents / specifications.

The detailed scope of work shall be as per specifications and scope defined in Tender Documents for Cooling Water System Package for KSTPS Kota Unit# 5.

- 3.0** This Tender notification can be viewed on department's website [www.rvunl.com](http://www.rvunl.com), Rajasthan State Public Procurement Portal website <http://sppp.rajasthan.gov.in> & <http://www.eproc.rajasthan.gov.in>.



## 3.1 GENERAL DETAILS OF TENDER

S. No.	Item	Particulars
	<b>Bidding Document No.</b>	FCE-1117155-ME-DOC-SPC-3000-033
1	Name of Work	EPC Package for Design, Engineering, supply, construction, erection, testing and commissioning and performance testing of Cooling Water System, for KSTPS Kota.
2	Type of Bidding	e-Tendering
3	Bid Security (EMD)	The bid must be accompanied by bid security of Rs. 246.42 Lacs to be paid through NEFT/IMPS/RTGS or in the form of irrevocable BG issued by Nationalized/ Scheduled Bank.
4	Tender Fee (Non Refundable)	Rs. 50000/- plus GST @ 18%, to be paid through NEFT/IMPS/RTGS
5	e-tender processing fee (Non Refundable)	Rs. 1000/- plus GST @ 18% (To be paid in the form of bankers cheque/ DD of Nationalized/ Scheduled Bank in favour of Managing Director, RISL, payable at Jaipur).
6	Validity of tender	120 days from the date of opening of Tender
7	Office Inviting Bid	Office of Dy. Chief Engineer (TD), RVUNL, Room no. 502, 5th floor, Dreamax Plaza, Sahkar Marg, Jaipur- 302005

Tender Cost is either to be paid through NEFT/IMPS/RTGS/Unified Payment Interface (UPI) (BHIMUPI)/ Unified Payment Interface Quick Response Code (UPI QR Code) or in the form of DD from Nationalized/ Scheduled Bank in favour of RAJASTHAN RAJYA VIDYUT UTPADAN. The details for making online payment are as under:-

A/c No.- 00000061003055384, Bank name- State Bank of India, Collectorate Branch(31026) Jaipur IFSC Code-SBIN0031026, UPI Id- 61003055384@sbi, Merchant Name- **RAJASTHAN RAJYA VIDYUT UTPADAN**.

The Demand Drafts, Tender Fee & Tender Processing Fee is to be submitted to the Dy. Chief Engineer (TD), RVUNL, Room no. 502, 5th floor, Dreamax Plaza, Sahkar Marg, Jaipur- 302005 up to scheduled date & time.



If paying through digital mode, the bidder is required to send payment advice/ Unique Transaction Reference number (UTR No.) of above transaction before scheduled date and time via E-mail on dyce.td.jpr@rrvun.com and account.td@rvun.in in-person by post in the office of Dy. Chief Engineer (TD), RVUN Jaipur. Proof of deposition of fee i.e. payment advice/Unique Transaction Reference number shall also be uploaded/mentioned along-with documents of Technical bid under Cover-I.

### **3.2 IMPORTANT DATES:**

S.No.	Events	Date& time	Website/Place
a)	Date & time for downloading of bid document	From 11.00 AM of Dated _____	<a href="http://www.eproc.rajasthan.gov.in">http://www.eproc.rajasthan.gov.in</a>
b)	Clarification Start Date	_____	
c)	Clarification End Date	_____	
d)	Date of Pre-bid conference	From 11.00 AM of Dated _____	Office of Dy. Chief Engineer (TD), RVUNL, Room no. 502, 5th floor, Dreamax Plaza, Sahkar Marg, Jaipur- 302005
e)	Clarification on Pre-Bid Query	_____	
f)	Start of Bid Submission	From 11:00 AM of Dated _____	<a href="http://www.eproc.rajasthan.gov.in">http://www.eproc.rajasthan.gov.in</a>
g)	Last Date & time for online submission of bid document	Up to 03:00 PM of Dated _____	<a href="http://www.eproc.rajasthan.gov.in">http://www.eproc.rajasthan.gov.in</a>
h)	Deposition of earnest money, processing fee, tender fee, Scanned & signed Bid & Tender Documents (03 No. Copies) physically	Up to 05:00 PM during working hours of Dated _____	Office of Dy. Chief Engineer (TD), RVUNL, Room no. 502, 5th floor, Dreamax Plaza, Sahkar Marg, Jaipur- 302005
i)	Date & time for opening of Technical Bid	On Dated _____ at 11:00 AM.	<a href="http://www.eproc.rajasthan.gov.in">http://www.eproc.rajasthan.gov.in</a>
j)	Date & time for submission of Price bid	To be intimated Later	<a href="http://www.eproc.rajasthan.gov.in">http://www.eproc.rajasthan.gov.in</a>
k)	Date & time for Opening of Price bid	To be intimated Later	<a href="http://www.eproc.rajasthan.gov.in">http://www.eproc.rajasthan.gov.in</a>
l)	Contact Person	09:30 AM to 06:00 PM	i) Shri. R.S. Agarwal Dy. Chief Engineer (TD) Mob:9413349670 Email: dyce.td.jpr@rrvun.com
			ii) Ms. Anita Bansal Executive Engineer (TD) Mob:9413349669



If the date mentioned against Sr. No. (d), (h), (i) & (k) above is declared public holiday, the dead line will be the next working day. No query and clarification will be entertained beyond the pre-bid date as detailed above.

**4.0 NIT consists of Documents as per the following MASTER INDEX:****MASTER INDEX****VOLUME - I : COMMERCIAL & GENERAL CONDITIONS****ATTACHMENTS**

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ANNEXURE-1.33      BIDDER TO FURNISH THE DETAILS OF THE RATES OF APPLICABLE GST ON THE SCHEDULE-1 OF BOQ,

ANNEXURE-1.34      RAJASTHAN GOVERNMENT CIRCULAR

ANNEXURE-1.35      DECLARATION REGARDING COMPLIANCE OF GOVERNMENT CIRCULARS

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SECTION - 6.0      TENDER DRAWINGS

SECTION - 7.0      SCHEDULES

### ATTACHMENTS TO TENDER DOCUMENT

5.0      NOT USED

6.0      OWNER reserves the right to accept/reject any or all Bids without assigning any reason whatsoever.

7.0      Bids complete in all respects should be uploaded timely on the e-proc Portal on or before the Bid Due Date and time. Bids through other media viz Fax / E-mails will not be accepted. OWNER takes no responsibility for loss or non/late-receipt of EMD, No Deviation Certificate and Integrity Pact, all in Original, sent by post/courier. Please be noted that all the dates mentioned herewith are firm and OWNER expect strict adherence, since this is a priority project.

8.0      Transfer of Bidding Document is not permissible.

9.0      Bidder may depute their representative with proper authorization letter to attend opening of bids.

10.0      Eligible bidders are requested to confirm their intention, within seven (07) days from the date of issuance of NIT, to participate in subject bidding through a letter or fax message or e-mail.



## **VOLUME-I : COMMERCIAL**

### **ATTACHMENT – 1.0**

### **INSTRUCTIONS TO BIDDERS FOR COOLING WATER SYSTEM**



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## 1.0 INTRODUCTION

- 1.1 Online e-Bids are invited by Dy. Chief Engineer(TD), RVUN, Jaipur, Office of Dy. Chief Engineer(TD), Room no. 502, 5th floor, Dreamax Plaza, Sahkar Marg, Jaipur-302005, from eligible and qualified Bidders to bid for supply & installation of Cooling Water System, all Electrical Systems, all Mechanical system, Complete Control & Instrumentation and Complete Civil, Structural & Architectural works on single turnkey EPC basis for KSTPS Kota Unit#5 with the brief scope of work mentioned herein after.

## 1.2 LOCATION OF THE PROJECT SITE

## 2.0 SCOPE OF WORK

The Scope of work of the EPC Contractor shall include Design, Engineering, Procurement, Supply, Fabrication, Insurance, Transportation of all equipment / materials to work site, Storage, construction and erection of all civil and structural, mechanical, electrical and instrumentation works, assembly and Installation, obtaining all necessary statutory approvals, Testing, Mechanical Completion, Pre-Commissioning, Commissioning, Sustained load test & Performance Guarantee Test Run (PGTR) for the entire plant including total Project Management and handing over of the **Cooling Water System** and facilities under contractor scope of work duly completed on single point responsibility basis.

**FOR DETAILED SCOPE OF WORK, PLEASE REFER VOLUME-II (TECHNICAL)**

## 3.0 BIDDING DOCUMENTS

- 3.1 The bidder is expected to examine the bidding documents, including IFB and all instructions, Pre-Qualification Criteria mentioned there in, Forms, Annexure, Terms and Conditions of Contract, Specifications, Drawings and other documents and to fully familiarize itself with the requirements of the bidding documents. Failure to furnish all the information required by the Bidding Documents or the submission of a bid not substantially responsive to the Bidding Documents in every respect may result in the rejection of the Bid.
- 3.2 Unincorporated Joint Venture Bids are acceptable, with the formal intent to enter into an agreement or under an existing agreement in the form of a Joint Venture, provided that:-
- All parties to the Joint Venture shall sign the bid and they shall be jointly and severally liable; and
  - A Joint Venture shall nominate a representative who shall have the authority to conduct all business for and on behalf of any or all the parties of the Joint Venture during the bidding process. In the event the bid of Joint Venture is accepted, they shall form a registered Joint Venture Company.



#### 4.0 AMENDMENT OF BIDDING DOCUMENTS

Bidders shall examine the Bidding documents thoroughly and in case of any apparent conflict, discrepancy or error in the Bidding documents, the same shall be brought to the OWNER's notice (for suitable clarification/amendment, as required) in the form of queries, preferably 03 days before the pre-bid conference. In response to the same, if required the OWNER shall issue the clarification 03 days prior to the deadline for submission.

At any time prior to the deadline for submission of bids, the OWNER may, for any reason whether at its own initiative or in response to a clarification or modification requested by any prospective Bidder(s), modify the Bidding documents, if required.

Notice of issuance of any Amendment to the bidding document (Corrigendum/ Addendum/Amendment) if any, shall be uploaded on sppp and e-proc website and shall not be advertised in press. The same shall also be notified in the websites of RVUN. Bidders are therefore advised to visit the website regularly for downloading the details of amendment to bidding document. The Bidders will be required to acknowledge notification of any such amendment to the Bidding documents. Bidders shall confirm the inclusion of Addendum/Corrigendum in their bid and shall follow the instructions issued along with addendum/corrigendum.

In order to afford Bidders reasonable time to take the amendment, issued prior to submission of Bids, into account in preparing their Bids, OWNER may, at its discretion, extend the deadline for the submission of Bids.

#### 5.0 LANGUAGE OF THE BID

The Bid prepared by the Bidders and all correspondence and documents relating to the Bid exchanged by the Bidder and the OWNER shall be written in the English language and all units shall be in Metric system. Any printed literature furnished by the Bidder may be written in another language, provided that such literature is accompanied by an English translation, in which case, for purpose of interpretation of the Bid, the English translation shall govern.

#### 6.0 TIME SCHEDULE

- 6.1 Bidder shall be required to complete the WORK under the CONTRACT in accordance with the attached Work Completion Schedule, **Annexure-1.25**.
- 6.2 The "**Effective Date of Contract**" shall be reckoned as 30 days after date of LOI or 15 days from the date of Work Order whichever is earlier or as specified in the Work Order.
- 6.3 The basic consideration and essence of the Contract is the strict adherence to the time schedules for performing the specified works as stipulated in the Contract.

#### 7.0 SIGNATURE ON BIDS

- 7.1 The Bid must contain the name, designation and place of business of the person or persons making the Bid and must be signed and sealed, on each page (**necessarily serially numbered**), by the Bidder with his usual signature. The names of all persons signing should also be typed or printed below the signature. The Bidder shall submit authority letter / Power of Attorney / Board Resolution in favour of the authorized signatory(s) of the Bid. The Bidder's name stated on the proposal shall be the exact legal name of the Bidder.



- 7.2** Bids by bodies corporate/limited Companies must be signed with the legal name of the Corporation/Limited Company by the President, Managing Director or by the Company Secretary or any other person or persons holding Power of Attorney for signing their Bid.
- 7.3** Bidder must submit Power of Attorney issued by the Board of Directors / CEO / MD / Company Secretary of the Bidder/ all partners in case of Partnership Firm / Proprietor in favour of the authorized employee(s) of the Bidder, in respect of the particular tender for signing the Bid and all subsequent communications, agreements, documents etc. Pertaining to the tender and to act and take any and all decision on behalf of the Bidder is to be submitted. The authorized employee(s) of the Bidder shall be signing the Bid and any consequence resulting due to such signing shall be binding on the Bidder.
- 7.4** Bid shall contain no cuttings, erasures or overwriting except as necessary to correct errors made by the Bidder in which case each such corrections or other changes in the Bid documents shall carry the initials of the person(s) signing the Bid.

- 7.5** Bids not conforming to the above requirements of signing may be disqualified.

## **8.0 PRE-QUALIFICATION REQUIREMENT (PQR)**

Evaluation of Technical and Commercial offers shall be carried out for only those Bidders who shall meet the Pre-qualification Criteria.

### **8.1 TECHNICAL CRITERIA**

#### **8.1.1 WORK EXPERIENCE CRITERIA**

Bidder should have Designed, Constructed and Commissioned at least one (01) number Induced Draught Cooling Tower (IDCT) in RCC Construction with splash/film type fill, of capacity not less than 13000 m<sup>3</sup>/hr which is in successful operation for at least one year as on date of Techno-commercial Bid opening.

The reference cooling towers should be of the same type i.e cross flow type Cooling Tower or counter flow type Cooling Tower as is being offered by the Bidder.

#### **8.1.2 Bidder should have executed during last 07 years prior to the date of Techno-commercial Bid opening meeting**

- (a) One completed Similar Work costing not less than **INR 98.568 Cr**  
**OR**
- (b) Two completed Similar Work each costing not less than **INR 61.605 Cr**  
**OR**
- (c) Three completed Similar Work each costing not less than **INR 49.284 Cr**

#### **Definition of Similar Works**

Similar works means, execution of works of Cooling Tower/ CWS (Cooling Water System)/ WTP (Water Treatment Plant).



To meet the above criteria, Bidder shall submit relevant supporting documents i.e. Execution Certificates and Copy of Work Order/ Agreement (duly signed & stamped) of above required experience.

## 8.2 FINANCIAL CRITERIA

**Annual Turnover** – The Average annual turnover of the bidder in the preceding three (03) financial years as on the date of Techno-commercial bid opening shall not be less than **INR 61.61 Crores**.

In case where audited results for the last financial year as on the date of Techno commercial bid opening are not available, the financial results certified by a practicing Chartered Accountant shall be considered acceptable. In case, Bidder is not able to submit the Certificate from a practicing Chartered Accountant certifying its financial parameters, the audited results of three consecutive financial years preceding the last financial year shall be considered for evaluating the financial parameters. Further, a certificate would be required from the CEO/CFO stating that the Financial results of the company are under audit as on the date of Techno commercial bid opening and the Certificate for the practicing Chartered Accountant certifying the financial parameters is not available.

(To meet the above criteria, Bidder shall submit the copy of Audited Annual Report including Profit & Loss a/c statement for the corresponding financial year and details thereof mentioned in the Annexure-1.02)

## 8.3 General Criteria:

- Bidder should not have been Banned/Blacklisted/debarred/ suspended/removed from registration, as on date of submission of bid by Government of India or any other procuring entity in India or in any other country. Declaration (as per attached Annexure-1.13) to this effect shall be required from Bidder in the Bid.

**Bidders are requested to study the provisions of RTPP ACT 2012 and RTPP Rules 2013 and also note that Acts, Rules & Notification issued by Rajasthan Transparency in Public Procurement (RTPP) will be applicable for the above Works. Further, if there is any contradiction in the tender document from the same, then the Acts, Rules & Notification of RTPP Act will prevail.**

- Joint Venture Bids are acceptable, with the formal intent to enter into an agreement or under an existing agreement in the form of a Joint Venture, provided that:-
  - The partners of such Joint Venture, put together collectively, shall fulfill all the Pre-qualification Criteria, viz., Technical Criteria, Financial Criteria and the General Criteria as specified in Clause 8 of the tender document, for the Joint Venture to be eligible for participation in this tender enquiry.
  - All parties to the Joint Venture shall sign the bid and they shall be jointly and severally liable; and



- iii) A Joint Venture shall nominate a representative who shall have the authority to conduct all business for and on behalf of any or all the parties of the Joint Venture during the bidding process. In the event the bid of Joint Venture is accepted, they shall form a registered Joint Venture Company /firm or otherwise all the parties to Joint Venture shall sign the Agreement.
- iv) Separate identity/name shall be given to the Joint Venture.
- v) Number of members in a JV shall not be more than three. One of the members of the JV shall be its Lead Member who shall have a majority (at least 51%) share of interest in the JV. The other members shall have a share of not less than 20% each. In case of JV with foreign member(s), the Lead Member has to be an Indian firm/company with a minimum share of 51%.
- vi) A member of JV shall not be permitted to participate either in individual capacity or as a member of another JV in the same tender.
- vii) The tender form shall be purchased and submitted only in the name of the JV and not in the name of any constituent member.
- viii) A copy of Memorandum of Understanding (MoU) duly executed by the JV members on a stamp paper, shall be submitted by the JV along with the tender. The complete details of the members of the JV, their share and responsibility in the JV etc. particularly with reference to financial, technical and other obligations shall be furnished in the MoU.
- ix) Once the tender is submitted, the MoU shall not be modified/ altered / terminated during the validity of the tender. In case the tenderer fails to observe/comply with this stipulation, the full Earnest Money Deposit (EMD) shall be liable to be forfeited.
- x) Approval for change of constitution of JV shall be at the sole discretion of the RVUN. The constitution of the JV shall not be allowed to be modified after submission of the tender bid by the JV, except when modification becomes inevitable due to succession laws etc., provided further that there is no change in qualification of minimum eligibility criteria by JV after change of composition. However, the Lead Member shall continue to be the Lead Member of the JV. Failure to observe this requirement would render the-offer invalid.
- xi) Similarly, after the contract is awarded, the constitution of JV shall not be allowed to be altered during the currency of contract except when modification become inevitable due to succession laws etc. and minimum eligibility criteria should not get vitiated. Failure to observe this stipulation shall be deemed to be breach of contract with all consequential penal action as per contract conditions.
- xii) On award of contract to a JV, a single Performance Guarantee shall be submitted as per tender conditions. All the Guarantees shall be accepted only



in the name of the JV/ Lead Member of JV and no splitting of guarantees amongst the members of the JV shall be permitted.

- xiii) On issue of LOA (Letter of Acceptance), the MOU/ JV agreement between members of the JV to whom the work has been awarded, with the same shareholding pattern as was declared in the MOU/JV Agreement submitted alongwith the tender, shall be got registered before the Registrar of the Companies under "The Companies Act -2013" (in case of Company) or before the Registrar/Sub- Registrar under the "The Indian Partnership Act, 1932" (in case of Partnership Firm). A separate PAN shall be obtained for this entity. The documents pertaining to this entity including its PAN shall be furnished to the RVUN before signing the contract agreement for the work. In case the tenderer fails to observe/comply with this stipulation within 60 days of issue of LOA, contract is liable to be terminated. In case contract is terminated RVUN shall be entitled to forfeit the full amount of the Earnest Money Deposit and other dues payable to the Contractor under this contract. This Joint Venture Agreement shall have, inter-alia, following clauses:
- a) Joint And Several Liability Members of the JV to which the contract is awarded, shall be jointly and severally liable to the RVUN for execution of the project in accordance with General and Special Conditions of Contract. The JV members shall also be liable jointly and severally for the loss, damages caused to the RVUN during the course of execution of the contract or due to non-execution of the contract or part thereof
  - b) Duration of the Joint Venture Agreement - It shall be valid during the entire currency of the contract including the period of extension, if any and upto the end of Defect Liability Period.
  - c) Governing Laws: The Joint Venture Agreement shall in all respect be governed by and interpreted in accordance with Indian Laws.
  - d) Bank account in the name of Joint Venture will be opened with any scheduled or nationalized bank to be operated by an signatories as decided mutually by the Joint Ventures partners. All payments pertaining to this work shall be made in this account only.
- xiv) Authorized Member - Joint Venture members in the JV MoU shall authorize one of the members on behalf of the Joint Venture to deal with the tender, sign the agreement or enter into contract in respect of the said tender, to witness joint measurement of work done, and similar such action in respect of the said tender/contract. All notices/ correspondences with respect to the contract would be sent only to this authorized member of the JV.
- xv) No member of the Joint Venture shall have the right to assign or transfer the interest right or liability in the contract without the written consent of the other members and that of the RVUN in respect of the said tender/contract.
- xvi) Documents to be enclosed by the JV along-with the tender:
  - (a) In case one or more of the members of the JV is/are partnership firm(s), following documents shall be submitted:



- (i) A copy of the Partnership Deed,
  - (ii) A copy of consent of all the partners or individual authorized by partnership firm, to enter into the Joint Venture Agreement on a stamp paper,
  - (iii) A copy of Power of Attorney (duly registered as per prevailing law) in favour of the individual to sign the MOU/JV Agreement on behalf of the partnership firm and create liability against the firm.
- (b) In case one or more members is/are Proprietary Firm or HUF, the following documents shall be enclosed:
- A copy of notarized affidavit on Stamp Paper declaring that his/her concern is a Proprietary Concern and he/she is sole proprietor of the Concern OR he/she is in position of "KARTA" of Hindu Undivided Family (HUF) and he/she has the authority, power and consent given by other partners to act on behalf of HUF.
- (c) In case one or more members of the JV is/are companies, the following documents shall be submitted:
    - (i) A copy of resolutions of the Directors of the Company. permitting the company to enter into a JV agreement,
    - (ii) A copy of Memorandum and Articles of Association of the Company.
    - (iii) A copy of Authorization/copy of Power of Attorney issued by the Company backed by the resolution of Board of Directors) in favour of the individual to sign the tender, sign MOU/JV Agreement on behalf of the company and create liability against the company.
  - (d) All the Members of JV shall certify that they are not blacklisted or debarred by RVUN or any other Ministry / Department/ PSU (Public Sector Undertaking) of the Govt. of India/State Govt. from participation in tenders/contract on the date of opening of bids either in their individual capacity or as a member of the JV in which they were/are members.

#### **AUTHENTICATION OF ALL DOCUMENTS SUBMITTED AGAINST PQR**

All documents in support of Technical criteria of PQR to be furnished by the bidders shall necessarily be:

Duly certified / attested by Notary Public with legible stamp

In support of Financial criteria of PQR, bidder is required to submit following:



Shall submit under Chartered Accountant (CA) Letter head “Details of Financial capability of Bidder” in prescribed format (as per Annexure-1.20), duly signed & stamped.

Further, a copy of Audited Annual Financial Statements submitted in bid shall be duly certified / attested by Notary Public with legible stamp.

## 9.0 EARNEST MONEY DEPOSIT (EMD)

**9.1** Bids must be accompanied with ‘Earnest Money Deposit (EMD) / Bid Security’ through NEFT/RTGS/IMPS/’ Bank Guarantee’ issued by any Nationalised /Schedule Bank of RBI as indicated in the NIT.

**9.1.1** In case EMD is submitted in form of BG, then the EMD offered shall be an irrevocable Bank Guarantee, issued by any Nationalised / Schedule Bank of RBI on a non judicial stamp paper of appropriate value as per Rajasthan Stamp Duty Act. Proforma of the Bank guarantee is enclosed as Annexure-1.10.

**9.1.2** The Bank Guarantee shall be valid for a period of three (3) months beyond validity of the Bid. The amount shall be as indicated in this NIT. The Bank Guarantee shall be extended suitably if there is a delay in awarding the contract. The relevant extension shall be on Bidders’ account.

EMD will not carry any interest.

**9.2** The bid must be accompanied by EMD along with No Deviation Certificate and Integrity Pact, all in original.

**9.3** The procuring entity shall promptly return the bid security after the earliest of the following events, namely:

- (a) the expiry of validity of bid security
- (b) the execution of agreement for procurement and performance security is furnished by the successful bidder.
- (c) the cancellation of the procurement process; or
- (d) the withdrawal of bid prior to the deadline for presenting bids,unless the bidding documents stipulate that no such withdrawal is permitted. Bidders may indicate the name and address in whose favour the said EMD shall be returned.

**9.4** The successful Bidder’s EMD will be discharged upon the Bidder accepting and signing the Contract and furnishing the Security cum Performance Bank Guarantee.

**9.5** The EMD shall be forfeited and appropriated by OWNER without prejudice to any other right of remedy to OWNER under the following conditions:

- (a) when the bidder withdraws or modified its bid after opening of bids.
- (b) when the bidder does not execute the agreement, if any, after placement of supply / work order within the specified period.
- (c) when the bidder fails to commence the supply of the goods or service or execute work as per supply / work order within the time specified.
- (d) when the bidder does not deposit the performance security within specified period after the supply / work order is placed; and



- (e) if the bidder breaches any provision of code of integrity prescribed for bidders specified in the Act and Chapter VI of RTPP rules.
- 9.6** In case of the successful bidder, the amount of bid security may be adjusted in arriving at the amount of the Performance Security, or refunded if the successful bidder furnished the full amount of performance security.
- 9.7** Bidders shall submit their EMD in original along with **No Deviation Certificate (as per given format – Annexure-1.05)** and **Integrity Pact**, at following address.

The envelope shall be super scribed with:

“ ..... ”

Chief Engineer (TD), RVUN, Jaipur  
Room No. 501, 5<sup>th</sup> floor, Dreamax Plaza, Sahkar Marg, Jaipur-302005

**10.0 COMPLIANCE TO ALL THE PROVISIONS OF THE BIDDING DOCUMENT / NIL DEVIATION :**

- 10.1** The Bidders are advised that while making their Bid and quoting prices, all conditions may appropriately be taken into consideration. **Any deviation, whatsoever, is not permitted** by the Owner to the provisions of Bidding Documents and its subsequent Amendment(s) / Clarification(s) / Addenda / Errata if any, issued by the Employer. Bidders are required to certify their full compliance to the complete Bidding Documents and its subsequent Amendment(s) / Clarification(s) / Addenda / Errata if any, issued by the owner by submitting the '**No Deviation Certificate**' as per **Annexure-1.05** in the tender documents. **In case the Certificate as per Annexure-1.05 duly signed and stamped is not furnished, the bid shall be rejected.**

**Acceptance of above shall be considered as Bidder's confirmation that any deviation to the Bidding Documents found anywhere in their Bid Proposal, implicit or explicit shall stand unconditionally withdrawn, without any cost implication whatsoever to owner, failing which the bid shall be rejected and bid security shall be forfeited.**

**11.0 PRE-BID CONFERENCE AND COST OF BIDS**

**11.1 Pre-Bid Conference**

- 11.1.1 OWNER** at its discretion may organize a pre-bid conference with the prospective Bidders at the place, date and time as indicated in NIT. The purpose of the conference will be to clarify the package related issues and to respond to the Bidder's queries, which may arise from the Bidding Documents, site visit etc.

- 11.1.2** The Bidders are required to submit their questions/ clarifications/queries etc. through e-mail or by post or by fax, so as to reach the OWNER at least 03 days before the pre-bid conference. It may not be practicable at the conference to answer the questions which are received late. However, mere submission of pre-bid queries by the prospective participants shall not be made the ground for a extension in Bid submission due date.



- 11.1.3 Any modification to the Bidding Documents which may become necessary as a result of the pre-bid conference shall be made by the OWNER exclusively through an amendment to the Bidding Documents.
- 11.1.4 Non-attendance of the pre-bid conference will not be a cause for disqualification of a Bidder or his bid.

## 11.2 Cost of Bids

- 11.2.1 The Bidder shall bear all costs associated with the preparation and submission of the Bid, and OWNER will, in no case be responsible or liable for these costs, regardless of the conduct or outcome of the bidding process.

## 12.0 MODIFICATION AND WITHDRAWAL OF BIDS

- 12.1 The Bidder may modify or withdraw its Bid after the Bid's submission, but before the last date and time of Bid submission as specified in this NIT provided that written notice of the modification or withdrawal is received by OWNER prior to the deadline prescribed for submission of Bids.
- 12.2 A withdrawal notice may also be sent by E-mail in signed and scanned form not later than the deadline for submission of Bids.
- 12.3 Deleted
- 12.4 No bid may be withdrawn in the interval between the deadline for the submission of bids and the expiration during the validity or agreed extension validity period duly agreed by the bidder. Withdrawal or unsolicited modification of a bid during this interval shall result in the Bidder's forfeiture of its EMD.

## 13.0 INFORMATION REQUIRED WITH THE BID

- 13.1 All technical information shall be furnished as per Volume-II, Technical. In addition, the bidder shall ensure that Technical and Unpriced Commercial Bid has been submitted.
  - 13.2 Requirement of Manpower / Equipment / Tools & Tackles for timely completion of the project.
- 13.2.1 Bidder shall furnish tentative month wise manpower requirement till completion of the job.



13.2.2 Bidder shall also furnish a tentative break up of equipment, tools & tackles for timely execution of job.

#### **14.0 PRELIMINARY EXAMINATION**

- 14.1** Full compliance to the complete provisions of the Bidding Documents and its subsequent Amendment(s) / Clarification(s) / Addenda / Errata if any, issued by the owner will be checked first in terms of para clause 10.0 above and other requirements of the bidding documents in respect of No deviation Certificate and Integrity pact. In case those documents duly signed and stamped are not found in separate envelope / techno-commercial bid and / or they are not found as per format of the bidding document, the bidder will be asked to furnish the same as per the format before price bid opening. Failure to comply with this requirement, the bid shall be rejected.
- 14.2** The Owner/Consultant will examine the bids to determine whether they are complete, whether any computational errors have been made, whether the documents have been properly signed, whether validity of the Bid is in conformity with ITB and whether the bids are generally in order.
- 14.3** Prior to the detailed evaluation, the Owner/Consultant will determine the substantial responsiveness of the bids, in line with clause 21.0 of ITB. A Bid determined as substantially non-responsive is liable to be rejected by the Owner/Consultant and may not subsequently be made responsive by the Bidder by correction of the non-conformity.
- 14.5** The Owner/Consultant may waive any minor informality or non-conformity or irregularity in a Bid, which does not constitute a material deviation inline with clause 21.0 of ITB.

#### **15.0 LOCAL CONDITIONS**

- 15.1** It will be imperative on each Bidder to fully make aware himself of all local conditions and factors which may have any effect on the execution of the works covered under these specifications and documents. Bidder shall inspect the site, examine and obtain at its cost and responsibility, all information required and satisfy himself regarding all matters and things such as access to site, communications, transport, right of way, the type and number of equipment and facilities required for the work, availability of local labour, materials and their rates, local working conditions, weather, flood levels, sub-soil conditions, natural drainage, and all information that may be necessary for preparing its Bid, performance of work and other obligations and related matters. By submitting the Bid the Bidder shall be deemed to have acknowledged and agreed that ignorance of the site and other said conditions shall not be basis for any claim for compensation or extension of time or loss of profits etc. and the OWNER shall not be liable on account thereof in any manner whatsoever to the Bidder or any person claiming through or under the Bidder.
- 15.2** Bidders must before submission of their Bids, acquaint themselves with all applicable regulatory and other legal requirements pertaining to insurance and health, safety and environment requirement in India and rules related to work permit and visa requirements in India or in any way or manner affecting the performance of Scope of



Work, the Contractor and the Plant operation and performance including social security, safety, pollution control, permits, licenses, and the other statutory requirements and regulations. The submission of a Bid by the Bidder will be construed as evidence that such an examination was made and the Bidder shall not raise at any time later any claims/disputes against the Owner and the Owner shall not be liable for the same in any manner whatsoever.

- 15.3** Deleted
- 15.4** The Owner shall not entertain any request for clarification from the bidder, regarding such local conditions.
- 15.5** The Bidder shall be deemed to have prepared the Bid on the basis of its independent judgment and to have made all necessary allowances and provisions to ensure that the PROJECT will meet all technical specification prescribed hereunder in the tender document and will be entirely suitable for the purpose for which it is intended. Accordingly, at the time of submission the Bid Price will, without extra price and/or extension of time, be held to include everything implicitly or otherwise required or necessary for the proper and timely completion of the WORK in accordance with the CONTRACT. Further, in case of any contract awarded under these specifications and documents, neither any change in the time schedule of the Contract nor any financial adjustments arising thereof shall be permitted by the Owner, which are based on the lack of such clear information or its effect on the cost of the works to the Bidder.
- 15.6** The Bidder is advised to visit and examine the site where the facilities are to be installed and its surroundings and obtain for itself on its own responsibility all information as to risks, contingencies and other circumstances, that may be necessary for preparing the bid and entering into a contract for supply and installation of the facilities. Bidder should inspect and examine the site and should satisfy himself as to the nature of the ground and subsoil, the quantities and nature of work, materials necessary for completion of the work and their availability, means of access to site. No consequent extra claims on any misunderstanding or otherwise shall be allowed by the Owner. The Bidder after prior permission from Owner may visit the project site during office hours prior to the last date of bid submission. Owners representatives shall be available at site. The costs of visiting the site shall be borne by the bidder fully. Based on site visit, bidder shall submit layout for Cooling water System along with their techno-commercial offer bid. Bidder shall bring out all necessary modification and relocation of existing facilities, if required, along with proposed layout submitted with the Bid. In absence of this, the bid shall be deemed incomplete and may be liable for rejection.
- 15.7** The Bidder and any of its personnel or agents will be granted permission by the Owner to enter upon its premises and lands for the purpose of such inspection, but only upon the express condition that the Bidder, its personnel and agents will release and indemnify the Owner and its personnel and agents from and against all liability in respect thereof and will be responsible for death or personal injury, loss of or damage to property and any other loss, damage, costs and expenses incurred as a result of the inspection.



## 16.0 PRICE BASIS & CURRENCY OF BIDS

- 16.1 The Bidder shall quote in Indian Rupees only.
- 16.2 The price/Unit Rates quoted by the Bidder shall be **FIXED & FIRM** and shall be valid until completion of the Contract, pursuant hereto and shall not be subject to variation / escalation on any account except as otherwise specifically provided in the Contract documents. Firm rate shall not be subject to any escalation on any account. Bids with variable prices shall be disqualified.
- 16.3 Site is located at Kota, Rajasthan, India and the bidder are required to check & confirm before bidding for applicability of all taxes & duties for the procurement of supply and service by them for the execution of contract.
- 16.4 The quoted prices shall be inclusive of all taxes, duties, levies including BOCW cess etc. except GST as applicable. GST amount will be quoted separately, in the space provided for GST, which will be reimbursed at actual by the owner limited to the GST amount quoted by the bidder in their bid.
- 16.4.1 **The Bidder shall quote their prices on LUMPSUM basis for the scope of work under Cooling Water System.**

- 16.5 All bank charges shall be to the Bidders account.

- 16.6 Income Tax, or any other tax and surcharge as applicable shall be deducted at source from the bills of the contractor and a certificate to that effect shall be issued by the Owner.

## 17.0 GRIEVANCE HANDLING PROCEDURE DURING PROCUREMENT PROCESS (APPEALS)

### (A) FILING AN APPEAL

If any Bidder or prospective Bidder is aggrieved with any decision, action or omission of the Procuring Entity, than he may file an appeal to the First Appellate Authority as specified in the bidding documents in prescribed format (Enclosed), within a period of ten days from the date of such decision, action, or omission, as the case may be, clearly giving the specific ground or grounds on which he feels aggrieved: Provided that after the declaration of a Bidder as successful, the appeal may be filed only by a Bidder who has participated in procurement proceedings: Provided further that in case a Procuring Entity evaluates the Technical Bid before the opening of the Financial Bid, an appeal related to the matter of Financial Bid may be filed only by a Bidder whose Technical Bid is found to be acceptable. After hearing the parties, the First Appellate Authority shall dispose of the appeal and pass an order within a period of 30 days of the date filing of the appeal. If the First Appellate Authority fails to dispose of the appeal within the period 30 days of the date of filing the appeal or if the bidder or prospective bidder or the procuring entity is aggrieved by the order passed by the First Appellate Authority, the bidder or prospective bidder or the procuring entity, as the case may be, may file a second appeal to the Second Appellate Authority as specified in the bidding documents, within fifteen days. The Second Appellate Authority, after hearing the parties, shall dispose of the appeal and



pass an order within a period of 30 days which shall be final and binding on the parties.

**(B) APPEAL NOT TO LIE IN CERTAIN CASES**

No appeal shall lie against any decision of the Procuring Entity relating to the following matters, namely:-

- a. determination of need of procurement;
- b. provisions limiting participation of Bidders in the bidding process;
- c. the decision of whether or not to enter into negotiations;
- d. cancellation of a procurement process;
- e. applicability of the provisions of confidentiality.

**(C) FORM AND PROCEDURE OF FILING AN APPEAL**

An appeal shall be in the annexed Form along with as many copies as there are respondents in the appeal. Every appeal shall be accompanied by an order appealed against, if any, affidavit verifying the facts stated in the appeal and proof of payment of fee. Every appeal may be presented to First Appellate Authority or Second Appellate Authority, as the case may be, in person or through registered post or authorized representative.

**(D) FEE FOR FILING APPEAL**

Fee for first appeal shall be Rs. 2500/- (Rupees Two Thousand Five Hundred only) and for second appeal shall be Rs. 10000/- (Rupees Ten Thousand only), which shall be non-refundable. The fee shall be paid in the form of bank demand draft or banker's Cheque of a Scheduled Bank in India payable in the name of Appellate Authority/ Accounts authority concerned as first appeal only.

**(E) PROCEDURE FOR DISPOSAL OF APPEALS**

The First Appellate Authority or Second Appellate Authority, as the case may be, upon filing of appeal, shall issue notice accompanied by copy of appeal, affidavit and documents, if any, to the respondents and fix date of hearing. On the date fixed for hearing, the First Appellate Authority or Second Appellate Authority, as the case may be, shall,-

- a.) Hear all the parties to appeal present before him; and
- b.) Peruse or inspect documents, relevant records or copies thereof relating to the matter.

After hearing the parties, perusal or inspection of documents and relevant records or copies thereof relating to the matter, the Appellate Authority concerned shall pass an order in writing and provide the copy of order to the parties to appeal free of cost.

**(F) HIERARCHY OF APPELLATE AUTHORITY SHALL BE AS UNDER:-**

- i.) First Appellate authority : Chairperson, Jaipur Discom
- ii.) Second Appellate authority : Principal Secretary/ Secretary, Energy Department, GOR



## 18.0 NUMBER OF BIDS

- 18.1 A bidder shall on no account submit more than one bid either directly or indirectly.
- 18.2 A bidder shall be deemed to have submitted an indirect bid if a subsidiary of the bidder is also a direct or indirect bidder in an independent bid or if the bidder or its subsidiary has with its consent been indicated as a sub-contractor in any other bid or even if not so indicated has entered into any arrangement (whether disclosed or undisclosed) with any other bidder or with a sub-contractor of that bidder for the performance of any work for that other bidder upon an award of the work to that other bidder.
- 18.3 If a bidder makes more than one bid and/or directly or indirectly participates in another bid as contemplated under Clause 18.2 above, all the bids of the bidder, including the bid of the bidder in whose bid the first named bidder has directly or indirectly participated, may be considered as cartel bids and may be rejected. If the factum of such bid(s) is discovered after the notification of award, the resultant contract shall be liable to be terminated pursuant to the provisions for termination contained in the General Conditions of Contract.

## 19.0 CONFIDENTIALITY OF DOCUMENTS

Bidders shall treat the bidding documents and contents therein as strictly confidential.

## 20.0 TAXES AND DUTIES

- 20.1 The Prices/Rates shall include all taxes & duties, levies etc. including but not limited to custom duty, personnel and corporate tax, BOCW Cess except GST. GST amount paid by the Bidder shall be reimbursed at actual by the owner limited to the amount quoted by the bidder in their bid.
- 20.2 Bidders are required to ascertain themselves the prevailing rates of applicable taxes & duties including income tax rates as applicable on the scheduled date of submission of bids and Owner would not undertake any responsibility whatsoever in this regard. However, due to any subsequent change in law, liability of the Owner as regards to payment of duties and taxes would be governed by Clause-13.0 of SCC.
- 20.3 Please note that the responsibility of payment of above taxes thereupon lies with the Service Provider only. Contractor providing taxable service shall issue an Invoice as per the law, a Bill or as the case may be, a Challan which is signed, serially numbered and in accordance with GST rules. The invoice shall also contain the following:
- (a) Name, Address & GST Registration No. of such Person/Contractor
  - (b) Name & Address of the Person/Contractor receiving Taxable Service
  - (c) Description, Classification & Value of Taxable Service provided like HSN/SAC Code.
  - (d) GST Amount & Cess thereupon, if any

Payments to Service Provider for claiming GST amount will be made provided the above formalities are fulfilled. Further, OWNER may seek copies of challan and



certificate from Chartered Accountant for deposit / submission of Return of GST thereupon collected from Owner.

Any changes in statutory rules and regulations under GST regime shall be followed by Contractor.

## 21.0 DETERMINATION OF BID'S RESPONSIVENESS

- 21.1** The Owner's determination of a bid's responsiveness is to be based on the contents of the bid itself without recourse to extrinsic evidence. If a bid is not substantially responsive, it will be rejected by the Owner, and may not subsequently be made responsive by the Bidder by correction of the nonconformity.
- 21.2** It is important that Bidder clearly demonstrates his experience and capability, giving OWNER a high level of confidence that if awarded, the Bidder will be able to perform the works within the stipulated Time Schedule and quoted rate/price and meeting all other requirements listed in the Bidding document.
- 21.3** Bidder is requested to furnish the complete and correct information required for evaluation of his Bid. If the information with regard to resources and concurrent commitments or any other information/documentation forming basis of evaluation is found incomplete/incorrect, the same may be considered as adequate ground for rejection of the Bid.

### 21.4 Examination of bids and determination of responsiveness

- 21.4.1 The owner's determination of bid's responsiveness is based on the content of the bid only.

Prior to the detailed evaluation of Bids, the Owner will determine whether each Bid:-

- (a) Meets the "Pre-Qualification Criteria" of the Bidding Documents;
  - (b) Has been properly signed;
  - (c) Is accompanied by the required 'Earnest Money, No Deviation Certificate and Integrity Pact'
  - (d) Is substantially responsive to the requirements of the Bidding Documents; and
  - (e) Provides any clarification and/or substantiation that the Owner may require to determine responsiveness pursuant to Clause-21.3.2 of this ITB.
- 21.4.2 A substantially responsive Bid is one which conforms to all the terms, conditions and specifications of the Bidding Documents without material deviations or reservations or omissions for this purpose Owner 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.

- 21.4.3 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 Owner'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.

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

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

## 22.0 SUBMISSION OF BIDS

**22.1** The Bid shall be submitted in electronic format (through e-procurement portal) as per time schedule mentioned in the IFB.

**22.2** The procedure of filling of bids is as below:

- (i) The bidding procedures, contract terms and technical requirements are prescribed in the bid documents. The bidder is expected to examine all instructions, forms, terms, specifications and other information in the bid documents. Failure to furnish all information required by the bid documents or submission of a bid proposal not substantially responsive to the bid documents in every respect will be at bidder's risk and may result in rejection of bid proposal.
- (ii) **The bidders who are interested in bidding can download tender documents from Website <http://eproc.rajasthan.gov.in>. Bids shall be submitted through on-line, E-Tendering Process on website <http://www.eproc.rajasthan.gov.in> and all blanks in the bid & the schedules of the specification shall be duly filled in, on or before the scheduled date and time for submission mentioned in the NIT. The completed forms & schedules to the specification shall be considered as part of the contract documents in case of successful bid(s).**
- (iii) The bidder will have to register themselves on website <http://www.eproc.rajasthan.gov.in> for participating in this tender (Bidder registered on [eproc.rajasthan.gov.in](http://eproc.rajasthan.gov.in) before 30.09.11 needs to be registered again). For this purpose Digital Signature Certificate (DSC) have to be obtained from any agency approved by CCA. This DSC will be used to sign the bids submitted online by the bidder. Un-signed tenders will not be entertained and will be rejected out rightly. Bidders who already have a valid Digital Signature Certificate need not to procure new Digital Certificate.
- (iv) The bidder shall submit their offer along-with tender documents (as downloaded from website) only in online electronic format both for technical & price bid / financial bid on website <http://www.eproc.rajasthan.gov.in> and all documents should be digitally signed.



The Bidder shall take print out of NEFT/RTGS/IMPS payment, DD/BC/BG details showing payment towards Earnest Money Deposit (EMD) & Tender Cost and upload the scanned copy of payment details (for EMD & tender cost) along-with scanned copy of DD towards e-tender Processing Fee on e-procurement website <http://www.eproc.rajasthan.gov.in>. **Physical submission of bids is not allowed.** However, the original DD(for Processing Fee) along-with hard print out copy of details of payment towards EMD & Tender cost of requisite value mentioned in NIT, No-Deviation Certificate and Integrity Pact and 03 Nos hard copy of Bid & Tender Document originally signed, in physical form, shall be deposited in address as specified in the Bid Document up to scheduled date & time mentioned in NIT, otherwise technical bid will not be opened even though they have uploaded copies of the same on e-tender portal.

The bid should be prepared and submitted strictly in accordance with the procedure mentioned. It should include information as desired and detailed in the bid documents.

- (v) Tenders, duly signed by the authorized signatory, shall be submitted on the website <http://www.eproc.rajasthan.gov.in> as per ITB before the scheduled date and time of submission mentioned in the NIT.
- (vi) The system does not permit electronic submission of tenders after due date and time.
- (vii) No alteration should be made to the form of the bid specification and schedules.  
The bid must comply entirely with the specifications.
- (viii) The bid and all accompanying documents shall be in English language and shall be signed by a responsible and authorized person. The name, designation and authority of the signatory shall be stated in the bid. Whenever, language is other than English, its authenticated translated English version shall be submitted.
- (ix) RVUN will not be responsible to accept any cost involved in preparation or submission of bid.
- (x) All bids and accompanying documents shall be addressed to **The Dy. Chief Engineer (TD), RVUN, Room no. 502, 5th floor, Dreamax Plaza, Sahkar Marg, Jaipur- 302005.**
- (xi) **The bidder should sign the bid on each page at the end. All bids and accompanying documents should be chronologically numbered.**
- (xii) Telegraphic/Fax quotation will not be considered.
- (xiii) Bidders not fulfilling pre-qualifying requirements are advised not to submit their offer against this bid specification. The offer of the bidder not fulfilling the pre-qualifying requirements will be rejected.
- (xiv) If any bidder withdraws his tender prior to expiry of validity period or mutually agreed extended period or makes modifications in the rates, terms and conditions in their submitted offer within the said validity period, which are not acceptable to RVUN, or fails to commence the work/supply in the specified period or fails to execute the agreement, RVUN shall without prejudice to any other right or remedy be at liberty to forfeit the amount of earnest money deposit given in any form absolutely.
- (xv) If any contractor, who having submitted a tender does not execute the agreement or does not start the work/supply or does not complete the work/supply and the



work/supply has to be put to re-tendering, he shall stand debarred from participating in such re-tendering in addition to forfeiture of earnest money deposit and other action shall be taken as per agreement/terms & conditions of the contract/tender.

- (xvi) If there is strong justification of believing that the bidder or his authorized person has been guilty of mal-practices such as submission of forged documents, influencing individually or politically, his offer will be liable to rejection and in such case his earnest money deposit shall be forfeited.
- (xvii) All tenders, in which any of the prescribed conditions are not fulfilled or which have been vitiated by errors in calculations, totaling or discrepancies in figures or words or other discrepancies, may be liable to rejection.
- (xviii) Conditional tenders shall not be accepted and will be liable to rejection.
- (xix) The bidder shall ensure that scanned copy of all the schedules as asked in tender document have been filled up and attached with the bid submitted in electronic format.
- (xx) The acceptance of the tender will rest with the competent authority who does not bind itself to accept the lowest tender, and reserves to itself the authority to reject any or all the tenders received without assigning any reason.
- (xxi) Tender Cost and Processing Fee are not refundable in any condition.
- (xxii) Tender, drawings, technical data or documents furnished by the bidder for Purchaser's approval or information, as provided under the said tender shall be self-contained and clearly readable without ambiguity.
- (xxiii) If the Bidder deliberately gives wrong information in his tender to create circumstances for the acceptance of his tender, the Nigam reserves the right to reject such tender at any stage.
- (xxiv) Tender documents are not transferable.
- (xxv) Not more than one tender for a work/supply shall be submitted by one bidder or one firm of bidders.
- (xxvi) Tender documents in which tender are submitted by a bidder shall become the property of the Purchaser and the Purchaser shall have no obligation to return the same to the bidder.
- (xxvii) The Purchaser shall not be liable for any expenses incurred by the Bidder in the preparation of the tender whether his Tender is accepted or not.
- (xxviii) The fact of submission of tender to the Purchaser shall be deemed to constitute an agreement between the bidder and the Purchaser, where by such tender shall remain open for acceptance by the Purchaser. The bidder shall neither withdraw his offer nor impair or derogate the same. If the bidder be notified during the period of validity of tender that his tender is accepted by the Purchaser, he shall be bound by the terms of the agreement constituted by his tender and such acceptance thereof by the Purchaser until a formal contract of the same has been executed between him and the Purchaser in replacement of such agreement.
- (xxix) The successful bidder shall have to execute the contract agreement in triplicate for proper fulfillment of the contract. This shall be done by the successful bidder at their own cost. All forms, schedule(s) etc. shall be considered as part of the contract document/agreement in case of successful bidder(s).



- (xxx) All other conditions shall be prevailing as detailed out in the tender document (in the respective sections/ volumes).
- 22.3** The Bidder is expected to examine all instructions, forms/annexures, terms and conditions in the NIT. The NIT together with all its attachments thereto, shall be considered to be read, understood and accepted by the Bidders. Failure to furnish all information required or submission of a Bid not responsive to the NIT in every respect will be at the Bidder's risk and may result in the rejection of the Bid.
- 22.4** **Pre-qualification Bid and Technical & Commercial Bid** to be submitted as specified below. The bid shall be submitted online on e-procurement website <http://www.eproc.rajasthan.gov.in> in Two Parts{**Part –I (Techno-Commercial Bid) consists of Cover-1 & 2 and Part-II(Price Bid) consists of Cover-3**} as detailed below and as per guidelines mentioned herein:

#### PART-I: TECHNICAL AND COMMERCIAL BID

##### COVER-1:

Scanned copy of details of payment made through electronic fund transfer towards Tender Cost, Earnest Money Deposit and Scanned copy of DD for Tender processing Fee.

##### COVER-2:

Signed complete tender document along-with IFB, ITB, GCC, SCC, Schedules & Annexures, all addendums/ amendments issued & uploaded by RVUN on the above website along with tender forms and schedules for techno-commercial bid, scanned copies of supporting documents and related documents as detailed below:-

- i. Letter of Submission
- ii. Pre-Qualification Requirement in favour of **Experience Criteria as per Annexure-1.01** along with Copies of Work Orders, Certificates from End User/OWNER and completion certificates in support of prequalification requirement.
- iii. Pre Qualification Criteria in favour of **Financial criteria as per Annexure-1.02** along with copies of Annual audited Report for the last three financial years. Annual Reports shall be a verifiable statement of annual accounts certified by a Chartered Accountant or Public Accountant in the form of printed annual reports or similar document.
- iv. **Format for Financial Capability of Bidder** as per **Annexure-1.20**.
- v. Photocopy of Earnest money Deposit (EMD), Tender Fee, Processing Fee
- vi. Power of Attorney of Bid Signatory from the Competent Authority, Annexure-1.29
- vii. Declaration-Tender **Acceptance Letter** as per Annexure-1.03
- viii. No Deviation Certificate as per Annexure-1.05
- ix. Details of Similar Works Executed as per Annexure-1.06
- x. Current Commitments of the Bidder as per Annexure-1.07
- xi. Contents of Bid and **Check List** as per Annexure-1.08
- xii. **Declaration** by Bidder as per Annexure-1.13
- xiii. **Declaration by Bidder** regarding Bidding Document as per Annexure-1.15
- xiv. Photocopy of **Integrity Pact** as per Annexure-1.16
- xv. **EFT details** as per Annexure-1.18



- xvi. A declaration shall be submitted to the effect that Bidder submitting their Bid is not under liquidation, court receivership or similar proceedings as per Annexure-1.21
- xvii. **Work Completion Schedule** as per Annexure-1.25
- xviii. ESCROW Agreement Format as applicable as per Annexure-1.26
- xix. Declaration by bidder for Past Safety Record
- xx. Bidder to furnish PAN Number, TIN Number, PF, ESI Number, GST Number, Latest Income Tax Clearance Certificate / ITR etc. along with the bid.
- xxi. **Master Index of Bidding Documents** alongwith copies of all technical and commercial amendments/addendums if any issued, duly signed and stamped on each page as a token of having received and read all parts of the bidding document and having accepted and considered the same in preparing their bid.
- xxii. **Other information** required in the Bidding Documents or considered relevant by the Bidder.
- xxiii. Guaranteed Consumption figures of Cooling Tower i.e Power in Kwh/day as per Annexure-1.04
- xxiv. Deployment Schedule of Supervisory Personnel as per Annexure-1.22
- xxv. Deployment Schedule of Construction Equipment / Declaration For Minimum Deployment Of Construction Equipments as per Annexure-1.23
- xxvi. Litigation History as per Annexure-1.28
- xxvii. Additional Conditions of the Contract as per Annexure-1.30
- xxviii. FORM-I, Memorandum of Appeal as per Annexure-1.31
- xxix. Bid Security Declaration as per Annexure-1.32
- xxx. Details of GST Rates as per Annexure-1.33

For convenience, the Bid shall be compiled in the form of Specific Sections conforming to the above. In case of non-submission of above documents or submission of incomplete documents, the OWNER/CONSULTANT reserves the right not to evaluate such offers further and not to enter into correspondence in this regard after opening the Technical and Commercial Bid.

## 22.5 PART-II: PRICED BID

22.5.1 **COVER-3 : Priced Bid (Schedule of Prices)** shall consist of following:

- (I) Digitally signed Price Schedule(s) along with break-up of prices. The bidder should quote corresponding prices inclusive of GST as per relevant spaces provided in the form detailed BOQ (Billing of Quantities) which is published with the NIT. Kindly note that breakup of other taxes & duties, transportation, insurance etc. to be filled in price schedule given in the BOQ is mandatory. Any changes in the prescribed format of BOQ will not be acceptable. However, GST shall be payable at actual applicable rate on production of documentary evidences limited to quoted amount.
- (II) The above prices shall be firm, fixed & without any variation (except for statutory variations) during the currency of contract and pricing other than this shall not be acceptable.
- (III) The bidder must quote the prices strictly in the manner as indicated herein, failing which bid is liable for rejection.



- 22.5.2** This part shall not contain any condition whatsoever failing which the Bids shall be liable to be rejected. **If the bidder fails to quote for any item in the price bid, it will be implied that such item is included elsewhere in the quoted prices.**
- 22.5.3** Prices must be strictly filled in format of BOQ as part of bidding document. If quoted in separate typed sheets and any variation in description, unit is noticed, the bid is liable to be rejected. In any case Bidder shall be presumed to have quoted against the description of work and the same shall be binding on the Bidder.
- 22.6** The priced Bid containing any comments, remarks, conditions deviations etc, which is not indicated in the Technical and Commercial Bid, is liable to be rejected.

## **23.0 DEADLINE FOR SUBMISSION OF BIDS**

- 23.1** Bids must be uploaded at e-procurement Portal within the time and date as specified in the NIT.
- 23.2** The OWNER may extend this deadline for the submission/uploading of Bids by amending the NIT documents in accordance with Clause No. 4.0 above. In such case all rights and obligations of the OWNER and Bidders under this NIT shall be subject to the extended deadline.

## **24.0 POLICY FOR BID UNDER CONSIDERATION**

Bids shall be deemed to be "Under Consideration" immediately after they are opened and until such time that the official intimation of award / rejection is made by the OWNER to the Bidders. While the bids are under consideration, bidders and/or their representatives or other interested parties are advised to refrain from contacting by any means, the OWNER and/or his employees / representatives on matters related to the bids under consideration.

The OWNER, if necessary may obtain clarifications on the bids by requesting for such information from any or all the Bidders, either in writing or through personnel contact as may be necessary. **The Bidder will not be permitted to change the substance of the bid after the bid had been opened.**

## **25.0 EFFECT AND VALIDITY OF BID**

- 25.1** The submission of any bid connected with these documents and specifications shall constitute an agreement that the Bidder shall have no cause of action or claim against the OWNER for rejection of his bid. The OWNER shall always be at liberty to reject or accept any bid or bids at his sole discretion and any such action will not be called into question and the Bidder shall have no claim in that regard against the OWNER.
- 25.2** The bids should be kept **valid for acceptance** for a period of **120 Days** from the date of **opening of Technical and Commercial Bids**. A Bid valid for shorter period may be rejected by the Owner as being non-responsive. Under the exceptional circumstances, prior to expiry of the original Bid validity period, the OWNER may request the Bidder for a specified extension in the period of validity. The request and the responses thereto shall be made in writing or by E-mail.



- 25.3** In the event of OWNER seeking extension of period of validity of the Priced Bids, the validity of EMD shall also be suitably extended.
- 25.4** A Bidder agreeing to the request of OWNER seeking extension will not be required nor permitted to modify his bid, and will be required to extend the validity of his EMD correspondingly. The provisions of Clause-9.0 regarding discharge and forfeiture of EMD shall continue to apply during the extended period of Bid Validity.

## **26.0 COMPLETE SCOPE OF SUPPLIES / WORK**

- 26.1** The complete scope of supplies and work/services has been defined in the bidding documents. Only those bidders who take complete responsibility and who bid for the complete scope of supplies and work/services as contained in the bidding document shall be considered for further evaluation subject to meeting Pre-Qualification Requirement.
- 26.2** If the contractor is required to engage a sub-contractor for any part of work, then such subcontractors shall have prior proven experience of similar work and shall require specific approval by OWNER.
- 26.3** If a proposed sub-contractor has been approved by the OWNER, the CONTRACTOR shall not replace such approved sub-contractor with another sub-contractor without obtaining the OWNER's prior approval for the proposed replacement.

## **27.0 OPENING OF BIDS**

- 27.1** Owner will open Bids in the presence of Bidder's representatives who choose to attend at Date and time specified on cover page of NIT or as informed by Owner. The Bidder's representative(s) present during the Bids opening shall sign a Bids opening record sheet evidencing their attendance.
- 27.2** The Owner shall allow only those bids for opening whose original EMD, has been received by the Owner before the Techno-Commercial bid opening. However, after opening of Techno-commercial Bid, if there is any discrepancy found in the EMD, Bidder shall be asked to rectify the same, as per the requirement of Bidding document, before the date of opening of the Price Bid. In case the Bidder fails to rectify the EMD before the date of opening of the Price Bid, its Bids will be rejected.
- 27.3** The Bids shall be opened in **e-Procurement Portal** at <http://www.eproc.rajasthan.gov.in>

### **27.3.1 STAGE-I: OPENING & REVIEW OF TECHNICAL AND COMMERCIAL BIDS (Cover-1 & Cover-2)**

OWNER after opening will first review Pre-qualification requirement. The Techno-Commercial examination will ascertain that the bidder fully meets the Qualifying Requirements, stipulated for the works in ITB (Clause-8.0) to the Owner satisfaction. It will be based upon an examination of documentary evidence of Bidder's qualifications submitted by the Bidder in the bid, as well as such other information as the Owner deems necessary and appropriate. Technical and Commercial Bids shall be evaluated only for those bidders whose bid is found to be Pre-qualified based on the Pre-qualification Requirement.



#### **Discussions with Bidders during Techno-Commercial Evaluation:**

During evaluation and comparison of Technical and Commercial Bids, OWNER may, at its discretion, ask the Bidder for clarification on its Bid. The request for such clarification and the response shall be in writing. Further, OWNER may ask BIDDER to visit OWNER's office for Technical, Commercial or Financial discussions/ clarifications.

BIDDER is expected to undertake such visits and participate in such meetings as and when called by the OWNER. All costs related to such visits shall be borne by BIDDER.

Bidders shall be required to submit their unconditional acceptance to such amendment/clarification failing which Price Bid shall not be considered for opening.

After opening of the Price Bid, no change in the quoted rate/price shall be offered or permitted.

#### **27.3.2 STAGE – II: OPENING OF PRICE BID (Cover-3)**

The date of the opening of the Price Bid shall be intimated to technically and commercially acceptable Bidders. The price bids of such shortlisted Bidders will be opened in the presence of Bidder's representative who chooses to attend, on the date and time to be intimated. The bidder's name, bid price and such other details as the OWNER at its discretion may consider appropriate, will be announced at the opening of price bids.

**The evaluation of the priced Bids shall be done as described under Clause No. 29.0 of the ITB.**

27.3.3 If the Bids as judged by the OWNER are unresponsive, the NIT may be declared void and a new procedure for selection of CONTRACTOR as deemed appropriate by OWNER may be adopted.

#### **28.0 CORRECTION OF ERRORS**

Bids determined to be substantially responsive will be checked by the Owner for any arithmetic errors. Errors will be corrected by the Owner as follows:

- (i) When there is a difference between the rates in figures and words, the rate which corresponds to the amount worked out by the Bidder (by multiplying the quantity and rate) shall be taken as correct.
- (ii) When the rate quoted by the Bidder in figures and words tallies but the amount is incorrect, the rate quoted by the contractor shall be taken as correct and not the amount and the amount shall be re-calculated/ corrected accordingly.



- (iii) When it is not possible to ascertain the correct rate, in the manner prescribed above, the rate as quoted in words shall be adopted and the amount worked out, for comparison purposes.
- (iv) All errors in totalling in the amount column and in carrying forward totals shall be corrected. The amount stated in the Bid will be adjusted by the Owner / Consultant in accordance with the above procedure for the correction of errors. If the Bidder does not accept the corrected amount of Bid, its Bid will be rejected, and the EMD shall be forfeited.

## 29.0 EVALUATION AND COMPARISON OF BIDS

### 29.1 General

- 29.1.1 The OWNER wishes to finalise the award of work of the facilities covered under this bidding documents within a limited time schedule. The bidders are advised to submit their bids complete in all respects conforming to all terms and conditions of the bid document.
- 29.1.2 Bids shall be evaluated based on the information / documents available in the bid. Hence bidders are advised to ensure that they submit appropriate and relevant supporting documentation along with their proposal in the first instance itself. Bids not complying with the requirements of Bid Documents are liable to be rejected. Bidders are advised to fill up all Annexure carefully and provide reference to all relevant documents given in their bid offer.
- 29.1.3 Bidders shall quote their prices on firm, fixed & F.O.R price basis. **The prices should be strictly quoted as per given format (BOQ)** otherwise the bid may be rejected. The Owner's evaluation will also include the costs resulting from application of the evaluation procedures described in ITB Clause 29.2. Any adjustments in price that result from the below procedures as per ITB Clause 29.2 shall be added, for the purposes of comparative evaluation only.

#### 29.1.4. Work Cost Loading on Technical Parameters:

- 29.1.4.1 Bidder shall furnish the Guaranteed Consumption figures under Schedule of Price/Price Bid.
- 29.1.4.2 The **work cost loading value** to be considered in the evaluation, shall be as illustrated under:

The differential Works Cost (in comparison to the Bidder quoting the Lowest Works Cost Cooling Water System as per Volume-II-Technical NIT) considering operating days per year (i.e. 350 days) will be calculated and will be discounted at the discount rate of 10.0% p.a, for the period of 12 years of operation starting from Preliminary Acceptance.



**Illustration:**

<b>Particulars</b>	<b>Bidder X</b>	<b>Bidder Y</b>	<b>Remarks</b>
Work Cost per day for Cooling Water System considering all the individual work cost finished by bidder in Schedule of Prices( SP)	'M' (Say)	N (Say lesser than 'M')	Lowest of 'M' and 'N' shall be considered as Base value
Differential daily Works Cost	'M'-‘N’	0 (zero)	
Differential Annual Works Cost= ‘W’	(‘M’-‘N’)	0 (zero)	
Works Cost Loading Value for Cooling Water System for <b>Bidder 'X'</b>	<p>W' for each year shall be discounted for 12 years @10% per annum using financial formula of “NPV”. i.e.</p> $\sum_{N=1}^{x=12} \frac{W}{(1 + R)^n}$ <p>Where, R=Rate of Discount i.e. @10% per annum and n= Number of years.</p>		
Works Cost Loading Value for Cooling Water System for <b>Bidder 'Y'</b>	0 (Zero)		

The above illustration is for Cooling Water System and the Total Works Cost Loading for entire PLANT( to be considered in evaluation (refer 29.2.1)) shall be derived by summing up all the **Works Cost Loading values** the Cooling Water System for Bidder X.

**29.2. The financial comparison of evaluated price or selection of Bidder / Contractor shall be arrived by using the following methodology:**

**29.2.1 Total Evaluated Price shall be derived as follows:**

Total Price quoted by the bidder plus GST Amount(\*) (after arithmetical corrections as per Clause no. 28.0 if any) quoted as per BOQ (Schedule of Prices) PLUS Work Cost Loading for entire PLANT, if any as per Clause 29.1.4 above.

(\*)If any bidder does not indicate the GST Amount in the Price Schedule by stating NIL / Blank / Not Applicable / NA then applicable GST shall be assumed included in the Quoted Price.



## 29.2.2 Award Criteria

The Owner will award the contract to the successful Bidder whose bid has been determined to be substantially responsive and to be the lowest evaluated bid, further provided that the bidder is determined to be qualified to perform the contract satisfactorily.

The owner reserves the right to vary the quantity of any of the spares and/or delete any item of Spares altogether at the time of Award of Contract.

## 30.0 REBATE

No suo-moto reduction in price(s) by Bidders is permissible after opening of the price bid. If any Bidder unilaterally reduces the price(s) / percentage quoted by him in his bid after opening of price bids, such reduction shall not be considered for comparison of prices but shall be binding on the Bidder if he happens to be selected for award of work.

## 31.0 CONTACTING OWNER

A Bidder shall not contact the OWNER/CONSULTANT on any matter relating to his bid from the time of priced bid opening to the time that the Contract is awarded, unless requested to do so in writing. Any effort by a Bidder to influence the OWNER/CONSULTANT in the OWNER's/ CONSULTANT's decisions in respect of bid evaluation or contract award will result in the rejection of that Bid.

## 32.0 AWARD OF CONTRACT

**32.1** Subject to ITB Clause 34.0, the OWNER will award the CONTRACT to the successful Bidder in terms of award criteria mentioned at Clause 29.2.2 above whose Technical and Commercial bid has been determined to be qualified, substantially responsive further provided that the Bidder is determined to be qualified to perform the CONTRACT satisfactorily.

**32.2** After selection, Letter of Intent s ("LOIs") as per mode of contracting shall be released by the OWNER to the selected Bidder. The selected bidder will return the duplicate copy duly signed & stamped as token of acceptance within 15 days.

**32.3** The Bidder shall enter into a Contract Agreement with the OWNER as per Clause 33.0, failing which the Bid Security/EMD is liable to be forfeited.

**32.4** In the case of successful bidder, the award of Contract shall be made as follows:

- (i) PART-A' For supply of all Plant and Equipment including type test charges, mandatory spares/ Tools & Tackles. Scope shall also include Transportation & transit insurance, Port Handling, Port Clearance and other Port Charges/ Costs incidental to delivery of Plant & Equipment and Mandatory Spares/ Tools & Tackles to KSTPS Kota site including all applicable Taxes & Duties.



- (iii) 'PART-B' for Erection, Testing and Commissioning including carrying out Guarantee Tests in respect of all the equipment supplied under the PART-A of CONTRACT and all other services specified in the Contract Documents. The scope shall also include Integration of the Cooling Water System including providing all other associated services i.e. further unloading, storage, handling at site and all the insurance covers (Storage cum Erection Insurance) for all Supplies/ Works covered in all the Three PARTS of CONTRACT (other than inland transit insurance).
- (iv) 'PART-C' for providing all services towards Civil, Architectural & Structural Steel Works (including supply of Structural Steel, Reinforcement Steel, Cement and Labour etc.), including Design & Engineering works related to construction works for all the required buildings, foundations and structures for the Cooling Water System.
- \* All the above parts of the Contract will contain a cross-fall breach clause specifying that breach of one part of Contract will constitute breach of the other part of Contract which will confer a right on the Owner to terminate the other parts of Contract also at the risk and the cost of the Contractor.

### **33.0 SIGNING OF CONTRACT**

- 33.1** The Bidder who is awarded the Contract will be required to execute the contract as per General Conditions of Contract on a non judicial stamp of requisite value as per Rajasthan government rules at his cost. On acceptance of the BID, the BIDDER shall be informed about it and he will be required to give his acceptance in writing within 15 (fifteen) days. Thereafter a contract agreement shall be executed between the OWNER and the BIDDER and signed within 15days of acceptance by the BIDDER. The EFFECTIVE DATE of the CONTRACT shall be as per ITB Clause 6.2. Until a formal contract is executed, LOA or LOI shall constitute a binding contract. In the event of failure of the Bidder to execute the Contract within notice period from the date of receipt of acceptance of his Bid, the full Bid security deposited, shall stand forfeited and shall at once be payable to the Rajasthan Rajya Vidyut Utpadan Nigam Ltd., Acceptance of his Bid will be withdrawn unless the period is extended by mutual agreement in writing.

- 33.2** The CONTRACT will be signed in triplicate, one copy each for CONTRACTOR, OWNER's Head Office and SITE office. All expenses for the preparation and stamping of CONTRACT shall be borne by the CONTRACTOR. The successful Bidder shall provide 05 DVDs of scanned signed Contract Agreement apart from 3 sets of Original Contract Agreement.

### **34.0 OWNER'S RIGHT TO ACCEPT / REJECT BIDS**

- 34.1** The OWNER 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(s) or any obligation to inform the affected bidder(s) of the ground of OWNER's action.
- 34.2** It is observed that many bidders indulge in trading in contracts by entering into undisclosed back-to-back arrangements for the whole or a substantial portion of a CONTRACTOR's obligations under the contract. If a bidder proposes to enter into



any such arrangements upon a successful award of work or has in place any such arrangement which will become operative upon the award of work, the bidder must make a complete disclosure of such arrangement or proposed arrangement in its proposal, and all provisions applicable to subcontractor(s) in terms of bidding documents shall apply to such arrangements.

- 34.3** If the existence of such an undisclosed arrangement is reasonably apprehended by the OWNER in the case of a bidder, the OWNER may reject such bidder's bid as not responsive.
- 34.4** If such an undisclosed arrangement is discovered after the award of work, such arrangement(s) shall be deemed to constitute an assignment of contract and a ground of termination pursuant to the provisions of termination under the General Conditions of Contract.
- 34.5** Owner reserves the right to accept or reject any tender in whole or part and/or accept other than the lowest quotation without assigning any reason. The whole work may be split up between two or more contractors if considered expedient by the Owner on their sole and absolute discretion. The bidder shall have no claim in this regards whatsoever.

#### **35.0 CONTRACT SECURITY CUM PERFORMANCE BANK GUARANTEE (CPBG)**

- 35.1** As a Contract Security, a successful Bidder, to whom the work is awarded, shall be required to furnish Security cum Performance Bank Guarantee(s) in the form attached as Annexure-1.11 within the timelines specified in GCC. These Bank Guarantee(s) shall be an irrevocable Bank Guarantee, issued by any Nationalised / Scheduled Bank of RBI on a non-judicial stamp paper of appropriate value as per Rajasthan stamp duty act and it shall guarantee the faithful performance of the CONTRACT in accordance with the terms and conditions specified in these documents and specifications.
    - 35.1.1** The Bidder is required to furnish the requisite CPBG as mentioned in GCC/SCC.
    - 35.1.2** In case of breach of contract the guarantee amount shall be encashed by the Owner without any conditions whatsoever.
  - 35.2** Failure of the successful Bidder to comply with the requirement of Clause 35.1 hereof shall constitute sufficient grounds for forfeiture of Bid Security/EMD without prejudice to its rights and remedies as set forth in this NIT or otherwise in law.
- #### **36.0 INCOME TAX & CORPORATE TAX**
- 36.1** 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.
  - 36.2** Corporate Tax liability, if any, shall be to the contractor's account.



### 36.3 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 fulfilment of above requirement.

## 37.0 GENERAL INSTRUCTIONS

- 37.1 Transfer of Bid submitted by one BIDDER to another is not permitted. No alteration in the essence of a Bid, once submitted, shall be permitted.
- 37.2 OWNER reserves the right to verify all statements/information submitted to confirm the Bidder's claim on experience on the performance of equipment offered and capabilities of the Bidder to perform the Scope of Work. OWNER may inspect similar facilities built by the Bidder. Bidder shall co-ordinate and arrange for visit.  
However all expenses of such visit of OWNER's Officials / OWNER's Representative will be borne by OWNER.
- 37.3 OWNER shall not entertain any correspondence with any Bidder on acceptance or rejection of any Bid.
- 37.4 Oral statements made by the Bidder at any time regarding any matter including quality, or arrangement of the equipment or any other matter will not be considered and will not be binding on the OWNER
- 37.5 Standard catalogue pages and other documents of the Bidder may be used in the Bid to provide additional information and data as deemed necessary by the Bidder.
- 37.6 Bidder will furnish the Bid with all relevant information's as called for. Bids with incomplete information are liable for rejection.
- 37.7 If at any later date, it is found that documents, information and data submitted by the Bidder in the Bid, and based on which the Bidder has been considered eligible or successful or has been awarded the Contract is incorrect or false to the extent that had the correct or true information been made available to the OWNER at the time of Bid evaluation, the bid would have been declared ineligible or unsuccessful, the Bidder shall be forthwith disqualified or, as the case may be, the contract awarded based on such incorrect or false information shall be cancelled and the EMD/PBG shall be liable to be forfeited.



### **38.0 INTEGRITY PACT**

Bidders are required to unconditionally accept the "Integrity Pact (IP)", as per Annexure-1.16, (executed on plain paper) and submit the same duly signed on all pages by the bidder's authorized signatory. In case, Annexure-1.16 duly signed & stamped is not found in the sealed envelope / techno-commercial bid and / or is not found as per the format required as per the bidding document, the bidder will be asked to furnish the same before price bid opening. Failure to comply with this requirement, the bid shall be rejected.

### **39.0 BIDDER TO QUOTE FOR ALL ITEMS**

The bidders shall quote their rates with reference to each item and must tender for each and all the items shown in the attached Schedule of Prices(SP).

### **40.0 BIDDER TO SIGN ALL PAGES**

All pages of the tender documents shall be signed and stamped by the bidder.

### **41.0 ERASURES AND ALTERATIONS**

Tenders containing erasures and alterations in the tender documents may be rejected. All rates shall be indicated both in words and figures. Where there is a difference between the rates quoted in words and figures, the rates given in words shall prevail.

### **42.0 INCOMPLETE AND LATE TENDER**

Unsolicited/Incomplete/late tenders are liable to rejection without any further reference.

### **43.0 EXECUTION OF CONTRACT**

The successful bidder shall be required to execute contract with Owner within reasonable time.

### **44.0 TESTING OF IMPORTED EQUIPMENTS/ITEMS**

To protect the security, integrity and reliability of equipment in this package, it is essential to remove vulnerabilities arising out of the possibility of cyber attack through malware/ Trojans etc embedded in imported equipments. This requirement shall apply to any item imported for end use or to be used as a component, or as a part in manufacturing, assembling of any equipment or to be used in this package.

Contractor shall comply all the requirements of Order No 25- 11/6/2018-PG, dated 02/07/2020, issued by Ministry of Power, Government of India and its subsequent amendments/revisions. Contractor shall furnish declaration of compliance of MOP order dt. 02/07/2020 requirements with dispatch of equipment/ item. Further, Contractor shall furnish back up testing certificates, whenever Owner ask the same.

**45.0 RESTRICTIONS ON PROCUREMENT FROM A BIDDER OF A COUNTRY WHICH SHARES A LAND BORDER WITH INDIA**

**45.1** Any Bidder (including its Partner/JV partner /Consortium Member /Assignee, wherever applicable) from a country which shares a land border with India will be eligible to bid in this tender only if bidder is registered with the Competent Authority.

Such registration should be valid for the entire period of bid validity or any extension thereof. However, in case period, the Bidder shall be required to submit the extension of the validity period of registration before the opening of price bids, failing which the bid shall be rejected.

Further the successful bidder shall not be allowed to sub-contract supplies/ services/ works to any "Subcontractor" from a country which shares a land border with India unless such Subcontractor is registered with the competent Authority.

However, the said requirement of registration will not apply to bidders/ sub-contractors 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. Bidders may apprise themselves of the updated lists of such countries available in the website of the Ministry of External Affairs.

**45.2** "Bidder" (including the term 'tenderer', 'consultant' or 'service provider' in certain contexts) means any person or firm or company, 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.

**45.3** "Sub-contractor" (including the term 'Sub-vendor'/Sub-supplier' in certain contexts) means any person or firm or company, every artificial juridical person not falling in any of the descriptions of Sub-contractors stated hereinbefore, including any agency branch or office controlled by such person, participating in a procurement process.

**45.4** "Bidders from a country which shares a land border with India" / "Sub-contractor from a country which shares a land border with India" mentioned above means;

- 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.



**45.5** The beneficial owner for the purpose of clause "45.4" above will be as under;

- a) In case of company of Limited Liability Partnership, the beneficial owner is the natural person(s), who, whether acting alone or together, or through one or more juridical person, has a controlling ownership interest or who exercises control through other means.

**Explanation**

- i. "Controlling ownership interest" means ownership of or entitlement to more than twenty-five per cent of shares or capital or profits of the company;
- ii. "Control" shall include the right to appoint majority of the directors or to control the management or policy decisions including by virtue of their shareholdings or management rights or shareholders agreements or voting agreements;
- b) In case of a partnership firms, the beneficial owner is the natural person(s) who, whether acting alone or together, or through one or more judicial person, has ownership of entitlement to more than fifteen percent of capital or profits of the partnership;
- c) In case of an unincorporated associations 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;
- d) Where no natural person is identified under (a) or (b) or (c) above, the beneficial owner is the relevant natural person who holds the position of senior managing officials;
- e) In case of a trust, the identifications of beneficial owner(s) shall include identification of the author of 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.

**45.6** An Agent is a person employed to do any act for another, or to represent another in dealings with third person.

The Contractor shall not be allowed to sub-contract works to any sub-contractor/ sub-vendor from a country which shares a land border with India unless such contractor is registered with the competent Authority.

The Competent Authority for the purpose of registration shall be as mentioned in the PPD GOI order No. 6/18/2019-PPD Dt. 23.07.2020 or Govt. of Rajasthan, Finance (G&T) Dept. Order No. F.2(1)FD/G&T-SPFC/2017 Jaipur Dt. 15.01.2021 and subsequent OM No. F.18/37/2020-PPD dated 08.02.2021.

Declaration by the bidder in compliance to above circulars shall be submitted in Annexure-1.35 of Volume I, Attachment 4 of this tender.



However, the said requirement of registration will not apply to sub-contractors 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. The Contractor may apprise itself of the updated lists of such countries available in the website of the Ministry of External Affairs.



Rajasthan Rajya Vidyut Utpadan Nigam Ltd

1x210 MW KSTPS Kota (Unit-5)

Commercial & General Conditions  
for Cooling Water System

## VOLUME-I : COMMERCIAL

### ATTACHMENT – 2.0

#### GENERAL CONDITIONS OF CONTRACT (GCC)

FOR

COOLING WATER SYSTEM

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## 1.0 SCOPE OF CONTRACT

The details Scope of Contract refers as mentioned at Clause 1.0 of NIT and Clause 2.0 of Instruction To Bidders (ITB).

- 1.1 All EQUIPMENTS to be supplied and WORK to be carried out under the CONTRACT shall conform to and comply with the provisions of relevant regulations/acts of Government of India as may be applicable to the type of EQUIPMENT/WORK carried out and necessary certificates shall be furnished.
- 1.2 The CONTRACTOR shall provide cross-sectional drawings wherever applicable to identify the spare part numbers and their location. The sizes of bearings, their make & number shall also be furnished.
- 1.3 Specifications, design and drawings issued to the CONTRACTOR along with tender specifications and CONTRACT are not sold or given but loaned. These remain property of OWNER or his assignees and are subject to recall by OWNER. The CONTRACTOR, his employees, and SUB-CONTRACTOR and his employees shall not make use of the drawings, specifications and technical information for any purpose at any time except for manufacture against the CONTRACT and shall not disclose, the same to any person, firm or corporate authorities, without written permission of OWNER. All such details shall be kept confidential.
- 1.4 CONTRACTOR shall pack, protect, mark and arrange for despatch of EQUIPMENT as per instructions given in the CONTRACT.

## 2.0 CONTRACT DOCUMENTS

The term 'Contract Documents' shall mean and include the following which shall be deemed to form an integral part of the Contract:

- a) Invitation for Bid, Instruction to Bidders, Contracts / Agreement, General Conditions of Contract, Special Conditions of the Contract, Technical Specifications, and all other related documents.
- b) Specifications of the equipment to be supplied and erected under the Contract as per requirements described in technical documents specifications and addenda thereto.
- c) CONTRACTOR's bid proposal including the letters of clarifications thereto between the CONTRACTOR and the OWNER prior to the award of the Contract.
- d) All the materials, literature, data and information of any kind given by the CONTRACTOR along with it's bid, subject to the approval of the OWNER.
- e) Agreed minutes of the meetings between OWNER and the CONTRACTOR& Letter of waiver.



- f) OWNER's Letter of Intent duly accepted by the CONTRACTOR.
- g) Any written agreed variations of the documents and specifications, if any.

The several Contract documents forming the CONTRACT are to read together as a whole and are to be taken as mutually explanatory.

## 2.1 INTERPRETATION OF CONTRACT DOCUMENTS

- 2.1.1 Notwithstanding the sub-division of the CONTRACT 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 and / or the agreed variations or if any provision of the SPECIAL CONDITIONS OF CONTRACT is repugnant to or at variance with any provision(s) of the agreed variations, and the two cannot be reconciled or otherwise co-exist, then unless a different intention appears, the provision(s) of the SPECIAL CONDITIONS OF CONTRACT shall be deemed to override the provision(s) of GENERAL CONDITIONS OF CONTRACT and the provision(s) of the agreed variations shall be deemed to override the provision(s) of the SPECIAL 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 and/or agreed variations or to the extent that such repugnancy in the SPECIAL CONDITIONS OF CONTRACT cannot be reconciled with the agreed variations, as the case may be.
- 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 LUMP SUM 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 practise shall be binding on the CONTRACTOR.
- 2.1.5 In case of an irreconcilable contradiction in the Commercial Terms or Conditions/ Technical Requirements or technical specifications between Indian standards/Applicable Codes & Standards, GENERAL CONDITIONS OF



CONTRACT, SPECIAL CONDITIONS OF CONTRACT, Specifications, DRAWINGS, Schedule of LUMP SUM PRICE and or Agreed variations to the extent that the two provisions cannot co-exist or be read together to satisfy both or all, the following order of precedence shall prevail:

- i) Formal Contract
- ii) Detailed Letter of Acceptance
- iii) Statement of Agreed variations
- iv) Job specifications/ Scope of Work
- v) Drawings
- vi) Technical/Material Specifications
- vii) Quality Assurance Procedures
- viii) Applicable Codes & Standards
- ix) Special Conditions of Contract
- x) General Conditions of Contract
- xi) Price Schedule
- xii) Instructions to Bidders
- xiii) Other documents

- 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 discernible 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 Project Manager 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 PROJECT MANAGER 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 Clause 2.1.9 hereof 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 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 PROJECT MANAGER in writing for his decision in resolution of any doubt, ambiguity or contradiction or for the correction of any error or for making good the omission as the case may be.
- 2.1.8 The decision of the PROJECT MANAGER 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.
- 2.1.9 In the event of the CONTRACTOR performing or executing any work or making any supply at variance with the decision of the PROJECT MANAGER as aforesaid, then such work shall, if the PROJECT MANAGER so consider necessary, be deemed to be a defective work/ supply and the provision of Clause 15.0 of GCC and associated clauses there under shall apply thereto.



- 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 PROJECT MANAGER on behalf of the OWNER and CONTRACTOR'S authorized representative as an agreed variation and amendment of the relative term(s) in the CONTRACT documents.
- 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 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 a 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 the specification in response to this NIT.
4. '**BIDDER**' shall mean the firm/party who quotes in response to an invitation to bid, from the OWNER.
5. '**CHANGE ORDER**' means an order by which a change is ordered or other notification made to the CONTRACTOR in accordance with the 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) AIEE Codes
  - d) American Society of Testing of Materials (ASTM) Codes
  - e) Other internationally applicable standards and/or Regulations the subject matter of the CONTRACT.
  - f) Indian Employees Provident Fund Act,
  - g) Pollution Control norms of STATE, INDIA
  - h) Contract Labour
  - i) Minimum Wages Act
  - j) Any other labour laws of INDIA applicable during execution of contract.
  - k) Any other codes/standards specified in the contract documents.
7. '**COMMERCIAL OPERATION**' shall mean the condition of operation in which the complete equipment covered under the CONTRACT is officially declared by the OWNER to be available for continuous operation at different loads up to and including rated capacity after completion of COMMISSIONING as per CONTRACT. Such declaration by the OWNER however, shall not relieve or prejudice the CONTRACTOR any of his obligations under the CONTRACT.
8. '**COMMERCIAL USE**' shall mean that use of the Plant, which the CONTRACT contemplates or of which it is commercially capable.
9. '**COMMISSIONING**' shall mean the putting into operation of Plant by CONTRACTOR with the assistance from OWNER'S Personnel.
10. Deleted
11. '**CONSULTANT**' shall mean the agency nominated/appointed by the OWNER for the project/job/WORKS.
12. The '**CONTRACT**' shall mean the written agreement made between the OWNER and the CONTRACTOR for the execution of the WORK, including all attachments and annexures thereto and all documents incorporated by reference therein.
13. '**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.
14. '**CONTRACT PERIOD**' shall mean the time period (as extended by the OWNER from time to time wherever appropriate) during which the CONTRACT shall be executed as agreed to between CONTRACTOR and the OWNER in the CONTRACT.



15. '**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.
16. '**CONTRACTOR'S SOFTWARE**' means standard Software owned by the CONTRACTOR.
17. '**CONTRACTOR'S WORKS' OR 'MANUFACTURER'S WORKS**' shall mean the place or places of work used by the CONTRACTOR/SUB-CONTRACTOR or their collaborator (s) for the manufacture of EQUIPMENT or performance of WORKS.
18. '**COST**' means the cost properly incurred by the CONTRACTOR in carrying out any of his obligations under the Contract, and 'Costs' shall be construed accordingly.
19. '**DAY**' shall mean a calendar day of 24 hours.
20. Deleted
21. '**DEFECT**' means any work done or any Material or the Plant or any part of it which does not comply with the CONTRACT, provided that such matter shall not be a Defect if it is caused by:
  - a) normal wear and tear;
  - b) a failure by the PURCHASER to operate and maintain the Plant in accordance with any operating and maintenance manuals provided by the CONTRACTOR and/or with good engineering practice;
22. '**DEFECT LIABILITY PERIOD**' shall mean a period of 12 months commencing from the date of PRELIMINARY ACCEPTANCE. CONTRACTOR shall warrant that the equipment and material supplied under the CONTRACT shall be new and free from any defect or deficiency with respect to design, material and workmanship. In the event of any, defect or deficiency arising during the DEFECTS LIABILITY PERIOD, CONTRACTOR shall repair or replace the defective or deficient EQUIPMENT and MATERIALS at its own cost. In such event the DEFECT LIABILITY PERIOD for the particular equipment which is repaired/ replaced shall be extended for another 12 months from the date of acceptance by OWNER of such replaced/repaired equipment/material. However, extended DEFECTS LIABILITY PERIOD shall have an upper limit of 36 months for extended DEFECTS LIABILITY PERIOD, starting from the PRELIMINARY ACCEPTANCE.
23. '**DOCUMENTATION**' means any relevant documents in paper or electronic form, including drawings, technical software, images, designs, manuals or records.



24. '**DRAWINGS**' or , '**PLAN**' shall mean all:

- a) Drawings furnished by the OWNER as a basis for proposals;
- b) Supplementary drawings furnished by the OWNER to clarify and to define in greater detail the intent of the CONTRACT;
- c) DRAWINGS submitted by the CONTRACTOR with his proposal provided such drawings are acceptable to the OWNER.
- d) DRAWING furnished by the OWNER to the CONTRACTOR during the progress of the WORKS; and
- e) Engineering data and DRAWINGS submitted by the CONTRACTOR during the progress of the work provided such drawings are acceptable to the OWNER.

25. '**EFFECTIVE DATE OF CONTRACT**' - The date shall be reckoned as 30 days after date of LOI or 15 days from the date of Work Order whichever is earlier or as specified in the Work Order.

26. '**ENGINEER'S INSTRUCTIONS**' shall mean any drawings and/or instructions in writing, details, directions and explanations issued by the OWNER from time to time during the CONTRACT PERIOD to the CONTRACTOR/ SUBCONTRACTOR for carrying out the WORK.

27. '**EXTENDED PERFORMANCE TEST PERIOD**' has the meaning stated in Clause 18 of Special Conditions of Contract.

28. '**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.

29. '**FINAL ACCEPTANCE**' shall mean that date when all of the conditions set forth in Clause as specified in SPECIAL CONDITIONS OF CONTRACT(SCC) have been satisfied, all liabilities and obligations under this CONTRACT have been discharged, except those specially to be continued or performed after FINAL ACCEPTANCE, and OWNER has issued the FINAL ACCEPTANCE CERTIFICATE to CONTRACTOR.

30 . '**FINAL ACCEPTANCE CERTIFICATE**' shall mean that certificate issued by the PROJECT MANAGER or OWNER to the CONTRACTOR subject to Clause 19 of SCC at the end of the DEFECTS LIABILITY PERIOD.

31. '**FINAL COMPLETION**' shall mean the completion of guarantee tests and handing over of the Plants and facilities to OWNER.

32. '**FINAL PROPOSAL**' means the document containing up to date technical offer of CONTRACTOR and technical information, data, etc., including drawings as agreed to in writing between the CONTRACTOR and OWNER, which is annexed to CONTRACT.

33. '**FORCE MAJEURE**' has the meaning stated in Sub-clause 35.0 of GCC.



34. '**GCC' or GENERAL CONDITIONS OF THE CONTRACT**' shall mean all the terms and conditions forming part of this agreement as defined in the Volume I Attachment 2.
35. '**GUARANTEED COMPLETION DATE**' shall mean the date corresponding to the Complete Time/Completion Schedule from effective date as mentioned at Clause 6.0 of ITB, subject to any extensions expressly provided for within which date CONTRACTOR shall have achieved PRELIMINARY ACCEPTANCE and upon which OWNER has issued the PRELIMINARY ACCEPTANCE CERTIFICATE.
36. Deleted
37. '**INITIAL OPERATION**' shall mean the first integral operation of the complete EQUIPMENT covered under the CONTRACT with sub-systems and supporting equipment in service or available for service and shall be undertaken as part of COMMISSIONING after completion of start-up activities.
38. '**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.
39. '**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.
40. '**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.
41. '**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.
42. "**MECHANICAL COMPLETION**" shall mean completion of erection to such an extent that the Plant is ready for COMMISSIONING. This shall happen when:
  - A) The EQUIPMENT capable of producing to rated capacities are installed, aligned and grouted (wherever applicable) in accordance with drawings, specifications as per finally approved P&I Diagrams after HAZOP Studies and in accordance with all applicable codes, and laws.



- B) All pressure EQUIPMENT are hydrostatically or pneumatically tested once either in CONTRACTOR'S shop or in the field in accordance with Technical Specifications.
- C) Boilers are hydrostatically or pneumatically tested. All non-operating preferring checks are made in accordance with the manufacturer's instructions.
- D) Compressor, Pumps, Machinery etc. are cold aligned. Couplings are assembled and guards installed.
- E) Instruments, control system, instrument cable, safety interlock are installed, inspected and such non-operating checks are made as to ensure operability in the manner required for the process application. Instrument air lines are checked for correct hook up. Air lines are leak tested.
- F) Relief valves are installed, prior to this they should have been checked by the CONTRACTOR in the CONTRACTOR's shop.
- G) Piping is hydrostatically or pneumatically tested in accordance with the specifications. Special treatment such as chemical cleaning is done as required by drawing or specifications. Suction screens are installed and test blinds are removed. Spring support anchors and guide are checked for removal of all shipping locks.
- H) The electric system is installed and tested in accordance with and to the extent required by electrical specifications. All wiring is checked for correct hook up. Motor rotation is checked. All power system protective devices are set.
- I) Insulation and drying out are completed to the extent necessary to permit start of COMMISSIONING and start up.
- J) Pipe support system installed as per drawings.
- K) Painting is completed. EQUIPMENT / MACHINERY, piping duly marked and labelled.
- L) Safety equipment, systems are installed and checked for operations. Cooling Water System are installed and operational.
- M) PRE-COMMISSIONING has been completed.
- N) The Plant is ready to take feed

43 'MONTH' shall mean the calendar month.

44. 'NOTICE OF AWARD OF THE CONTRACT' shall mean the official notice issued by the OWNER notifying the CONTRACTOR that his bid has been accepted, subject to such conditions as may have been stated therein as



Agreed on between CONTRACTOR and OWNER and that the CONTRACTOR is required to sign the CONTRACT Agreement.

45. '**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/ email to the last known private or business address/email 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.
46. '**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.
47. '**OWNER**' shall mean the M/s RVUN having its registered office at Jaipur, Rajasthan.
48. '**PERFORMANCE & GUARANTEE TEST RUN (PGTR)**' shall mean all operational checks and tests required to determine and demonstrate capacity, efficiency and operating characteristics as specified in the CONTRACT documents of the EQUIPMENT by the CONTRACTOR, before the Plant is taken over under guarantee by the OWNER.
49. '**PLANT**' shall mean each of the individual Cooling Water System, as defined in the design basis as per VOLUME-II TECHNICAL.
50. '**PRELIMINARY ACCEPTANCE**' shall mean that following milestones have been achieved
  - (i) MECHANICAL COMPLETION has occurred,
  - (ii) PRE-COMMISSIONING and COMMISSIONING of the Plant have been accomplished,
  - (iii) the sustained load test has been passed,
  - (iv) the Plant has passed all performance tests and is in compliance with all applicable LEGISLATIONS
  - (v) OWNER has accepted the Plant
  - (vi) CONTRACTOR and OWNER agree that the Plant is ready for normal continuous operation
  - (vii) all Government approvals required to operate and maintain the Plant have been obtained by Contractor
  - (viii) OWNER has confirmed that the Plant conforms with the requirement under the WORK
  - (ix) OWNER has received all DOCUMENTS required hereunder for OWNER to start up, operate and maintain the Plant
  - (x) 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
  - (xi) all special tools and spare parts purchased by CONTRACTOR as provided herein have been delivered to OWNER; and



- (xii) CONTRACTOR has completed the training program of OWNERS personnel as required under this CONTRACT.
51. '**PRELIMINARY ACCEPTANCE CERTIFICATE**' shall mean that certificate issued by the PROJECT MANAGER or OWNER to the CONTRACTOR following satisfaction of conditions under PRELIMINARY ACCEPTANCE, the acceptance of which commences the DEFECT LIABILITY PERIOD.
52. "**PRE-COMMISSIONING**" shall mean preparation of Plant so that it is capable of operating on a continuous basis at or near rated capacity for carrying out COMMISSIONING activities.
53. '**PROJECT**' shall mean the Project specified in the Technical specification.
54. **PROJECT MANAGER** shall mean the person designated by the OWNER and shall include those who are expressly authorised by the OWNER to act for and on his behalf for operation of this CONTRACT.
55. Deleted.
56. '**PURCHASER**' shall mean OWNER
57. '**SCC**' or **SPECIAL CONDITIONS OF THE CONTRACT** shall mean all the terms and conditions forming part of this agreement as defined in the Bid Document
58. '**SITE**' shall mean and include the land and other places on, into or through which the EQUIPMENT and related facilities/Plant shall be erected/established 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.
59. '**SOFTWARE**' means all forms of software and firmware and their documentation.
60. '**SPECIFICATION**' shall mean collectively all the terms and stipulations in conditions of the CONTRACT, 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.
61. '**START UP**' shall mean bringing the equipment covered under the CONTRACT from an inactive condition, when construction is essentially complete, to the state ready for initial operation. The start-up shall include preliminary inspection and checkout of EQUIPMENT and supporting sub-



systems; perform calibration and corrective action and chemical cleaning of the Plant/system/equipment covered under the CONTRACT.

62. '**SUB-CONTRACTOR**' 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.
63. '**TAKE OVER', 'TAKING OVER' AND 'TAKEN OVER**' shall mean OWNER taking possession of and use of the Plant following issue of PRELIMINARY ACCEPTANCE CERTIFICATE.
64. '**TEMPORARY WORKS**' means all temporary WORKS and structures of every kind construed at the SITE and required for the provision and construction of the Plant.
65. '**TEST ON COMPLETION**', shall mean all such tests as prescribed in NIT/CONTRACT Documents to be performed by the CONTRACTOR have been carried out satisfactorily.
66. '**THIRD PARTY SOFTWARE**' means standard Software which is owned by a third party.
67. '**TOTAL CONTRACT PRICE' or 'CONTRACT PRICE' or "LUMP SUM PRICE"** shall mean the total price (including Duties, Levies etc and GST) payable to the CONTRACTOR for the full and proper performance of it's contractual obligations under the CONTRACT.
68. '**GST**' means any tax or cess or both imposed on the supply of goods or services or both under GST Law.  
**GST Laws**' means IGST Act, GST (Compensation to the States for Loss of Revenue) Act, CGST Act, respective UTGST Act and respective SGST Act, 2017 and all related legislations, Rules, Notifications, Orders, etc.
69. '**WEEK**' shall mean continuous period of 7 (Seven) DAYS.
70. '**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 TEMPORARYWORKS when no longer required, and any other WORKS to be carried out by the CONTRACTOR in accordance with the CONTRACT.
71. '**WRITING**' shall include any manuscript, typewritten or printed statement, under or over signature and/or seal as the case may be.
72. **NOTICE INVITING TENDER (NIT)** means Tender as originally issued and any addendum/Amendment(s) issued thereafter.
73. **LIQUIDATED DAMAGES (LD)** means the predefined mutually agreed rates between OWNER and CONTRACTOR as detailed in NIT representing the CONTRACTOR's liability (without possibility to recourse at law) for the delay



in achieving GUARANTEED COMPLETION DATE and/or for the failure to meet guaranteed Work Cost Guarantee provided under Article 31 of GCC for reasons attributable to the CONTRACTOR.

74. '**SECURITY CUM PERFORMANCE BANK GUARANTEE**' shall mean a bank guarantee to be furnished by CONTRACTOR in the format attached herewith and further described in Clause 8 herein below.

75. '**SUB-CONTRACT**' shall mean any subcontract issued by CONTRACTOR after acceptance of its BID for the execution of WORKS.

76. '**NOTICE INVITING TENDER (NIT) / BIDDING DOCUMENT /**' means Tender Documents issued originally along with subsequent Addendum / Amendment(s), if any, issued thereafter.

#### **4.0 CONTRACT CONFIRMATION**

4.1 Within fifteen (15) days from date of receipt of the CONTRACT, CONTRACTOR shall sign the CONTRACT and return it to the OWNER. The copy of the CONTRACT shall be signed by an authorised officer of the CONTRACTOR in whose name Power of Attorney has been issued.

4.2 After CONTRACT confirmation/signing, the terms and conditions contained therein take precedence over CONTRACTOR's bid conditions and all previous correspondence.

4.3 If after award of CONTRACT, the CONTRACTOR does not acknowledge receipt of award of CONTRACT and/or fails to deposit the SECURITY CUM PERFORMANCE BANK GUARANTEE within the time period specified in the CONTRACT, the OWNER reserves the right to cancel the CONTRACT and forfeit the EMD without prejudice to various rights and remedies the OWNER may be entitled to as per terms and conditions of CONTRACT and without being liable in any manner whatsoever to the CONTRACTOR.

#### **5.0 MODIFICATIONS IN CONTRACT**

5.1 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 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 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, or pursuant to mutual agreement.

5.2 OWNER shall not be bound by any printed conditions, provisions in the CONTRACTOR'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.

**6.0 USE OF CONTRACT DOCUMENTS AND INFORMATION**

- 6.1** 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.
- 6.2** 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.
- 6.3** 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.

**7.0 PATENT INFRINGEMENT AND INDEMNIFICATION****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 and/or any other process licensor's processes used in Plant will not infringe any valid patent rights of a third party. However, if at any time such infringement arises, CONTRACTOR agrees to keep OWNER indemnified and harmless against such claims and costs thereof and make arrangements that will allow OWNER to continue the operation of Plant.
- 7.1.3** OWNER shall promptly advise CONTRACTOR in writing of any claim of infringement or any action for infringement of patents brought against it by a third party and based upon the use of CONTRACTOR's Technical Information. If such use is in accordance with instructions given in writing by CONTRACTOR, CONTRACTOR shall undertake the defence, or assist OWNER in the defence, of the claim or suit up to final judgment or settlement.



- 7.1.4** CONTRACTOR shall undertake the defence on behalf of OWNER and shall have sole charge and direction of the defence, and shall bear all costs related thereto. CONTRACTOR shall further hold OWNER harmless from any damages or other sums that may become payable by OWNER under a final judgment or settlement. However, OWNER shall render to CONTRACTOR all reasonable assistance that may be required by CONTRACTOR in the defence, and shall have the right to be represented therein by advisory counsel of its own selection and at its own expense.
- 7.1.5** In addition to the measures specified in 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.
- 7.1.8** Notwithstanding any other provisions under this CONTRACT, the liabilities arising on account of patent infringement shall be unlimited and all costs to these liabilities shall be borne by CONTRACTOR.

## **7.2 INDEMNITIES**

### **7.2.1 INDEMNIFICATION FOR LIABILITIES**

#### **7.2.1 CONTRACTOR Indemnification for Liabilities**

To the fullest extent permitted by Law, CONTRACTOR assumes liability for, and agrees to indemnify, protect, save and hold harmless OWNER from and against any and all Liabilities (including, any strict liability), of whatsoever kind and nature 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 (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 .



However the CONTRACTOR shall indemnify the owner 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 after PRELIMINARY ACCEPTANCE. CONTRACTOR shall ensure that in addition to "Erection All risk policy" the coverage in respect of workmen compensation, Mediclaim Policy, Professional Indemnity (with the amount of minimum excess) has been appropriately taken.

#### **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 except GST, shall be deemed to be included in TOTAL 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 help in obtaining permits for CONTRACTOR's personnel to undertake any WORK in connection with CONTRACT.

#### **7.2.6 Mechanics Lien**

CONTRACTOR agrees to indemnify and hold harmless OWNER against all labourer's material, man's and/or mechanic's liens arising from its work, and shall keep the premises of OWNER free from all such claims, liens and encumbrances.

**8.0 SECURITY CUM PERFORMANCE BANK GUARANTEE**

- 8.1** As a Contract Security, a successful Bidder, to whom the work is awarded, shall be required to furnish Security cum Performance Bank Guarantee(s) in the form attached as Annexure-1.11 within the timeline specified at Clause 8.1.1 of GCC. These Bank Guarantee(s) shall be an irrevocable Bank Guarantee, issued by any Nationalised / Scheduled Bank of RBI on a non-judicial stamp paper of appropriate value and it shall guarantee the faithful performance of the CONTRACT in accordance with the terms and conditions specified in these documents and specifications.
- 8.1.1** The Bidder is required to furnish:
- 1 (one) no. CPBG shall be for Cooling Water System. The Bank Guarantee amount shall be equal to three per cent (3%) of the Total CONTRACT PRICE. The Contractor shall be required to furnish this CPBG in the form attached as Annexure-1.11 within thirty (30) days of issuance of Work Order. The Performance Bank Guarantee shall be valid for a period till Preliminary Acceptance of Cooling Water System & Completion of Defect Liability period plus a claim period of 180 days.
- 8.1.2** In case of breach of contract the guarantee amount shall be encashed by the Owner without any conditions whatsoever.
- 8.1.3** Failure of the successful Bidder to comply with the requirement of Clause 8.1 hereof shall constitute sufficient grounds for forfeiture of Bid Security/EMD without prejudice to its rights and remedies as set forth in this NIT or otherwise in law.
- 8.2** The proceeds of SECURITY CUM PERFORMANCE BANK GUARANTEE 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.
- 8.3** The SECURITY CUM PERFORMANCE BANK GUARANTEE shall be denominated in the currency/currencies of the CONTRACT.
- 8.4** The SECURITY CUM PERFORMANCE BANK GUARANTEE in the form of a bank guarantee shall be valid for the duration upto the completion of DEFECT LIABILITY PERIOD plus six (06) months. The SECURITY CUM PERFORMANCE BANK GUARANTEE 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 SECURITY CUM PERFORMANCE BANK GUARANTEE will be invoked by the OWNER against the failure of CONTRACTOR in performing it'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 SECURITY CUM PERFORMANCE BANK GUARANTEE 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 SECURITY CUM PERFORMANCE BANK GUARANTEE, then the CONTRACTOR shall arrange to get the SECURITY CUM PERFORMANCE BANK GUARANTEE extended for the period asked for by OWNER. In case SECURITY CUM PERFORMANCE BANK GUARANTEE 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 SECURITY CUM PERFORMANCE BANK GUARANTEE. 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 CONTRACT shall be deemed to be 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 SECURITY CUM PERFORMANCE BANK GUARANTEE whole or part of the value of SECURITY CUM PERFORMANCE BANK GUARANTEE. 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 SECURITY CUM PERFORMANCE BANK GUARANTEE shall be refunded after CONTRACT has been successfully completed and certificate to this effect has been issued by OWNER. It shall be lawful for OWNER if any differences or dispute is likely to arise to defer payment of the SECURITY CUM PERFORMANCE BANK GUARANTEE or any portion thereof which may be due for release until such differences and dispute has been finally settled or adjusted. SECURITY CUM PERFORMANCE BANK GUARANTEE amount shall not bear any interest.

**NOTE**

- 1) Any bank guarantee such as SECURITY CUM PERFORMANCE BANK GUARANTEE shall be issued by any Nationalised/Schedule Bank of RBI.
- 2) The non-judicial Stamp paper of appropriate value prevailing in the State of Rajasthan of the CONTRACTOR shall have to be purchased in the name of the bankers executing the bank guarantee and not in the name of the CONTRACTOR.

**9.0 CONTRACT AGREEMENT**

- 9.1** The Bidder who is awarded the Contract will be required to execute the contract as per General Conditions of Contract on a non-judicial stamp of requisite value as per Rajasthan government rules at his cost. On acceptance of the BID, the BIDDER shall be informed about it and he will be required to give his acceptance in writing within 15 (fifteen) days. Thereafter a contract agreement shall be executed between the OWNER and the BIDDER and signed within 15days of acceptance by the BIDDER. The EFFECTIVE DATE of the CONTRACT shall be as per ITB Clause 6.0. Until a formal contract is executed, Work Order or LOI shall constitute a binding contract. In the event of failure of the Bidder to execute the Contract within notice period from the date of receipt of acceptance of his Bid, the full Bid security deposited, shall stand forfeited and shall at once be payable to the Rajasthan Rajya Vidyut Utpadan Nigam Ltd., Acceptance of his Bid will be withdrawn unless the period is extended by mutual agreement in writing.



- 9.2** The CONTRACT will be signed in triplicate, one copy each for CONTRACTOR, OWNER's Head Office and SITE office. All expenses for the preparation and stamping of CONTRACT shall be borne by the CONTRACTOR.
- 10.0 MANNER OF EXECUTION OF CONTRACT**
- 10.1** All documents as per Clause 2.0 of GCC shall be included in the CONTRACT document and detailed specifications be inserted as mutually agreed between OWNER and CONTRACTOR.
- 10.2** Every page of the CONTRACT agreement shall be initialled by the authorised representatives of OWNER and CONTRACTOR under the Seal of their respective Companies.
- 10.3** The CONTRACT agreement shall be prepared on stamp paper as per specified Form of Contract as per Annexure- 1.14.
- 10.4** The CONTRACTOR shall present the above CONTRACT so prepared in three copies along with proper power of attorney and other requisite material on the day of signing the agreement.
- 10.5** One signed copy shall be returned to CONTRACTOR while the other two including the original shall be retained by OWNER.
- 10.6** Deleted
- 10.7** Notwithstanding anything mentioned in any other clause, any conditions imposed from time to time by Government of India/Rajasthan shall be followed by the CONTRACTOR.
- 11.0 EFFECTIVENESS AND JURISDICTION OF CONTRACT**
- 11.1** The CONTRACT shall be considered as having come into force from the EFFECTIVE DATE of the CONTRACT.
- 11.2** The laws applicable to this CONTRACT shall be the laws in force in India/Rajasthan from time to time and shall be subject to the jurisdiction of the Court in Jaipur.
- 12.0 ASSIGNMENT OR SUBLetting OF CONTRACT AND SUB-CONTRACTING**
- 12.1** Neither CONTRACTOR nor OWNER shall assign CONTRACT or any part of it or any share of interest therein, without the prior written consent of the other Party. This consent shall not be unreasonably denied.
- 12.2** CONTRACTOR shall not subcontract the whole or any part of WORK without the prior written consent of OWNER provided always that CONTRACTOR may subcontract any part of WORK to any of its affiliates or subsidiaries in which event CONTRACTOR shall remain fully responsible to OWNER for the WORK performed by such affiliates or subsidiaries.

**12.3 Sub-Contracts and Purchase Orders****12.3.1 General**

All vendors, suppliers, consultants and SUB-CONTRACTORS 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 "SUBCONTRACTORS"/ "VENDORS", and any such SUBCONTRACTS, purchase orders and similar purchase forms and arrangement entered into by or on behalf of CONTRACTOR with SUB CONTRACTORS/VENDORS are herein referred to as "SUBCONTRACTS" provided that none of OWNER's CONTRACTORS or SUBCONTRACTORS shall be deemed to be a SUBCONTRACTORS under of the CONTRACTOR. The CONTRACTOR shall be obligated to select SUBCONTRACTORS it retains in connection with the performance by CONTRACTOR of the WORK from a SUBCONTRACTORS list which would be finalised and approved by the OWNER in the FINAL PROPOSAL. 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 SUBCONTRACTOR.

**12.3.2 Approval of Major SUB-CONTRACTOR/VENDOR**

12.3.2.1 The vendor list for procurement of EQUIPMENT and the list of SUB-CONTRACTOR shall be as attached in the NIT. Any changes/ Additions to such list of VENDOR/SUBCONTRACTOR shall require the prior approval of OWNER. CONTRACTOR shall provide name, address, fax/telex number and name of contact person of major VENDOR/SUBCONTRACTOR for use in future, to OWNER. VENDORS, SUBCONTRACTORS as per agreed vendor list are not subject to approval.

12.3.2.1.1 A. Deleted.

B. As it is not possible to ascertain credentials of all the vendors suggested by BIDDERS at his stage, following prequalification criteria, shall be adopted:

The BIDDER should specify, while pre-qualifying the vendors, that during the past 15 years the vendor should have supplied at least two similar Plant equipment or machinery. The BIDDER should satisfy themselves that sufficient documentary proof is submitted by the vendors in support of this criterion. The BIDDER 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 SUBCONTRACTOR's/ VENDOR List or as to CONTRACTOR's entering into any SUBCONTRACT / 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 SUBCONTRACT 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 SUBCONTRACTORS/ 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 coordinating the work of SUB-CONTRACTORS/ VENDORS.
- (c) If CONTRACTOR fails to correct, or commence to correct and prosecute the correction with due diligence of deficient or defective work performed by any SUBCONTRACTOR/VENDOR 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/VENDORS to perform the SUB-CONTRACTS in accordance with the relevant requirements of the CONTRACT including FINAL PROPOSAL, all LEGISLATIONS/ applicable laws and applicable permits, prudent utility practice, good engineering practices, the requirements of the NIT, and all Warranties of SUB-CONTRACTORS/VENDORS and Manufacturers and all insurance policies relating to the Plant or the WORK.
- (e) CONTRACTOR shall be solely responsible for paying each SUBCONTRACTOR/ VENDOR and any other person to whom any amount is due from CONTRACTOR for services, equipment, construction equipment, materials or supplies otherwise related to or in connection with 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/VENDORS such directives and impose such restrictions as may be required to obtain such compliance herewith and with the terms of the SUBCONTRACTS.



#### 12.3.2.4 SUB-CONTRACTOR/VENDOR and Manufacturer Warrantee

- (a) CONTRACTOR shall, ensure that all equipment and other items used in connection with the performance of the WORK or incorporated in the Plant will be purchased in compliance with CONTRACT Technical Specification and Requirements in order to allow the Plant to achieve the Guarantee and Warrantee as provided for in the CONTRACT, unless otherwise agreed with Owner. Any residual warranty from sub-CONTRACTOR/vendor shall be passed to the OWNER after expiry of DEFECT LIABILITY PERIOD.
- (b) Neither CONTRACTOR nor its SUBCONTRACTORS/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/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 professional judgement enforce all guarantees and warranties provided hereunder to the fullest extent thereof till such time they are transferred to the OWNER pursuant to sub-clause (g) below.
- (e) Upon the expiration or termination of any of the guarantees or warranties provided by CONTRACTOR pursuant to the CONTRACT, the CONTRACTOR shall assign, and hereby assigns, effective as of such date, or otherwise make available, to OWNER all of CONTRACTOR's rights under all such SUBCONTRACTOR's residual Guarantees and warrantee as per 12.3.2.4(a) & (b) (except to the extent CONTRACTOR has thereof provided warranty services to OWNER and is enforcing CONTRACTOR's rights with respect to such services under the applicable guarantee or warranty) and shall deliver to OWNER copies of all contracts providing for such guarantees and warranties.
- (f) CONTRACTOR, in accordance with the CONTRACT, shall require all SUBCONTRACTORS/ VENDORS to be covered by the insurance specified in the CONTRACT, during the time in which they are engaged in performing WORK.
- (g) CONTRACTOR shall require all SUB-CONTRACTORS/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 or 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 SUBCONTRACTORS/ 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 SUBCONTRACTOR

The review by and approval and consent of, OWNER as to the approved SUBCONTRACTORS 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/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 SUBCONTRACT 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/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/ VENDOR shall be pursuant to an appropriate SUB-CONTRACT, PURCHASE ORDER or similar agreement which shall, as appropriate, contain provisions that:
- 12.3.3.1 Preserve and protect all the rights of OWNER here under for WORK to be performed or EQUIPMENT to be supplied under PURCHASE ORDER or SUB-CONTRACT.
- 12.3.3.2 Require that such WORK be performed or EQUIPMENT be fabricated, supplied and installed in strict accordance with the applicable requirements of this CONTRACT.
- 12.3.3.3 Obligate such SUB-CONTRACTOR/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/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.



12.3.3.5 Include a price list (which shall be valid for a period of at least for 12 months from the date of COMMISSIONING) covering all mandatory spares and replacement parts relating to the subject matter of such PURCHASE ORDER or SUB-CONTRACT.

### 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 SUBCONTRACTOR/ VENDOR to perform or any disagreement between any SUBCONTRACTOR/ VENDOR or between any SUBCONTRACTOR/VENDOR and CONTRACTOR. CONTRACTOR shall furnish such information relative to its SUBCONTRACTOR/ VENDOR (including copies of unpaid SUB-CONTRACT or PURCHASE ORDER) as OWNER may request.

### 12.3.5 Damages

12.3.5.1 It is within the discretion of CONTRACTOR, that CONTRACTOR shall agree to hold all SUBCONTRACTOR/ 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 and WORK performed under this CONTRACT shall conform to the standards mentioned in the technical specifications and when no applicable standard is mentioned, the standards shall conform to International Standards proposed by the BIDDER and approved by the OWNER. "

## 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, excepting what is herein provided, be given by OWNER/ CONSULTANT
- B) All the work shall be carried out under the direction of OWNER and according to the CONTRACT requirements.
- C) All communications including technical/ commercial clarifications and/ or comments shall bear reference to the CONTRACT.
- D) Invoice for payment against CONTRACT shall be addressed to OWNER.
- E) The CONTRACT number shall be shown on all invoices, communications, packing lists, containers and bills of lading etc.

**15.0 INSPECTION, TESTING AND EXPEDITING**

- 15.1** The OWNER or his representatives shall have their right to inspect and/or to test the – EQUIPMENTS, MATERIALS and WORK to conform to the specifications laid down in the CONTRACT. The SPECIAL CONDITIONS OF CONTRACT and/or the TECHNICAL SPECIFICATIONS shall specify what inspections and test the OWNER require and where they are to be conducted. The OWNER shall notify the CONTRACTOR in writing of the identity of any other representatives 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.
- 15.2** The inspections and tests may be conducted on the premises of the CONTRACTOR or its SUB-CONTRACTOR at any stage of completion and/or at the goods final destination. When conducted on the premises of the CONTRACTOR or his SUBCONTRACTOR, all reasonable facilities and assistances including access to drawings and production data shall be furnished to the inspector at no charge to the OWNER.
- 15.3** 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 above mentioned institutions will not be considered a case 'f Force Majeure'. In case of the EQUIPMENT, MATERIALS and /or WORKS fail to pass the inspection performed by OWNER or by INSPECTOR and re-inspection is to be carried out, then any cost be incurred by OWNER or INSPECTOR for carrying out such re-inspection shall be borne and paid by CONTRACTOR, any delay due to failure of such re-inspection shall be to the account of CONTRACTOR and shall not become a reason for extension of time.
- 15.4** 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.
- 15.5** Copies of all test results/report of the tests shall be furnished promptly by the CONTRACTOR to the OWNER.

**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 to meet the GUARANTEED COMPLETION DATE quoted in months from the date of notification of award.



- 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, construction erection & COMMISSIONING.
- 16.1.3 The original issue and subsequent revisions of CONTRACTOR's time schedule and or SUBCONTRACTORS' time schedules shall be sent in four copies (of which one shall be reproducible) 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. / MS Projects (latest version), acceptable to the OWNER.
- 16.2 Progress Trend Chart/Monthly Report**
- 16.2.1 CONTRACTOR shall report fortnightly to OWNER, the progress of the execution of CONTRACT and achievement of targets set out in time bar chart.
- 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 Deleted.
- 16.2.8 Deleted
- 16.2.9 The time for completion and phased time schedule shall be subject to and in accordance with the provision of Sub-Clauses 16.2.10, and 16.2.12 below.
- 16.2.10 Neither OWNER nor CONTRACTOR shall be considered in default in performance of their obligations if such performance is prevented or delayed by FORCE MAJEURE conditions as stated in Clause 35.0.
- 16.2.11 Deleted.
- 16.2.12 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 GUARANTEED COMPLETION DATE, the provisions of Clause 34 of GCC shall apply.



**17.0 CONTRACTOR TO INFORM HIMSELF FULLY**

**17.1 CONTRACTOR to Inform Himself**

17.1.1 The CONTRACTOR shall be deemed to have carefully examined the specification thoroughly and to have removed any doubts he may have had as to the meaning of the Specification and in addition to have fully informed himself as to the SITE and local conditions affecting the carrying out of the CONTRACT and to have made due allowance in his offer. If he shall have any doubt as to the meaning of any portion of the CONTRACT documents, he shall, at the time of BID submit the particulars in writing to the OWNER. The OWNER will provide necessary clarifications in WRITING to the CONTRACTOR. The soil investigation report furnished in the technical part is to be considered for preparation of bid.

**17.2 Discrepancies in Documents**

17.2.1 If the CONTRACTOR finds any discrepancies between the SPECIFICATION, drawings or schedules he shall immediately refer them to the OWNER for decision. Figured dimensions on the drawings shall be followed. Dimensions shall not be scaled unless permission is given in writing by the OWNER.

17.3 Any information otherwise obtained from the OWNER shall not in any way relieve the CONTRACTOR of his responsibility to fulfil his obligations under the CONTRACT.

**18.0 SUITABILITY OF PLANT FOR INTENDED PURPOSE**

18.1 It is a condition of the CONTRACT and the CONTRACTOR warrants that the Plant will be suitable in all respects for the purpose mentioned or inherent in the specification.

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 fifteen (15) days after receipt of any requirement or direction of OWNER which he considers will render the PLANT unsuitable in any respect or is not in accordance with the meaning and intent of the CONTRACT otherwise prevent the CONTRACTOR from carrying out the CONTRACT 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 decision and the decision shall become final and binding.

**19.0 FEES FOR ROYALTIES AND PATENT RIGHTS****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.

**19.2 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 COMPLIANCE WITH LAWS, 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 from owner. If the CONTRACTOR does not receive such instructions from owner within thirty (30) days, he shall conform to those requirements and inform the OWNER accordingly.

**20.2 Notices and Fees**

The CONTRACTOR shall give all notices required to be given by the Acts, regulations, bye-laws, orders and requirements referred to in sub-clause 20.1 of this clause and shall pay all fees payable in connection herewith.

**21.0 TIME - PROJECT SCHEDULE**

21.1 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 the utmost importance. The CONTRACTOR shall so organise his resources and perform his work as to complete it not later than the date agreed to.



**21.2** The CONTRACTOR shall submit the schedule in MS Projects within thirty (30) days or as specified elsewhere after EFFECTIVE DATE of the CONTRACT. The MS Project level 3 pert 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 and (iv) PRE-COMMISSIONING, COMMISSIONING, sustained load test ,testing. BIDDER shall be contractually obliged to issue a primavera level 3 pert 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  
**21.3** The above PERT network / Bar Chart shall be periodically reviewed and reports shall be submitted by the CONTRACTOR as directed by the OWNER.

**21.4** CONTRACTOR shall give the WORK the highest priority and no other work of CONTRACTOR shall take precedence over the WORK, nor shall CONTRACTOR make any allocation of its resources which would have the effect of delaying the timely performance of the WORK.

## **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) Deleted
- b) Residual Basic Engineering and Detailed Engineering
- c) Supply of all PLANT, Equipment, Bulk Materials, consumables, Chemicals, Lubricants, etc.
- d) Supply of spares as per Volume-II-Technical
- e) Civil and Structural WORKS,
- f) Custom Clearance, Port Handling and onward despatch to SITE and forwarding charges,,
- g) Freight up to SITE,
- h) Unloading, storage at SITE, SITE Assembly, Civil/Structural Work, Erection, PRE-COMMISSIONING and COMMISSIONING until Preliminary Acceptance Of Plant.
- i) Insurance.
- j) All duties, Levies, Custom Duty etc. including but excluding GST, as applicable in India and outside India for execution of work and for supply of goods & services under CONTRACT
- k) Inspection and expediting charges
- l) Project management and overheads,
- m) Guarantee test runs and handing over of Plant to OWNER.
- n) All other costs, expenses and outgoings of the CONTRACTOR not otherwise expressly set forth herein necessary, required or incidental to the full, complete and proper performance and discharge of the CONTRACTOR's obligations under and in accordance with the CONTRACT including completion of the Plant in all respects and overheads of the CONTRACTOR.
- o) All the costs related to obtaining all statutory clearances required for the execution of the PROJECT and completion of the PROJECT till the PRELIMINARY ACCEPTANCE of the PLANT By OWNER.



- p) The other costs not mentioned but necessary for the completion of the scope as per NIT/CONTRACT conditions.

- 22.2** OWNER shall pay to CONTRACTOR a Lump-sum / Unit Rate Basis as applicable, 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. The CONTRACT PRICE is fixed and firm and not subject to any escalation during the contract period unless and otherwise specified in the CONTRACT documents.
- 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 and their agents 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** The lump-sum price quoted by the CONTRACTOR in his bid with additions and deletions as may be agreed upon before signing of the CONTRACT, for the entire scope of the work as indicated in Clause 2.0 of ITB and Clause 1.0 of GCC.
- 22.6** The price quoted shall be firm and fixed without any escalation whatsoever on any account except the statutory variations in Taxes or introduction of any new taxes, duties, cesses levied by the Government of India/ Rajasthan, within GUARANTEED COMPLETION DATE and otherwise specified in the CONTRACT.
- 22.7** Deleted.
- 22.8** The prices indicated for spare parts in the item wise lists shall be fixed and not subject to any escalation.

### **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. Income Tax including withholding tax (if any) along with surcharge of Income Tax & cess as applicable at the prevailing rate on the gross amount billed shall be deducted from the CONTRACTOR'S bill as per applicable laws and price quoted by BIDDER shall be deemed to include the same.

**24.0 DELETED****25.0 PAYMENT TERMS**

**25.1** The payment to CONTRACTOR for the performance of the WORKS under the CONTRACT will be made by OWNER as per the guidelines & conditions specified herein in VOLUME-I of Attachment-3.0 i.e. SPECIAL CONDITIONS OF CONTRACT.

**25.2 Schedule of Payment**

The CONTRACTOR shall submit within 30 days of the EFFECTIVE DATE OF CONTRACT a billing schedule which is to be approved by the OWNER. The CONTRACTOR shall submit one progressive bill every month based on the billing schedule duly certified by OWNER with related documents.

**25.3 Due Date for Payment**

OWNER will make progressive payments as and when the payment is due as per the terms of payment set forth in the CONTRACT. Payment will become due and payable by OWNER within due course of time provided the documents submitted are complete in all aspects and are submitted as per billing schedule. The monthly invoice shall be submitted for certification of OWNER's Representative as per the mutually agreed Billing schedule. The monthly invoice shall be in a form mutually agreed between OWNER and CONTRACTOR and shall provide the details of the supplies or services performed within the provisions of GST Laws. Each Monthly Invoice shall be accompanied with a certification by CONTRACTOR as to the invoice's truth and accuracy and should be signed by the CONTRACTOR Project Manager. Each Monthly Invoice shall set forth the gross amount due to CONTRACTOR in respect of the WORK done and the net amount to be paid after adjusting Mobilisation Advance and any LD under this CONTRACT due to OWNER and any other amounts owed by CONTRACTOR to OWNER. In the event the Monthly Invoice submitted by CONTRACTOR is not accompanied by all relevant and requisite documents, details, and such items as required under this CONTRACT, OWNER shall return such incomplete invoice. In the event OWNER has an objection in a monthly invoice or a portion of such invoice, OWNER shall notify CONTRACTOR of such objection within fifteen (15) days following OWNER's receipt of such Monthly Invoice. OWNER shall pay to CONTRACTOR any amount of such invoice that is not in dispute. However the last payment shall not become due until CONTRACTOR has furnished to OWNER (i) certification that CONTRACTOR has fulfilled all of its obligations under this CONTRACT through such date. The last payment shall be made within ninety (90) days (as per the provisions of sub-clause 56.4.5) after receipt by OWNER of the last invoice, complete in all respects.

**26.0 TAXES, PERMITS & LICENCES**

The CONTRACTOR shall be liable and pay all taxes, duties, levies, lawfully assessed against the OWNER or the CONTRACTOR or the SUBCONTRACTOR in pursuance of the CONTRACT. The CONTRACTOR shall be solely responsible



for all taxes that may be levied on the CONTRACTOR'S turnover & profit or on the earnings of any of his employees or personnel engaged by him and shall hold the OWNER indemnified and harmless against any claims that may be made against the OWNER in this behalf. The OWNER does not undertake any responsibility whatsoever regarding any taxes levied on CONTRACTOR and/or his personnel/sub-CONTRACTOR 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.

**26.1** Deleted

**26.2** Deleted

**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/trailor 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. CONTRACTOR shall follow the guidelines of Ministry of Road Transport and Highways (MORTH), India, for the shipping/transportation of the all packages/ consignments.

**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, MATERIALS & machineries etc.



- 27.6** The CONTRACTOR shall be solely responsible for generation of E-way bills, wherever applicable, for all the packages and containers as required under the GST Laws. All packing material shall be property of RVUN.
- 28.0 INSURANCE**
- 28.1** CONTRACTOR shall take in the joint name of CONTRACTOR and OWNER for 100% replacement value, comprehensive transit insurance for imported and indigenous goods. Transit-cum-Storage-Erection or its equivalents and third party liability insurance policies with reputed underwriters to cover ALL RISK whatsoever during the whole period starting with dispatch of GOODS from CONTRACTOR's warehouses/ Ex WORKS in foreign country to CIF port of shipment for imported GOODS and EXW at CONTRACTOR's WORKS for indigenous GOODS and shall further cover for performing services in India for transportation, loading, unloading, assembly, erection, testing COMMISSIONING of PLANT till PRELIMINARY ACCEPTANCE.
- 28.1.1 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 part 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.
- a. Workmen's Compensation Insurance to the limit to which compensation may be payable under the laws of Govt. of Rajasthan/ Republic of India.
  - b. Third Party Insurance for body injury and property damage to the limit of not less than Rs. 10,00,000/- (Rupees Ten Lakh Only) in accident at each job site and to a limit not less than Rs 1,00,00,000/- (Rupees One Crore Only) for all accidents at all job sites. Provided that the limits specified above shall operate only as a specification of minimum limits for insurance purposes, but shall not anywise limit the CONTRACTOR'S liability in terms of this clause or otherwise to the limit(s) specified.
- 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 including marine insurance 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 up to 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/ CONTRACTOR's WORKS to SITE.
2. Erection and All Risk (EAR) Insurance
3. Third Party Liability Insurance

Marine Cargo Insurance and Third Party Liability Insurance can be a part of Global Policy of the CONTRACTOR. However certificate of endorsement in favour of OWNER shall be provided by the CONTRACTOR from the insurance company. These two global policies of Marine Cargo Insurance and Third Party Liability Insurance shall be counter guaranteed by Indian Insurance Company. However, Erection and All Risk (EAR) is to be covered from Insurance Company registered in India and shall be separate dedicated policies for OWNER.

**28.5** Any loss or damage to the EQUIPMENT during handling, transportation, storage, erection, putting the EQUIPMENT into satisfactory operation and all activities to be performed till the successful completion of trial operation of the PLANT shall be to the account of the CONTRACTOR. The CONTRACTOR shall be responsible for reference of all claims and make good the damages or loss by way of repairs and/or replacement of the equipment, damaged or lost. The transfer of title shall not in any way relieve the CONTRACTOR of the above responsibility during the period of CONTRACT. 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** License /facilities, to the extent it remains the responsibility of the OWNER, in respect of supplies to be made by the foreign CONTRACTOR from outside India required for purposes of replacement of equipment lost in transit and /or during erection and /or during storage shall be made available by the OWNER. CONTRACTOR shall however, be required to follow the procedure as may be laid down by the Owner to facilitate him arranging such license /facilities. 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 OWNERS. The workman compensation policy taken by the SUB-CONTRACTOR of the CONTRACTOR shall be passed on to the OWNER.

**28.7** All cost on account of insurance liabilities covered under the CONTRACT will be to the CONTRACTORs account and will be included in the TOTAL CONTRACT PRICE. The CONTRACTOR, while arranging the insurance, shall ensure to obtain all discounts on premium, which may be available for higher volume or for reason of financing arrangement of the project.

**28.8** Irrespective of single or separate insurances, the CONTRACTOR shall take the same in the joint name of CONTRACTOR and OWNER, with CONTRACTOR as primary beneficiary and OWNER 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.

**29.0 GUARANTEES / DEFECT LIABILITY PERIOD**

**29.1** It shall be a condition of the CONTRACT and the CONTRACTOR shall guarantee that the PLANT shall achieve the requirement as set forth herein and as per Volume-II, Technical of NIT shall form part of the CONTRACT.

**29.2** The CONTRACTOR shall guarantee that the PLANTS, EQUIPMENT, MATERIALS and machineries will be new and in accordance with the CONTRACT documents and free from defects in design, material & workmanship and shall give DEFECT LIABILITY PERIOD of Twelve (12) calendar months commencing immediately upon PRELIMINARY ACCEPTANCE as specified in SCC. The CONTRACTOR's liability shall be limited to the replacement of any defective parts in the equipment of his own manufacture or those of his SUBCONTRACTOR or re-performance of the WORK under normal use and



arising from faulty design, materials and/ or workmanship provided always that such defective parts are not repairable at the SITE and are not in the meantime essential in the commercial use of the PLANT. Such replaced defective parts shall be returned to the CONTRACTOR unless otherwise arranged.

- 29.3** After the issue of the PRELIMINARY ACCEPTANCE CERTIFICATE, 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.
- 29.4** Deleted
- 29.5** Deleted
- 29.6** 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.
- 29.7** The acceptance of the equipment by the OWNER shall in no way relieve the CONTRACTOR of his obligation under this clause.
- 29.8** In the case of those defective parts which are not repairable at SITE but are essential for the commercial use of the equipment and machineries, the CONTRACTOR shall mutually agree to a programme of replacement or renewal which will minimise interruption to the maximum extent, in the operation of the equipment and machineries.
- 29.9** At the end of the DEFECTS LIABILITY PERIOD or the extended DEFECTS LIABILITY PERIOD, the CONTRACTOR's liability ceases. In respect of goods/ EQUIPMENTS supplied by the SUB-CONTRACTORS to the CONTRACTOR where a long guarantee (more than 12 months) is provided by such CONTRACTORs, the OWNER shall be entitled to the benefit of such longer guarantees.
- 29.10** 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.
- 29.11** The provisions of Clause 48 of GCC including the cost of transport, insurance etc. shall be implemented at the CONTRACTOR's expenses.
- 29.12** Deleted



### 29.13 Guarantees for Time of Completion

The CONTRACTOR shall guarantee the date of PRELIMINARY ACCEPTANCE of the WORKS calculated from the EFFECTIVE DATE OF CONTRACT, for the purpose of determining pre-determined LIQUIDATED DAMAGES on account of delay in GUARANTEED COMPLETION DATE. No damages will be levied on account of delay in GUARANTEED COMPLETION DATE for the reasons not attributable to the CONTRACTOR.

### 29.14 Performance Guarantees

CONTRACTOR shall guarantee the performance of PLANT as specified in the Technical Documents Volume II, Technical.

### 29.15 Design and Vendors'/ Sub-Contractors' Guarantees

- 29.15.1 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.
- 29.15.2 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 12 (Twelve) MONTHS from the date of PRELIMINARY ACCEPTANCE of PLANTS.

## 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 guarantee tests.
- 30.2 The CONTRACTOR shall indemnify the OWNER in respect of all damage or injury to any person or to any property (other than property forming part of the Work) and against all actions, suits, claims, demands, costs, charges and expenses arising in connection therewith which shall have been occasioned by the negligence of the CONTRACTOR or any SUB-CONTRACTOR, or by defective design (other than a design made, furnished or specified by the OWNER and which the CONTRACTOR has disclaimed responsibility in writing within a reasonable time after receipt of the OWNER's instructions) material or workmanship, any breach of the CONTRACTOR's obligations.

**31.0 LIQUIDATED DAMAGES (LD)****31.1 For Delay in Completion**

- 31.1.1 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 and more defined in Clause 21 hereinabove. The CONTRACTOR declares that he has familiarised himself with the SITE and rights of way, ground conditions, with all the local conditions, and with all the circumstances which may or are likely to affect the performance and completion of the WORK and that he has allowed for such conditions in the preparation of this schedule. The progress of work shall be checked at regular monthly intervals and the percentage progress achieved shall be commensurate with the time elapsed after the award of the CONTRACT.
- 31.1.2 However, it is not incumbent upon the PROJECT MANAGER 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.
- 31.1.3 The time stipulated in the CONTRACT for the execution and completion of the WORKS is the essence of CONTRACT and shall be deemed to be of utmost importance of the CONTRACT. In the event the CONTRACTOR fails to achieve the PRELIMINARY ACCEPTANCE within the GUARANTEED COMPLETION DATE from the EFFECTIVE DATE OF CONTRACT then the CONTRACTOR shall pay to the OWNER as LIQUIDATED DAMAGES (LD) @0.5% of the Total Contract Price of component of Cooling Water System as per BOQ for every complete week of delay or part thereof, subject to a maximum of 10% of the Total Contract Price component of Cooling Water System excluding liabilities for extra cost incurred due to Termination of CONTRACT and carrying out balance work at the risk and cost of the CONTRACTOR.
- 31.1.3.1 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, this clause will be applicable after expiry of such extended period.
- 31.1.3.2 LIQUIDATED DAMAGES represent, without prejudice to the respect of the contractual obligation under the CONTRACT by CONTRACTOR, the sole and exclusive remedy of OWNER for delay upto 10 weeks from the GUARANTEED COMPLETION DATE.
- If the GUARANTEED COMPLETION DATE is delayed beyond 10 weeks then the OWNER shall have the right to terminate the CONTRACT as per the provisions of Clause 34.2 of GCC.



### 31.2 LD For Failing to Meet Works Cost Guarantee

Bidder shall guarantee the daily consumption of Power) in the tables of Schedule of Prices(SP), so as to guarantee the works cost as per the given conditions under Section-7.0 of Volume-II-Technical NIT.

In the event works cost for Power is more than 100% but up to 110% of the Guaranteed Works Cost, then the CONTRACTOR will pay Owner, Liquidated Damages for Power as specified hereunder.

*For every 0.50% increase in Works cost for Power above the guaranteed works cost or part thereof, CONTRACTOR will pay Liquidated Damages for Power equal to 0.50% of the Total CONTRACT Price component of Cooling Water System.*

*The maximum liability of CONTRACTOR w.r.t. the above Liquidated Damages for Power shall be limited to 10% of the Total CONTRACT Price component of Cooling Water System.*

*If the Works cost for Power as demonstrated during the performance test is more than 110% of the respective Guaranteed Works Cost then it shall be breach of CONTRACT requiring corrective action by CONTRACTOR irrespective of the cost involved.*

In the event of increase in Cold Water temperature from the Guaranteed parameters, then the CONTRACTOR will pay Owner, Liquidated Damages for Power as specified hereunder.

*For every 0.2°C increase in Cold Water temperature above the guaranteed parameters or part thereof, CONTRACTOR will pay Liquidated Damages equal to 1.0% of the Total CONTRACT Price component of Cooling Water System.*

The maximum overall liability of CONTRACTOR under the Clause 31.2 (**Works Cost Guarantee**) above shall be limited to 15% of TOTAL CONTRACT PRICE.

### 32.0 NOTWITHSTANDING ANYTHING CONTAINED ELSEWHERE IN CONTRACT OR IMPLIED TO THE CONTRARY

- a) CONTRACTOR shall, in no circumstances, be liable in respect of any indirect or consequential loss or loss of profit suffered by OWNER in connection with or arising out of performance of WORK under CONTRACT.
- b) OWNER shall, in no circumstances, be liable in respect of any indirect or consequential loss or loss of profit suffered by CONTRACTOR in connection with or arising out of performance of WORK by CONTRACTOR under the CONTRACT.



### **33.0 TIME EXTENSION OF CONTRACT**

- 33.1** Deleted.
- 33.2** The CONTRACTOR shall promptly notify the PROJECT MANAGER 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.
- 33.3** If the CONTRACT is delayed at any time in the commencement or during the progress of the WORK by any act, delay or neglect of the OWNER or his employees, or by any other CONTRACTOR employed by the OWNER or by FORCE MAJEURE, the time of completion shall be extended for a reasonable period upon application from the CONTRACTOR immediately on occurrence of such special circumstances.
- 33.4** 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 provided the suspension is caused due to reasons attributable to OWNER.

### **34.0 TERMINATION OF CONTRACT**

#### **34.1 Termination due to Legal Incapacity**

If the CONTRACTOR goes into liquidation or has an administrative order made against him or carries on his business or any part of it under an administrator or receiver or manager for the benefit of the creditors or any of them, without prejudice to any other rights or remedies, the OWNER may forthwith by notice in writing terminate the CONTRACT.

#### **34.2 Termination due to Default by CONTRACTOR**

- 34.2.1** If the CONTRACTOR is in default in that he:
- (a) neglects to execute the work or part of the WORK; or
  - (b) without reasonable cause, suspends or abandons the carrying out the WORKS, either partly or wholly, before their completion; or
  - (c) fails to proceed regularly and diligently with the WORKS; or
  - (d) defaults in the performance or observance of any conditions or terms of the CONTRACT or neglects to carry out any order, instruction, direction or determination which the OWNER is empowered to give or make under the CONTRACT and which is given or made in writing to the CONTRACTOR, then, without prejudice to any other rights or remedies which the OWNER may possess, the OWNER may, by notice in writing (which shall specify with reasonable particularity the neglect, default or refusal on the part of the CONTRACTOR) require the CONTRACTOR to put forward his proposals for i) Rectifying such neglect, default or refusal as the case may be and



ii) Commence and diligently pursue the rectification of the default.

34.2. 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) Entrust the whole or part of the remaining work to any agency for undertaking the balance WORK at the risk and COST of Contractor notwithstanding any provision of the contract in respect of confidentiality and license clauses And / or
- b) Terminate the CONTRACT and encash the SECURITY CUM PERFORMANCE BANK GUARANTEE.

**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 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 person or persons 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 which shall be handed over to the CONTRACTOR but without payment or allowance for the fair wear and tear they may have sustained in the meantime, provided that if there by a deficiency as referred to in sub clause 34.4.2 of this clause, and if the CONTRACTOR fails to make good such deficiency such of the tools, equipment and materials as are necessary to make good the deficiency may be sold and a sufficient part of the monies received be 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 the issue of the certificate of taking over, the OWNER shall ascertain the cost of the WORK to the OWNER comprising payments to the CONTRACTOR and costs incurred by the OWNER in carrying out of the work taken out of the CONTRACTOR's hands, 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 certified be greater than the amount 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 a debt due by the CONTRACTOR to the OWNER and which may be recovered as provided in sub clause 34.4.1 of this clause or in Jaipur Court of Competent jurisdiction in 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 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** The jobs that are complete and ready for handover, within 30 days after the CONTRACTOR's receipt of notice of termination shall be paid by OWNER at the CONTRACT terms and prices. For the remaining jobs, the OWNER may opt:

- To have any portion completed at the CONTRACT terms and prices; and/or
- To cancel the remainder and pay to the CONTRACTOR a mutually agreed amount for partially completed jobs and for materials and parts previously procured by the CONTRACTOR, in which event such goods shall be the property of the OWNER.

#### **34.7.3 Termination for Insolvency**

OWNER may at any time terminate CONTRACT giving written notice to CONTRACTOR, without compensation 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.

#### **34.8 Surviving Obligations**

Termination of this CONTRACT (a) shall not relieve CONTRACTOR of its obligations with respect to the confidentiality as set forth in this CONTRACT, (b) shall not relieve CONTRACTOR of any obligation hereunder which expressly or by implication survives termination hereof, and (c) except as otherwise provided in any provision of this CONTRACT expressly limiting the liability of CONTRACTOR, shall not relieve CONTRACTOR of any obligations or liabilities for loss or damage to the other Party arising out of or caused by acts or omissions of CONTRACTOR prior to the effectiveness of such termination or arising out of such termination, and shall not relieve CONTRACTOR of its obligations as to portions of WORK



already performed or of obligations assumed by CONTRACTOR prior to the date of termination, except as otherwise agreed by OWNER in writing.

### 35.0 FORCE MAJEURE

- 35.1** Neither CONTRACTOR nor OWNER shall be considered in default in the performance of their obligations under CONTRACT, as long as such performance is prevented or delayed for reasons such as acts of God, severe earthquake, typhoon or cyclone (except monsoon), floods, lightening, land slide, fire or explosions, plague or epidemic, strikes of a whole National category of workers and concerted act of workmen or other industrial disturbances (lasting more than 14 consecutive calendar DAYs), lockouts (lasting more than 10 consecutive calendar DAYs), sabotage, blockade, war, riots, invasion, act of foreign enemies, hostilities (whether war be declared or not), civil war, rebellion, revolution, insurrection or military or usurped power of confiscation or trade embargoes or destruction or requisition by order of any Government or any Public Authority, provided notice of any such cause is given forthwith and in any event not later than one week (7) DAYs of the happening of the event by the party claiming the benefit of this Clause to the other specifying the matter constituting FORCE MAJEURE explaining to what extent contractual obligations will thereby be prevented or delayed and the further period for which it is estimated that such prevention or delay will continue. CONTRACTOR shall provide justificatory documents countersigned by the local Chamber of Commerce. Notwithstanding the forgoing, FORCE MAJEURE shall not include (a) weather conditions reasonably to be expected for the climate in the geographic area of the SITE including but not limited to the monsoon season, (b) the occurrence of any manpower or material shortages unless such a shortage is itself caused by an event of FORCE MAJEURE, or (c) any delay, default or failure (direct or indirect) in obtaining materials, or in any SUB-CONTRACTOR/VENDOR or worker performing any WORK or any other delay, default or failure (financial or otherwise) attributable to SUBCONTRACTOR/ Vendor/worker, unless such delay, default or failure results from any act, event or condition which would, with respect to such SUB-CONTRACTOR/VENDOR/ worker, constitute an event of force majeure.
- 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 GUARANTEED COMPLETION DATE 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 and no longer duration than is reasonably necessitated by the Force Majeure act, circumstance or event , provided that on the occurrence of any such contingency, the CONTRACTOR immediately reports to the OWNER in writing, the cause of delay and likely duration of cause of delay with requisite documentary evidence.
- 35.3** Deleted.
- 35.4** Should one or both the Parties be prevented from fulfilling the contractual obligations by a state of FORCE MAJEURE lasting continuously for a period of 6 weeks, the two Parties shall consult each other regarding the future implementation of the CONTRACT. The mere shortage of labour, materials or



utilities shall not constitute FORCE MAJEURE unless caused by circumstances which are themselves FORCE MAJEURE.

**35.5** CONTRACTOR and OWNER shall endeavour to prevent, overcome or remove the causes of FORCE MAJEURE.

**35.6** No ground for exemption can be invoked if CONTRACTOR has failed to give timely notice by registered letter/ Email and subsequently supported it by documentary evidence.

**35.7** 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. The non-performance of any obligation of either Party that was required to be performed prior to the occurrence of a Force Majeure shall not be excused as a result of such Force Majeure.

**35.8** 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 one year 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 and shall be detailed at the time of CONTRACT closure. CONTRACTOR shall have the right to take action to mitigate the impact of the prolonged Force Majeure event in mutual consent with OWNER; for instance CONTRACTOR shall have the right to demobilize CONTRACTOR's equipment and personnel from the PLANT.

### **36.0 NO WAIVER OF RIGHTS**

Neither the inspection by the OWNER or any of their officials, employees, or agents nor any order by the OWNER for payment of money or any payment for or acceptance of, the whole or any part of the WORKS by the OWNER nor any extension of time, nor any possession taken by the OWNER shall operate as a waiver of any provision of the CONTRACT, or of any power herein reserved to the OWNER or any right to damages herein provided, nor shall any waiver of any breach in the CONTRACT be held to be a waiver of any other subsequent breach.

### **37.0 BANKRUPTCY AND LIQUIDATION OF CONTRACTOR OR BUSINESS UNDER RECEIVERSHIP**

If the CONTRACTOR becomes insolvent or bankrupt, or have 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 CONTRACT subject to his providing a guarantee for the due and faithful performance of the CONTRACT upto the CONTRACT value of the WORK for the time being remaining unexecuted and subject to his taking all reasonable steps to prevent stoppage of the WORK. In the event of stoppage of the WORK, the period of the option under this clause shall be fourteen (14) days only.

**38.0 CERTIFICATE NOT TO AFFECT RIGHT OF OWNER AND LIABILITY OF CONTRACTOR.**

No interim payment certificate of the OWNER nor any sum paid on account by the OWNER nor any extension of time for execution of the WORKS granted by the OWNER shall affect or prejudice the rights of the OWNER against the CONTRACTOR or relieve the CONTRACTOR of his obligations for the due performance of the CONTRACT or be interpreted as approval of the WORK done or of the equipment furnished and no certificate shall create liability on the OWNER to pay for alterations, amendments, variations, or additional WORKS not ordered, in writing, by the OWNER or discharge the liability of the CONTRACTOR for the payment of damages whether due, certified or not or any sum against the payment of which he is bound to indemnify the OWNER and the Consultant nor shall any such certificate nor the acceptance by him of any sum paid on account or otherwise affect or prejudice the rights of the CONTRACTOR against the OWNER.

**39.0 SETTLEMENT OF DISPUTES**

**39.1** Except as otherwise specifically provided in the CONTRACT all disputes concerning questions of fact arising under the CONTRACT shall be considered by the OWNER subject to a written appeal by CONTRACTOR to the OWNER.

**39.2** Any disputes or differences including those considered as such by only of the parties arising out of or in connection with the CONTRACT shall be to be extent possible settled amicably between the parties.

**39.3** All Settled dispute(s) or difference(s) arising out of or in connection with the Contract shall be decided by the Owner/Owner's Representative whose decision shall be final and binding on the parties.



- 39.4** If any dispute or difference of any kind whatsoever is to arise between Owner and Contractor on the following matters viz.,
- i. The meaning of the tender, designs, drawings and instructions
  - ii. The quality of workmanship or materials used
  - iii. Any other question, claim, right, matter, thing whatsoever in anyway arising out of or relating to the Contract, estimates, orders or those conditions to failure to execute the same whether arising during the progress of the work or after the completion, termination or abandonment thereof, the dispute shall be referred to the Owner/Owner's Representative
- 39.5** The Owner/Owner's Representative shall within a period of 90 days from the date of being requested by Contractor to do so, give written notice of his decision to Contractor.
- 39.6** Subject to other form of settlement hereafter provided, the Owner decision in respect of every dispute or difference shall be final and binding upon Contractor. The said decision shall forthwith be given effect to and Contractor shall proceed with the execution of the work with all due diligence.
- 40.0** **NOT USED**
- 41.0** **GOVERNING LAWS, LANGUAGE AND MEASURES**
- 41.1** The applicable law shall be Indian Law and shall be subject to the jurisdiction of the Court in Jaipur, Rajasthan. 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 Jaipur, Rajasthan.
- 41.2** The governing language for all communication, notices, Technical Information, etc. pertaining to CONTRACT shall be English. Any literature, correspondence, documents, etc., shall be considered only if its accompanied by English translation. For the purpose of interpretation English translation shall govern and be binding on all parties.
- 41.3** The metric system of measurement shall be used exclusively in the CONTRACT.
- 42.0** **RELEASE OF INFORMATION**
- The CONTRACTOR shall not communicate or use in advertising, publicity, sales releases or in any other medium, photographs or other reproduction of the WORKS under this CONTRACT or descriptions of the SITE, dimensions, quantity quality or other information, concerning the WORK unless prior written permission has been obtained from the OWNER. Notwithstanding the above, CONTRACTOR is entitled, under intimation to OWNER, to make such public Announcements, as it may be bound to in compliance with the Law, the Rules and any Governmental Agency or Stock Exchange Regulation the CONTRACTOR is subjected to.



#### **43.0 COMPLETION OF CONTRACT**

Unless otherwise terminated under the provisions of any other relevant clause, this CONTRACT shall be deemed to have been completed at the expiry of the guarantee period as provided for under the clause entitled guarantee.

#### **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 it may have hereunder.

#### **45.0 OWNER'S DECISION**

- 45.1** In respect of all matters which are left to the decision of the OWNER including the granting or withholding of the certificates, the OWNER 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 to the CONTRACTOR stipulations of Clause 39.0 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), each Party shall disclose information which the other might reasonably need to 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 to employment of any person at SITE and the objection shall be communicated in writing and CONTRACTOR shall make immediate arrangements for removal of such person.

**46.2 Cooperation with other CONTRACTORS**

The CONTRACTOR shall not object to the execution of the work by other CONTRACTORS or tradesmen and offer them every facility for the execution of their several WORKS simultaneously with CONTRACTOR's work. 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. The CONTRACTOR shall agree to cooperate with the OWNER and other CONTRACTORS and freely exchange with them such technical information 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 WORK**

- 47.1** The OWNER reserves the right to suspend and reinstate execution of the whole or any part of the WORK without invalidating the provisions of the CONTRACT. Orders for suspension or reinstatement of the WORKS will be issued by the OWNER to the CONTRACTOR in writing. The time for completion of the WORKS will be extended for a period equal to the duration of the suspension.

**48.0 REPLACEMENT OF PARTS AND MATERIALS DEFECTIVE/DAMAGED/LOST DURING TRANSIT/ ERECTION AND COMMISSIONING.**

- 48.1** If during the progress of the WORKS, the OWNER shall decide and inform in writing to the CONTRACTOR that the CONTRACTOR has manufactured any PLANT or part of the PLANT unsound or imperfect 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 cost of the CONTRACTOR perform all such work or furnish all such equipment provided that nothing in this clause shall be deemed to deprive the OWNER of or affect any rights under the CONTRACT which the OWNER may otherwise have in respect of such defects and deficiencies.

- 48.2** The CONTRACTOR's full and extreme liability under this clause shall be satisfied by the payments to the OWNER of the extra cost, of such replacement procured including erection as provided for in the CONTRACT, such extra cost being the ascertained difference between the price paid by the OWNER for such replacements and the CONTRACT price portion for such defective PLANTS and repayments of any sum/ paid by the OWNER to the CONTRACTOR in respect of such defective PLANT.



**48.3** If the material/ equipment or any portion thereof is damaged or lost during transit and handling, storage, erection, COMMISSIONING at SITE, the replacements of such material / equipment shall be effected by the CONTRACTOR within a reasonable time to avoid unnecessary delay in the COMMISSIONING of the EQUIPMENT and without waiting for realisation of cost of damages from the insurance company, appointed by him for this purpose. This will not alter the schedule of COMMISSIONING & guarantee tests 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** 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.

**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 timely manner in accordance with the CONTRACT.

**50.2** All WORK to be carried out by the CONTRACTOR shall be carried out with sound workmanship and materials, safety and in accordance with good engineering practice, applicable Legislation and codes. The Work shall be carried out in accordance with the CONTRACT requirements, as per Clause 50.4. Except as may otherwise be specifically provided in this CONTRACT, the CONTRACTOR shall be responsible to perform the WORKS and any other services/deliverables not specifically described in this CONTRACT if:

The provision of such additional services/deliverables is necessary in order for CONTRACTOR to satisfy the warranties and guarantees set forth in Clause 29 or to otherwise make the WORK comply with this Contract. WORK undertaken and additional services/deliverables provided pursuant to this clause shall be deemed to have been included within the TOTAL CONTRACT PRICE and shall not give rise to any adjustment in TOTAL CONTRACT PRICE.



- 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 (Part II- Technical ) or any other provision of the CONTRACT.
- 50.5** If any time during the performance of the CONTRACT the CONTRACTOR is of the opinion that a change to the WORKS or the design or method of operation of the PLANT:
- (a) is necessary to eliminate a potential defect in the PLANT or a specific hazard to any person or party in the performance of the WORKS or in the operation of the PLANT which has occurred or would otherwise occur' or
  - (b) would improve operating or life cycle costs of the PLANT; or
  - (c) would otherwise be beneficial to the OWNER;
- The CONTRACTOR shall bring the matter to the attention of the PROJECT MANAGER 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 PROJECT MANAGER on the progress of the WORKS, supporting his reports with appropriate Documentation(including mitigation plan for slippages) 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.
- 50.9** The CONTRACTOR shall avail the most beneficial notifications, abatements, exemptions etc., if any, as applicable for the supplies under the GST Laws as well as Custom Laws.
- 50.10** The CONTRACTOR shall comply with all the compliance requirements under GST law.



**50.11** The CONTRACTOR shall raise invoice in the prescribed format with all the required information within the due date in terms of the provisions of GST Laws. Taxes will not be reimbursed if such invoices are raised after the due date.

**50.12** The CONTRACTOR agrees to do all things that may be necessary to enable the OWNER to claim input tax credit in relation to any GST payable under this CONTRACT or in respect of any supply under this CONTRACT. This shall include (but not limited to):

- ]  
Issuing invoices/ debit notes/ revised invoices/ credit notes as per the prescribed format, containing all the information as is required for the OWNER to avail input tax credit basis such invoices/ debit notes/ revised invoices.
- ]  
Submission of periodic returns as per the GST laws within specified time lines with complete and correct details as may be prescribed
- ]  
Deposit of tax within the due dates as may be prescribed
- ]  
Issuance of debit note within the prescribed time limit to enable the OWNER take the credit.

**50.13** The CONTRACTOR shall continuously maintain a high GST compliance rating score as per the GST law. The OWNER reserves the right to terminate this CONTRACT if the CONTRACTOR fails to achieve/ maintain an appropriate GST compliance rating score.

## **51.0 PROGRESS REPORTS AND PHOTOGRAPHS**

**51.1** The CONTRACTOR shall furnish each of one hard copy and one electronic copy of progress photographs of the work done in his shop/SITE. Photographs shall be taken when and where indicated by the PROJECT MANAGER. Photographs shall be approximately 8 inches by 10 inches in size, including a margin on one 10 inch side for binding. Adequate number of photographs shall be submitted indicating various stages of manufacture and erection. Each photograph shall contain the date, the name of the CONTRACTOR and the title of the view taken.

**51.2** Required number of monthly progress reports, in prescribed proforma, shall be submitted by the CONTRACTOR to the PROJECT MANAGER for review. These shall detail the status of design, procurement of raw materials and bought outs, expediting status, 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 and construction work and programme of work for succeeding month and statement showing position of payment. The reports shall also include section on critical issues, action taken reports and mitigation plans etc.

## **52.0 SPARES**

All the necessary Start-Up/ Commissioning spares and Mandatory spares shall be included in the scope of CONTRACT.

**53.0 SECRECY**

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, 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. 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.

**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 on each SITE at least three copies of each and every Drawing, Specification and CONTRACT Document in excess of his own requirement and those copies shall be available at all times for use by the OWNER and PROJECT MANAGER and by any other person authorized by the OWNER who have a need to know the same for the PROJECT, who shall be provided an adequately sized SITE office or offices, for the safe-keeping and use of such documents, by the CONTRACTOR throughout the duration of the CONTRACT. Where one or more of CONTRACTOR'S yards/offices/offshore spreads are deployed in the WORKS, all requirements of the CONTRACT and CONTRACTOR'S obligation under the CONTRACT shall apply equally at each yard/office/offshore spread so deployed.

**54.0 CORRESPONDENCE**

- 54.1 All correspondence from the CONTRACTOR to the OWNER shall be as per the correspondence distribution schedule. All communications including technical-commercial clarification and/or comments shall be addressed to OWNER and shall always bear reference to CONTRACT.
- 54.1.1 Correspondence on technical and commercial matters shall be dealt with in separate letters and each copy of the letter shall be complete with all Annexure, if any.
- 54.2 Any notice to the CONTRACTOR under the terms of the CONTRACT shall be served either by registered mail/Speed Post, fax , or courier or mail.



**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, to the OWNER, all MATERIALS required for incorporation in the permanent WORKS as determined by the CONTRACTOR, within the scope of WORK, to be necessary to establish, commission and operate (so far as concerns mandatory spares) the PLANT/ Unit delivered on CIF basis at Indian port of CONTRACTOR's choice, custom clearance in India and transportation upto SITE in respect of imported materials and delivered at Site basis for all Indian MATERIALS and EQUIPMENT at the price specified in the Schedule of Price.

### **55.1.2 INVOICES**

CONTRACTOR's invoices shall be raised as per the 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 post appointed date, 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 services, 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 PROJECT MANAGER, 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, for which purpose the OWNER shall, from time to



time, grant to the CONTRACTOR or the CONTRACTOR's designate(s), such authority(ies) as may be reasonably required by the CONTRACTOR in this behalf.

- ii) Stevedoring, clearing, forwarding and handling services as required for clearing, forwarding and handling imported and indigenous materials and consignments including payment at CONTRACTOR's cost of any demurrage, wharfage, port charges, siding charges, retention charges, detention charges or other charges whatsoever and howsoever designated or levied by any railway, air-port, ship and/or other authorities for or in connection with the loading, unloading or detention of any materials or vessels or other means of transport beyond the free period or unloading, clearance, retention or detention or loading, as the case may be, provided by the relevant authority(ies) or carrier(s) in this behalf.
- iii) All WORKS and operations necessary to lift and to remove the material from port, ware-house, railway or other siding, factory or other places of delivery, loading, handling, transporting and unloading and safely stacking, placing or storing the same at approved godowns, yards or other place(s) of storage including lashing or other-wise securing or protecting the same in transit and during and in storage.
- iv) Supply, procurement, mobilization, and deployment of all labour thereof, equipment & machinery necessary for lifting, loading, handling, removing, transporting, unloading, stacking or securing the materials.
- v) Transit and storage insurance of all materials for the full replacement value thereof delivered at SITE.
- vi) All acts, deeds, matters or things required to fulfil all local, municipal and other statutory authorities with respect to the transportation of any materials through or into any State, municipal, local or other barriers or limits or for the import of the materials or any of them within the limits of such barrier, other local toll, terminal and/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.
- 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 there under in respect of materials:

- i) The CONTRACTOR shall in taking delivery, ensure compliance of any condition for delivery applicable to deliveries from the concerned authority or



carrier, and shall be exclusively responsible to pay and bear any detention, demurrage or penalty or other charges payable by virtue of any delay or failure by the CONTRACTOR in lifting the materials or in observing any of the conditions aforesaid, and shall keep the OWNER indemnified from and against all consequences thereof

- ii) The CONTRACTOR shall maintain a day-to-day account of all materials indicating the daily receipt(s), consumption(s) and balance of each material and category thereof. Such account shall be in the format, if any, prescribed by the PROJECT MANAGER 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 MANAGER's 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 PROJECT MANAGER with authority at all times without obstruction to enter into or upon any go-down 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) All MATERIALS, including materials in respect of which licences / release orders/permits/ authorization have been accorded in the name of the OWNER shall, without prejudice to the responsibility/liability of the CONTRACTOR in respect thereof, vest in the OWNER - upon shipment from the country of manufacture [FOB basis] with respect to the items to be procured or supplied from the source outside India and, - ex-WORKS VENDOR shop with respect to the items to be procured in India and the CONTRACTOR shall be deemed to be acting on behalf of the OWNER, importer of records, and as an agent of the OWNER in respect of deliveries taken by the CONTRACTOR.
- v) 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.
- vi) The CONTRACTOR shall take out, at his own cost and keep in force at all times, during transit, handling, storage, and erection upto completion in all respect of the work, policy(ies) with Insurance Company(ies) approved by the OWNER for the full replacement value of the materials at SITE against the risks hereinafter specified. 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.

- a) Notwithstanding anything herein provided, the CONTRACTOR shall be and remain solely and exclusively liable to repair, restore or replace, as the case may be, the materials damaged or destroyed as a result of any act or omission, notwithstanding the existence or otherwise of any policy(ies) of insurance aforesaid, with the intent that any policy(ies) of insurance aforesaid taken out by the CONTRACTOR or by the OWNER, on default by the CONTRACTOR, shall not anyhow absolve the CONTRACTOR from his full liability up to and until issue of the PRELIMINARY ACCEPTANCE as provided for herein in respect of the WORKS, the work(s) and all materials incorporated therein shall be and remain at the risks 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, but 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 aforesaid.
  - c) The CONTRACTOR shall, as a condition to the certification of any Running Account Bill, satisfy the OWNER/ Project Manager 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.
- vii) Notwithstanding anything herein provided and notwithstanding the transference of all risks in respect of the materials to the CONTRACTOR, the ownership in respect of the material shall at all times be and remain in the OWNER.
- viii) An inventory shall be made by the CONTRACTOR of all surplus construction materials and empties including but not limited to scrap, wastages and unserviceable material supplied and/or remaining in the hands of the CONTRACTOR upon completion of the CONTRACT for whatsoever reason, and the CONTRACTOR shall forthwith, upon being required to do so, place the OWNER in undisputed possession of and transport the said material to the OWNER's stores or otherwise as reasonably directed by the PROJECT MANAGER.



- ix) If the CONTRACTOR shall default in replacing at the job SITE, without any additional cost to the OWNER, any material lost, damaged, deteriorated, misused, wasted, short, stolen, misapplied or disposed of within the provisions hereof above, or shall fail to return to the OWNER any surplus material or empties within the provision hereof above, the CONTRACTOR shall be liable to pay to the OWNER the cost of such materials or empties delivered at OWNER's stockpile/godown.

#### 55.3.0 BILLS OF MATERIALS

- 55.3.1 The CONTRACTOR shall within 45 days of EFFECTIVE DATE OF CONTRACT furnish to the OWNER a detailed Bill of Materials 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 WORKS/ Unit and to operate the PLANT/Unit (to the extent of the Mandatory spares), including construction materials.
- 55.3.2 Each item entered in the Bill of Materials shall be priced, so far as possible, in conformity with the details given in this behalf in the priced bid. The Bill of Materials and said price break-up therein and in the price bid 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.
- 55.3.3.1 The priced Bill of Materials as approved by the OWNER shall constitute the Bill of Materials envisaged in the contract documents. However, no such approval shall, in any manner, absolve the CONTRACTOR of his full responsibility under the CONTRACT to sell and supply to the OWNER at and within the price of materials quoted in the Price Schedule, all materials required for the permanent incorporation in the WORKS and which are required to establish, commission and operate (to the extent of Mandatory spares) the PLANT/ Unit in accordance with the CONTRACT and the specifications, complete in all respects including spares, tools, tackles and testing equipment, so far as included within the scope of supply, whether or not any particular material is actually included within or omitted in the Bill of Materials and whether or not the price thereof is included in the price indicated in the Bill of Materials and whether or not the price thereof is in conformity with the price thereof indicated in the Bill of Materials. The review and approval of the Bill of Materials and the prices therein are intended only for the satisfaction of the OWNER that the priced Bill of Materials, *prima facie* covers the materials required to be supplied by the CONTRACTOR within the scope of supply.



55.3.4 The Bill of Materials shall be subject to amendment in both items and prices in so far as necessary consequent upon any amendment in any relevant related technical particulars, and upon any amendment, the amended Bill of Materials as approved by the OWNER, shall thereafter constitute the Bill of Materials as envisaged in the CONTRACT documents, provided that unless the amendment results from a CHANGE ORDER and/or agreed variation, no such amendment shall anyhow impose any liability on the OWNER to pay any amount, taxes or customs and other import duties in excess of the amount, taxes customs and other import duties payable on the value of imported materials as indicated in the Price schedule but for such amendment.

#### 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 Within 30 (thirty) days from the EFFECTIVE DATE OF CONTRACT, the CONTRACTOR shall submit to the OWNER for approval in respect of each work or groups of work, a detailed Delivery Schedule in Graphical or other suitable form giving dates of starting and finishing the various supplies relating to the WORK, providing sufficient margin to cover for contingencies. The PROJECT MANAGER and the CONTRACTOR shall thereafter, within 14 (Fourteen) days, settle the Delivery Schedule which shall form part of the CONTRACT with attendant obligations upon the CONTRACTOR to make the various deliveries/supplies involved on or before the date(s) mentioned in respect thereof in the Delivery Schedule.

55.4.4 All materials shall be deemed to have been accepted only when the material is received at the project SITE and accepted by the PROJECT MANAGER. Such acceptance shall however, be subject to the terms and conditions hereof, including the right of rejection and/or replacement as elsewhere herein specified.

55.4.5 Deleted.

55.4.6 Any reference in the CONTRACT documents to the "approved Delivery Schedule" or to the "Delivery Schedule" shall mean the approved Delivery Schedule specified in Clause 55.4.3 above or the Delivery Schedule prepared and issued by the PROJECT MANAGER, whichever shall be in existence.



- 55.4.7 Within 7 (Seven) days of the occurrence of any act, event or omission which, in the opinion of the CONTRACTOR, is likely to lead to delay in the commencement or completion of delivery of any particular material or of all material and is such as would entitle the CONTRACTOR for an extension of the time specified in this behalf in the Delivery Schedule(s), the CONTRACTOR shall inform the PROJECT MANAGER in writing of the occurrence of the act, event or omission and date of commencement of such occurrence. Thereafter, if even upon the cessation of such act or event or the fulfilment of the omission, the CONTRACTOR is of opinion that an extension of time specified in the Delivery Schedule related to particular material(s) or in relation to all materials is necessary, the CONTRACTOR shall within 7 (Seven) days after the cessation or fulfilment as aforesaid make a written request to the PROJECT MANAGER for extension of the relative time specified in the Delivery Schedule and the PROJECT MANAGER shall at any time, prior to completion of the work, extend the relative time of completion in the Delivery Schedule for such period(s) as he considers necessary, if he is of reasonable opinion that such act/event/omission constitutes a ground for extension of time in terms of the CONTRACT and that such act/event/omission has in fact resulted in insurmountable delay to the CONTRACTOR.
- 55.4.8 Notwithstanding the provisions of Clause 55.4.7 hereof, the OWNER may at any time after the completion of the work in all respects at the request of the CONTRACTOR made by way of appeal either against a decision of the PROJECT MANAGER taken under Clause 55.4.7 or against the PROJECT MANAGER's refusal to take a decision under the said clause, if satisfied of the existence of any ground(s) justifying the delay/omission, extend the date of delivery of any materials for such period(s) as the OWNER may consider necessary.
- 55.4.9 Subject as elsewhere herein or in the CONTRACT documents, otherwise expressly provided, only the existence of force majeure circumstances as defined in Clause 55.4.10 hereof, shall afford the CONTRACTOR a ground for extension of time for delivery of materials, and specifically without prejudice to the generality of the foregoing:
- i) Inclement or unforeseen weather, strike or lock-out (except as provided in Clause 55.4.10), shutdown, third party breach, delay in payment or commercial hardship shutdown or idleness or other impediment in progress or completion of the supply or work due to any reason whatsoever shall not afford the CONTRACTOR a ground for extension of time or relieve the CONTRACTOR of his/its full obligations under the CONTRACT.
  - ii) No delay whatsoever in the supply of any material by the CONTRACTOR or any of the CONTRACTOR's vendors, suppliers or SUB-CONTRACTORS shall anywise entitle the CONTRACTOR to any extension of time for completion or to any claim for additional costs, remuneration or damages or compensation notwithstanding that an increase in the time of performance of the CONTRACT is involved by virtue of the delay or failure and notwithstanding that any labour, machinery or equipment brought to or upon the job SITE by the CONTRACTOR or any SUB-CONTRACTOR is rendered idle by such delay.



- 55.4.10 "Force Majeure" shall mean an event beyond the control of the CONTRACTOR and not involving the CONTRACTOR's fault or negligence and not foreseeable as per Clause 35.0 of GCC.
- 55.4.11 No assurance, representation, promise or other statement by any personnel, Engineer or representative of the OWNER regarding the extension of time for the supply by the CONTRACTOR of any material within the CONTRACTOR's scope of supply shall be binding upon the OWNER or shall constitute an extension of time for the supply of any material(s) within the provision of Clause 55.4.7 or Clause 55.4.8 hereof, unless the same has been communicated by the PROJECT MANAGER to the CONTRACTOR in writing under Clause 55.4.7 or by the Managing Director under Clause 55.4.8 and the writing specifically states that it constitutes an extension of time within the provisions of Clause 55.4.7 or 55.4.8, as the case may be. Without prejudice to the foregoing, 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 otherwise constitute an extension of time in 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.
- 55.4.12 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.

#### 55.4.13 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 PROJECT MANAGER / OWNER.
- ii) Wherever any item is specified by a brand name, manufacturer or vendor, the make mentioned shall be for establishing type, function and quality desired. Other makes will be considered, provided sufficient information is furnished to the OWNER/ PROJECT MANAGER, to assess the makes proposed by the CONTRACTOR as equivalent and acceptable and approved by PROJECT MANAGER.
- iii) 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/ PROJECT MANAGER's approval.

**55.5.0 CERTIFICATE OF VERIFICATION AND GOOD CONDITION**

- 55.5.1 The CONTRACTOR shall, before supply of material covered within the scope of supply, at his own risks, costs and initiative, undertake or cause to be undertaken all tests, analysis and inspections as shall be required to be undertaken with regard to the materials under the specifications and any codes, practices, orders and instructions with respect thereto and shall cause the results thereof to be recorded, reported or certified, as the case may be, and shall not offer for delivery or deliver any material(s) which has/have not passed such tests/analysis or inspection and which are not accompanied by the tests results, reports and/or certificates in this behalf provided in the applicable specifications, code(s) and/or practices.
- 55.5.2 On arrival of the material at SITE the CONTRACTOR shall give written notice thereof to the PROJECT MANAGER 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 PROJECT MANAGER 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 PROJECT MANAGER 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 PROJECT MANAGER 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 PROJECT MANAGER or Inspection Agency.
- 55.5.4 If on Inspection or proof, analysis or tests as aforesaid the PROJECT MANAGER 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 PROJECT MANAGER 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.
- 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 otherwise absolve the CONTRACTOR of his/its full responsibility under the CONTRACT in relation thereto, including in relation to specification fulfilment and/or performance or other guarantees.



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 otherwise relieve the CONTRACTOR of his full liability in respect of the suitability and quality of the material(s) obtained from said source(s) and the CONTRACTOR shall obtain material(s) there from and incorporate the same within the permanent WORKS entirely at his own risks and costs in all respects, with the intent that any such suggestion by the OWNER shall only be by way of assistance to the CONTRACTOR and shall not entail any legal responsibility or liability upon the OWNER.

#### **55.6.0 MATERIALS WITHIN THE CONTRACTOR'S SCOPE OF SUPPLY**

55.6.1 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 DELETED

#### **55.8 PACKING AND FORWARDING**

##### **(a) IMPORTED SUPPLIES**

- ] The CONTRACTOR wherever applicable, shall, after proper painting, pack and crate all materials for shipment in a manner suitable for export to a tropical, humid climate in accordance with internationally accepted export practices and in such a manner so as to protect them from damage and deterioration in transit by road, rail and/or sea and/or air 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) to the materials due to improper packing.
- ] The Contractor shall notify the OWNER and PROJECT MANAGER of the date of each shipment from the port of embarkation as well as of the expected date of arrival of such shipment at the designated port of arrival only for the OWNER's/ PROJECT MANAGER'S information.
- ] The notification shall give complete shipping information concerning the weight, size and content of each package and such other information as the OWNER may require.
- ] The packing material used should be duly certified by a Phytosanitary Certificate issued as per international norms.
- ] Insurance Certificate (2 copies) or copy of MCE Policy
- ] Third Party Inspection Release Note or Inspection Certificate as per QAP approved by OWNER/ PROJECT MANAGER or waiver certificate issued by OWNER/ PROJECT MANAGER (2 copies).

**(b) INDIGENOUS SUPPLIES**

- ] The CONTRACTOR shall, wherever applicable, after proper painting, pack and crate all items in such a manner 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/ PROJECT MANAGER of the date of each shipment from the WORKS and expected date of arrival at the SITE for the information of OWNER/ PROJECT MANAGER.
- ] 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/ PROJECT MANAGER may require.
- ] The following documents shall be sent to the OWNER/ PROJECT MANAGER within 10 (ten) days from the date of shipment :
  - o Invoice (2 copies)
  - o Packing List (2 copies)
  - o Test Certificate (4 copies)
  - o Railway Receipt/Lorry Receipt (2 copies)
  - o Insurance Certificate (2 copies) or copy of MCE Policy
  - o Third Party Inspection Release Note or Inspection Certificate as per QAP approved by OWNER/ PROJECT MANAGER or waiver certificate issued by OWNER/ PROJECT MANAGER (2 copies).

**55.9 EQUIPMENT**

- 55.9.1 The CONTRACTOR shall be exclusively responsible to arrange for importation into India in its own name on drawback or re-export or other basis all equipment, if any, required to be imported into India for the purposes of the WORK and to pay and bear the customs, import and other duties and levies (if any) payable thereon or in respect thereof, and will be solely responsible for the timely and proper compliance of all applicable terms and conditions and formalities relative thereto.
- 55.9.2 The CONTRACTOR shall within 4 (four) months from the date of receipt of Acceptance of Bid, furnish to the PROJECT MANAGER a list of the said equipment which he proposes to import into India on a draw-back/re-export basis for the purposes of the work, together with complete details thereof. The OWNER may without obligation or responsibility furnishes to the Import Licensing Authorities in India its recommendations relative to import of such equipment which the OWNER considers necessary for the work. The OWNER may also without obligation or responsibility render such assistance as may be reasonably required by the CONTRACTOR from the OWNER to enable the CONTRACTOR to obtain the relative Import License(s)/Permit(s) for the importation of the said equipment on a draw-back/re-export basis.

**55.10 MISCELLANEOUS IMPORTS**

- 55.10.1 The CONTRACTOR shall be exclusively responsible at his own costs and initiative to arrange for importation into India, to import into India, to pay Custom



duties and Port and other charges and levies, to clear from Customs and to transport to job SITE all consumables, spares for the CONTRACTOR's equipment and other materials and things whatsoever not covered under the OWNER's obligation provided that the OWNER may, without obligation or responsibility, render the CONTRACTOR such assistance by way of recommendation to the Import Control authorities in India or otherwise as may be reasonably required by the CONTRACTOR from the OWNER to enable the CONTRACTOR to obtain Import License(s)/Permit(s) for importation of such consumables, spares, material and other items as the OWNER considers necessary for importation by the CONTRACTOR for the purpose of the CONTRACT, taking into account local availability.

- 55.10.2 Any obligation undertaken or recommendation, facility or assistance provided by the OWNER to the CONTRACTOR for or in relation to the importation of any equipment or material whatsoever into India by or on behalf of the CONTRACTOR pursuant to the provisions hereof or otherwise shall be without any responsibility or liability whatsoever upon the OWNER and without right in the CONTRACTOR to raise any claim or demand or to seek extension of time on account of any delay or failure on the part of the OWNER or any delay or failure by the CONTRACTOR in obtaining Import License(s) and/or permits for importation thereof into India.
- 55.10.3 All materials and equipment Imported into India by or on behalf of the CONTRACTOR for and in connection with the WORK and any obligation undertaken or recommendation, facility or assistance provided by the OWNER relative thereto shall be on the clear understanding that the MATERIALS and EQUIPMENT shall be utilised only for and relative to the performance of the WORK covered by the CONTRACT.
- 55.10.4 All the EQUIPMENT and temporary WORKS and MATERIALS when brought to or erected on the job SITE, shall be exclusively intended for execution of WORKS and the CONTRACTOR shall not remove the same or any part thereof, except for the purpose of moving it from one part of the job SITE to another, without the prior consent in writing of the PROJECT MANAGER.
- 55.10.5 Upon completion of the WORKS, the CONTRACTOR shall within the scope of work remove from the job SITE all the equipment and temporary WORKS remaining thereon.
- 55.10.6 All EQUIPMENT, MATERIALS and temporary WORKS shall at all times be and remain at the risks of the CONTRACTOR in all respects. The OWNER shall not, at any time, be liable for the loss or destruction of or damage to any EQUIPMENT, temporary WORKS or MATERIALS for any reason whatsoever.
- 55.11 UTILITIES AND CONSUMABLES ETC.**
- 55.11.1 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 Measurements:**

- 56.1.1 Within 15 (fifteen) days from the date of certification of works completed / milestones achieved in respect of the WORK, 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 PROJECT MANAGER and the CONTRACTOR as herein provided.
- 56.1.2 If the CONTRACTOR fails to apply to the PROJECT MANAGER for Measurements within 15 (fifteen) days from the date of certification of works completed / milestones achieved as specified in Clause 56.1.1, the PROJECT MANAGER 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 PROJECT MANAGER, whose decision in this regard shall be final and binding upon the CONTRACTOR.
- 56.2.3 All measurements shall be taken jointly by the PROJECT MANAGER or person nominated by PM 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 PROJECT MANAGER and the measurements so recorded and signed by the PROJECT MANAGER as correct, shall be final and binding upon the Parties.
- 56.2.5 Except in cases covered by Clause 56.2.4, in all other cases measurements shall be signed and dated on each page by the CONTRACTOR / CONTRACTOR's MANAGER and PROJECT MANAGER 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 / CONTRACTOR's MANAGER and PROJECT MANAGER 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 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 PROJECT MANAGER. The decision of the PROJECT MANAGER 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.
- 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 FINAL BILL

- 56.4.1 On the basis of the LUMPSUM PRICE provided in the CONTRACT, the CONTRACTOR shall prepare a Final Bill in the prescribed form with reference to the total supplies covered by the scope of supplies and shall prepare a separate Final Bill with reference to the total services covered by the scope of services. Such Bill shall be prepared by applying the price of materials specified in Price Schedule in respect of supplies broken up with respect to the indigenous materials and with respect to imported materials (including Plant, parts and components) in accordance with the break-up of the Price of Materials given the Price Schedule and the various formats there under, and by applying the price of services specified in the Price Schedule in respect of WORKS/services broken up with respect to the various heads of services/WORKS in accordance with the break-up of the Price of services given the Price Schedule and the various formats there under. Additions claimed to the LUMPSUM PRICE or reductions there from resultant upon any CHANGE ORDER(S) shall be separately indicated in the Final Bill with reference to the relative CHANGE ORDERS(S).
- 56.4.2 The Final Bill shall, in addition to the payment entitlements arrived at according to the provisions of Clause 56.4.1 hereof separately state, include therein all claims of the CONTRACTOR if any with full particulars of the nature of such claim, grounds on which it is based and the amount claimed.
- 56.4.3 The Final Bill drawn in accordance with Clause 56.4.1 shall be submitted together with the PRELIMINARY ACCEPTANCE CERTIFICATE to the PROJECT MANAGER for certification, who shall certify the Final Bill, if drawn in accordance



with Clause 56.4.1. After certification of the PROJECT MANAGER, 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.

- 56.4.4 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 56.4.1 hereof and associated provisions there under accompanied by the PRELIMINARY ACCEPTANCE CERTIFICATE in respect of the WORKS.
- 56.4.5 Payments of the amount(s) due on the Final Bill to the extent certified by the PROJECT MANAGER, shall be made within 90 (Ninety) days from the due date as specified in Clause 56.4.4 hereof, subject to the deductions provided in Clause 56.4.5.1.
- 56.4.5.1 All payments due to the CONTRACTOR on the Final Bill shall be subject to deduction of "on account" payments and other amounts due from CONTRACTOR to the OWNER, tax deductions as provided for in Clause 56.7.2 and associated clauses there under, and any other deduction provided for herein or agreed to between the parties 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.

#### **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 Price Schedule and LUMPSUM 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, civil work and construction activity and the CONTRACTOR shall be deemed to have known the nature, scope, magnitude and the extent of the WORKS and items, MATERIALS, EQUIPMENT, and components required for the proper and complete execution of the WORKS though the CONTRACT documents



may not fully and precisely set out, describe or specify them, and the generality hereof shall not be deemed to be anywise limited, restricted or abridged because in certain cases the CONTRACT documents or any of them shall or may and/or in other cases they shall or may not expressly state that the CONTRACTOR shall do or perform any particular labour or service or because in certain cases the CONTRACT documents state that a particular work, operation, supply, labour or service shall be performed/made by the CONTRACTOR at his own cost or without additional payment, compensation or charge or without entitlement of claim against the OWNER or words to similar effect, and in other cases they do not, or because in certain cases it is stated that the same are included in or covered by the Price Schedule and in other cases it is not so stated.

- (ii) The cost of all construction and related vessels, craft, vehicles, movements, Plant, equipment, distribution of water and power, construction of temporary roads and access, temporary WORKS, pumps, wiring, pipes, scaffolding, piling, shuttering and other materials, supervision, labour, insurance, fuel, stores, spares, supplies, appliances and materials, items, articles and things whatsoever (foreseen 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, ware houses for storing EQUIPMENT and MATERIALS 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 GST and other taxes or terminal taxes payable in India with regard to materials supplied by the CONTRACTOR within the scope of supplies, all customs and import duties, GST, any applicable Cess and other direct and indirect taxes and duties, quay, wharfage, 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 premium on insurance required in terms of the CONTRACT documents or otherwise under any law, rule or regulation, and the cost of all risks whatsoever (foreseen and unforeseen) including but not limited to risks of delay or extension of time or reduction or increase in the work or scope of work and/or cancellation of CONTRACT, and/or accident, strike, civil commotion, war, strike, labour trouble, third party breach, fire, lighting, inclement weather, storm, tempest, flood, earthquake and other acts of God, Government regulation or imposition or restriction, dislocation of road, rail, sea, air and other transport, access or facility, flooding of SITE and/or access roads and approaches thereto, suspension of work, sabotage and other cause whatsoever.
- (vii) The cost of all inspections, tests and certificates relative thereto including third party tests and/or inspections where necessary, and of items, instruments, Plant and/or tools and appliances required to conduct such inspection and tests.
- (viii) The cost of all materials supplied and/or intended for incorporation in the WORKS supplied within the scope of work, delivery thereof to the job SITE, loading, transportation and unloading thereof, waste on materials, and return of empties and surpluses.
- (ix) The cost of all escalations (foreseen and unforeseen) including but not limited to increase in Government taxes and duties (beyond contractual completion period and any extension hereof due to reasons attributable to CONTRACTOR), labour 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.
- 56.5.3 The prices stated in the Price Schedule and the LUMP SUM PRICE(s) shall not be subject to escalation or increase for any reason whatsoever unless otherwise provided in the CONTRACT documents.



56.5.4 In view of GST regime, Bidder to quote the Prices after considering Input Tax Credit (ITC).

56.6.0 Not Used

#### **56.7.0 MODE OF PAYMENT AND TAX DEDUCTIONS**

56.7.1 All payments made under or in terms of the CONTRACT, payable in Indian currency, shall be paid through RTGS/ Electronic Fund Transfer mechanism (EFT) in the CONTRACTOR's bank account (RTGS shall mean Real Time Gross Settlement- a term used by Indian banking industry for electronically transferring money from one account to the other account). CONTRACTOR shall within 15 days of the EFFECTIVE DATE provide to OWNER its bank account details for the purpose of RTGS/EFT. All cheques drawn shall be payable at the designated office of the OWNER's bankers and in no case will the OWNER be responsible if the cheque is mislaid, misappropriated or otherwise lost or stolen.

56.7.1.1 Deleted

56.7.2 The CONTRACTOR shall be primarily responsible for the payment of all Indian Income tax.

56.7.2.1 Deleted

56.7.2.2 The CONTRACTOR shall be exclusively liable to pay directly to the concerned Income Tax Authorities in India and to bear all Indian Taxes payable relative to employment of any personnel by the CONTRACTOR.

56.7.2.3 Payments to a CONTRACTOR resident in India shall be subject to deduction of taxes under Section 194 C of Income Tax and/or under other Section, law, rule or regulation for the time being in force providing for the deduction of tax at source.

56.7.3 If any TDS is deductible by the OWNER on the WORK undertaken by the CONTRACTOR, the OWNER shall be responsible for issuing the TDS Certificates within the timelines prescribed under GST laws.

#### **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 PROJECT MANAGER shall be authorised to require the CONTRACTOR to furnish, and the CONTRACTOR shall, upon the request of the PROJECT MANAGER /OWNER, furnish all invoices, vouchers and accounting records as may be deemed necessary by the PROJECT MANAGER /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 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 and accepted claims included in his Final Bill and the right to receive payment of the unadjusted balance of the Security Deposit in accordance with the provisions of Clause 56.10.3 on successful completion of the DEFECT LIABILITY PERIOD. But 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 notwithstanding any qualifying remarks, protest or condition imposed or purported to be imposed by the CONTRACTOR relative to the acceptance of such payment made as aforesaid with the intent that upon acceptance by the CONTRACTOR of any payment made as aforesaid, 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 security deposit in accordance with clause 56.10.3.0 hereof on successful completion of the DEFECT LIABILITY PERIOD. But 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 of GCC, 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 of GCC and shall be and remain entitled to receive the unadjusted balance of the Security Deposit remaining in the hands of the OWNER in terms of Clause 56.10.3 of GCC and associated clauses thereunder.

**56.10.0 FINAL ACCEPTANCE CERTIFICATE AND RELEASE OF SECURITY**

- 56.10.1 Forthwith on the CONTRACTOR's application made after the expiry of DEFECT LIABILITY PERIOD provided and associated clauses thereunder and satisfaction of all liabilities of the CONTRACTOR in respect thereof, the PROJECT MANAGER 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.
- 56.10.2 Upon application for the FINAL ACCEPTANCE CERTIFICATE, the CONTRACTOR shall:
- (i) Be deemed to have warranted that it had been fully paid and satisfied all claims for or arising out of the WORK, labour, MATERIALS, supplies and EQUIPMENT used in or connected with the CONTRACT and all other liabilities whatsoever touching or affecting the CONTRACT, or its performance, including in relation to SUBCONTRACTORS 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, Infringement of patents, copy right etc.
- 56.10.2.1 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.
- 56.10.3 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 security deposit shall be subject to the CONTRACTOR replacing such Bank Guarantee(s) with a Bank Guarantee from any Nationalised / Schedule Bank of RBI in a format acceptable to the OWNER covering 10% ( ten percent) of the value (as determined by the OWNER) of equipment/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.

**56.11 CLAIMS OF OWNER**

56.11.1 The release/payment of any unadjusted balance of the Security Deposit (furnished in the form of a Bank Guarantee or otherwise) by the OWNER to the CONTRACTOR as aforesaid or otherwise shall not be deemed or treated as a waiver of any right(s) or claim(s) of the OWNER existing before the issuance of the FINAL ACCEPTANCE CERTIFICATE or shall not stop or prevent the OWNER from thereafter making or enforcing any claim or any rights existing before the issuance of the FINAL ACCEPTANCE CERTIFICATE against the CONTRACTOR with the intent that the claims of the OWNER, against the CONTRACTOR shall continue to survive and shall not get extinguished notwithstanding the issue of FINAL ACCEPTANCE CERTIFICATE and/or the release of Security Deposit to the CONTRACTOR.

**57.0 UNDERGROUND OBSTRUCTIONS**

Underground obstructions, if any will be removed by Owner. The soil investigation report furnished in the technical part is to be considered for preparation of bid.

**58.0 REGISTRATION OF THE CONTRACTOR WITH STATUTORY AUTHORITIES**

58.1 Within 30 days of execution of the CONTRACT, the CONTRACTOR shall, insofar as necessary, register itself and the CONTRACT at their own cost with the Reserve Bank of India, Income Tax, GST and/or any other applicable statutory authorities as required under the rules and regulations governing in India. The TOTAL 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.

58.2 Immediately after notification of the acceptance of Bid, the foreign CONTRACTOR shall obtain permission for opening of their office(s) in India from the Reserve Bank of India, and shall obtain Income Tax clearance from Indian Income Tax authorities. Among other formalities, these will be required by the OWNER to release any payment due to the CONTRACTOR.

**59.0 STATUTORY APPROVALS**

59.1 Unless otherwise specified in Bidding Documents, it shall be the CONTRACTOR's sole responsibility to obtain all approvals from any authority required under any statute, RPCB, 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 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 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.



**59.2** 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 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.

**59.3** No extension of time shall be granted for meeting the requirement and/or obtaining APPROVAL of statutory authorities.

#### **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 surplus MATERIALS including scrap shall belong to the CONTRACTOR upon completion of the WORKS.

**62.2** For taking out balance 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 PROJECT MANAGER and OWNER in this regard.

#### **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 PROJECT MANAGER 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.



**63.3** The CONTRACTOR shall do the necessary co-ordination and liaison work, with the Piling contractor (to be engaged by the OWNER, separately) for taking over the completed piling work front from the piling contractor.

**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 PROJECT MANAGER for his APPROVAL. No EQUIPMENT shall be erected in the absence of an approved erection scheme for such EQUIPMENT. The quoted prices 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 CONTRACTORS 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 PROJECT MANAGER 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. The contractor shall deposit royalty and obtain necessary permit for supply for the red earth, moorum, sand chips, bajri, stone, kankar etc. from local authorities.

**67.0 DELETED**

**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 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** OWNER shall have the right to instruct and direct CONTRACTOR, as to the results to be obtained under the CONTRACT, and shall be entitled to ascertain whether the WORK is carried out in accordance with the requirements of the CONTRACT, including the right to inspect the WORK at all stages of its performance. Such instructions direction and/or inspection by OWNER shall not relieve CONTRACTOR of his obligation, duties or liabilities under the CONTRACT.
- 70.2** 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 CONTRACTOR obligations here under, unless otherwise specified in the CONTRACT.

#### **71.0 PAYMENT TO THE SUB-CONTACTOR**

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 good supplies in connection with the performance of the WORK.
- 71.2** If such satisfactory evidence is not supplied than the OWNER shall not be bound to make any further payment to CONTRACTOR for that part of work until it is supplies.
- 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 plan 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. OWNER shall approve the CVs of important personnel of CONTACTOR viz. Project Manager, Engineering Manager, Procurement Manager and Construction Manager.

#### **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 PROJECT MANAGER before start of WORK.
- 74.2** The CONTRACTOR shall not undertake or execute or permit any other agency or SUBCONTRACTOR 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 law, 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 PROJECT MANAGER 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 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 CONTRACT. 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 PROJECT MANAGER periodically or at any date upon such request, as may be made by PROJECT MANAGER 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**

### **75.1.0 Confidential Information**

#### **75.1.1 Non-disclosure**

- 75.1.1.1 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 nondisclosure to the other Party.



#### 75.1.2 Disclosure to Govt. Agency

- 75.1.2.1 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.
- 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.

#### 75.2.0 Training of Personnel

CONTRACTOR shall make necessary arrangements for the practical training of reasonable number of Technicians/Engineers of OWNER, if so desired by OWNER at its office or SUBCONTRACTOR's WORKS of manufacture in the operation and maintenance of EQUIPMENT without any extra cost such training shall be completed by CONTRACTOR before PRELIMANRY ACCEPTANCE. The expenses for travelling, lodging and boarding of the personnel of OWNER deputed for training shall be borne by OWNER.

#### 75.3.0 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 Liquidated 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 Liquidated Damages, CONTRACTOR shall pay immediately to OWNER such Liquidated Damages or the balance Liquidated Damages on demand.
- 75.3.3 For avoidance of doubt all the rights and remedies of OWNER and liabilities of the CONTRACTOR as set out in the CONTRACT shall be to the exclusion of any other rights, remedies or liabilities available at law.

**75.4.0 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.

**75.5.0 Cut-Off Dates**

No claims or correspondence on claims on this CONTRACT shall be entertained by either parties after expiry of the SECURITY CUM PERFORMANCE BANK GURANTEE, unless specified otherwise in CONTRACT.

**75.6.0 Paragraph Heading**

The paragraph heading in those conditions shall not affect the construction thereof.

**75.7.0 SITE Working and Safety Conditions**

CONTRACTOR shall follow the SITE working and safety conditions enclosed as per attached Volume-II of Technical Documents.

**75.8.0 Miscellaneous**

75.8.1 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.

75.8.2 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 fees payable under CONTRACT by reason of its being unable to carry out WORK owing to inclement weather.

**76. ADDITIONAL PERFORMANCE SECURITY**

76.1 In addition to performance security as specified an Additional Performance Security shall also be taken from the successful bidder in case of unbalanced bid. The Additional Performance Security shall be equal to fifty percent of unbalanced bid amount. The Additional Performance Security shall be deposited in lump sum by successful bidder before execution of Agreement. The Additional Performance Security shall be deposited through Demand Draft, Banker's cheque, Bank Guarantee.

Explanation: For the purpose of this rule:

- i) Unbalanced bid means any bid below more than fifteen percent of Estimated Bid Value.
- ii) Estimated Bid Value means value of subject matter of procurement mention in bidding documents by the Procuring Entity.



- iii) Unbalanced Bid Amount means positive difference of eighty five percent of Estimated Bid value minus Bid Amount Quoted by the bidder.

76.2. Additional Performance Security shall be refunded to the contractor after satisfactory completion of the entire work. The Additional Performance Security shall be forfeited by the procuring entity when work is not completed within stipulated period by the contractor.

**77. PUBLIC PROCUREMENT ( PREFERENCE TO MAKE IN INDIA)-GUIDELINES:**

Bidder is also required to comply the conditions laid down in respective Order(s) (amended time to time) issued by Ministry of Power, GOI and Department for Promotion of Industry & Internal Trade (DPIIT), GOI regarding "Public Procurement (preference to Make in India) to provide for Purchase Preference (linked with local content) in respect of Thermal Power Sector.

- (a) For supply of equipment / material from the country of origin other than India, the bidder shall submit performance certificate in support of satisfactory operation in India or a country other than the country of origin having climatic and operational conditions including ambient temperature similar to that of India for more than 02 years.
- (b) The technologies/products offered shall be environmentally friendly, consuming less energy, and safe, energy efficient, durable and long lasting under the prescribed operational conditions.
- (c) The supplier shall ensure supply of spares, materials and technological support for the entire life of the project.
- (d) The manufacturers/suppliers shall list out the products and components producing Toxic E-waste and other waste as may be specified. It shall have an Extended Producers Responsibility (EPR) so that after the completion of the lifecycle, the materials are safely recycled / disposed of by the Manufacturer/ supplier and for this the Manufacturer/ supplier along with procurer has to establish recycling / disposal unit or as may be specified.
- (e) The equipment/material sourced from foreign companies may be tested in accredited labs in India before acceptance wherever such facilities are available.
- (f) The bidder shall have to furnish a certificate regarding cyber security/safety of the equipment/process to be supplied / services to be rendered as safe to connect.
- (g) Applicable safety requirements shall be met. Regular safety audit shall be carried out by the manufacturer/supplier.
- (h) Statutory laws/regulations including the labour and environmental laws shall be strictly complied with during supply, storage, erection, commissioning and operation process. A regular compliance report shall be submitted to the procurer/appropriate Authorities
- (i) Wherever required, the foreign supplier shall establish fully functional service centers in India and shall keep spares/material locally for future needs of utilities.



## PART-I : COMMERCIAL

### ATTACHMENT- 3.0

### SPECIAL CONDITIONS OF THE CONTRACT (SCC)

FOR

**COOLING WATER SYSTEM**



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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 lump sum 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 design, engineering, supply of equipment, procurement (including, without limitation, all transportation services in connection therewith), construction, erection, start up, PRE-COMMISSIONING, COMMISSIONING, sustain load test, testing including conducting of Performance Tests and other work and services upto the PRELIMINARY ACCEPTANCE OF PLANT by the OWNER and in connection therewith provide all materials, equipment, machinery, tools, labour, transportation, administration and other services and items required to complete the PLANT in all respects upto the PRELIMINARY ACCEPTANCE OF PLANT and having the performance as guaranteed under the CONTRACT by the CONTRACTOR, submission of As-built Drawings on a total, fixed price basis in accordance with this CONTRACT. 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, completion commissioning, conducting of PERFORMANCE AND



**GUARANTEE TESTS and remedying of DEFECTS during DEFECTS LIABILITY PERIOD.**

- (c) Transportation from vendor 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; testing and commissioning, and PERFORMANCE AND GUARANTEE TESTS 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 (but not fuel, water and electricity for commissioning, testing and operating the PLANT which OWNER will provide to CONTRACTOR at no cost), chemicals, utilities, tools, supplies and other consumables and services; and
- (h) Rectification of defects during DEFECTS 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, based on mutual agreement between OWNER and CONTRACTOR, CONTRACTOR shall include such item of EQUIPMENT in the design and perform such items of WORK, for such EQUIPMENT or WORK without any additional 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 (previously 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 SUBCONTRACTOR/ vendor.



- 1.1.5** The CONTRACTOR shall be responsible for obtaining necessary approvals which are required for performing the WORK and which are to be issued in the OWNER's name from the various statutory authorities.
- 1.1.6** The CONTRACTOR shall provide full technical assistance including follow-up to OWNER 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 SECURITY CUM PERFORMANCE BANK GUARANTEE as per the enclosed format in line with the provisions of GENERAL CONDITIONS OF THE CONTRACT.
- 1.1.8** The enumeration in subsequent Clauses of SPECIAL CONDITIONS OF CONTRACT, in GENERAL CONDITIONS OF CONTRACT and other documents of CONTRACT shall not in any manner limit the general scope of obligations and responsibilities of designing, engineering, procurement, supply, construction, commissioning and proving the performance guarantees of PLANT within the scope of CONTRACT.
- 1.1.9** Deleted

**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**

**1.2.3.1** CONTRACTOR shall provide all design and engineering services necessary for completion of the PLANTS in conformity with the CONTRACT and Good Engineering Practices and the NIT including but not limited to:

- (a) Preparation of
  - ] Project design book which shall form the basis of PLANT design;
  - ] The conceptual design; and
  - ] The engineering and design necessary to describe and detail the PLANT and the Project.
- (b) Provision of criteria for the detailed design by other suppliers of equipment/system/structures for incorporation into the PLANTS.
- (c) Preparation of design, engineering, drawings, plans, bill of material, schedule and estimates for the PLANT and the project and the performance by CONTRACTOR of its obligations hereunder so that the PLANT constructed and commissioned by the CONTRACTOR is capable of meeting the performance guarantees and will be such as could be legally, safely and reliably placed in commercial operation by the OWNER.



- (d) CONTRACTOR shall perform the design and engineering for PLANT so that when constructed and commissioned, PLANT shall be capable of meeting the guarantees with respect to quality and quantity of products, consumption of raw materials and utilities (in terms of WORKS COST for PLANT), and Pollution Level as guaranteed under CONTRACT and shall be reliable and safe and operable in accordance with the sound engineering practice. CONTRACTOR shall ensure design capacity of all sections of PLANT in accordance with CONTRACTOR's experience and expertise for obtaining a full throughput under varying conditions within the limits specified in CONTRACT. PLANT shall be designed so as to be capable of producing at full plant capacity when operated as specified in FINAL PROPOSAL. CONTRACTOR shall review the basic design conditions, including soil data, and other conditions furnished by OWNER in NIT. If CONTRACTOR observes any inconsistency or insufficiency in these data, CONTRACTOR shall bring to the notice of OWNER the same, before its use.

#### 1.2.4 Review and Analysis

CONTRACTOR shall review, analyse and optimise the steam system and power network of PLANT. CONTRACTOR shall allow PROJECT MANAGER to review WORK under CONTRACT including the optimisation of the steam and power network for PLANT. Subject to Clause 3 – CHANGE IN WORK/CHANGE ORDER CONTRACTOR shall incorporate in its design and engineering such additions and changes suggested by PROJECT MANAGER as long as these do not conflict with the responsibility of CONTRACTOR in fulfilling its guarantees under CONTRACT. CONTRACTOR shall not use any technical data, drawing, or document given by OWNER except for purpose of CONTRACT.

#### 1.2.5 Codes and Standards

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. CONTRACTOR shall comply with and shall cause the WORK and all components thereof (including, without limitation, the design and engineering of the PLANT) to comply with all APPLICABLE LAWS and APPLICABLE PERMITS as they may be in effect at the time of CONTRACTOR's performance under the CONTRACT.

The CONTRACTOR shall ensure that all actions on its behalf in connection with the WORKS shall be in compliance with applicable laws of India. The CONTRACTOR agrees to take all reasonable steps to ensure that Persons appointed by it in connection with the WORK shall comply with the applicable laws/ regulations/ guidelines and obligations.



### 1.2.6 Drawings and Documents

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, The CONTRACTOR shall also furnish As-built Documents to OWNER within 2 months of the PRELIMANRY ACCEPTANCE.

### 1.2.7 Owner's Review

CONTRACTOR shall associate PROJECT MANAGER, (appointed by OWNER at OWNER's cost), with WORK as carried out by CONTRACTOR and SUBCONTRACTOR / vendor. PROJECT MANAGER/ CONSULTANT shall review all documents and give its comments to CONTRACTOR within 14 (fourteen) days from the date of receipt of the same. Review as aforesaid by OWNER/Owner's Consultant and furnishing of comments by OWNER or the failure of OWNER to review or comment as aforesaid shall not relieve CONTRACTOR in any manner of its obligations including performance guarantees under this CONTRACT.

### 1.2.8 Procurement Services

1.2.8.1.1 As part of the WORK, CONTRACTOR shall procure and pay for, 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 of 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 MECHANICAL COMPLETION as given by CONTRACTOR. EQUIPMENT shall be procured from the vendor list agreed between CONTRACTOR and OWNER. In connection with its procurement work, CONTRACTOR shall be responsible for the shipping, transportation and delivery of all items fabricated, manufactured, constructed or procured as set forth in the FINAL PROPOSAL and the CONTRACT. All such items and equipment, materials and supplies to be provided by the CONTRACTOR pursuant to the CONTRACT shall be new and of required quality, free from improper workmanship or defects and properly warranted or guaranteed in accordance with the CONTRACT. Any apparent omission or error in the equipment specifications will be corrected by the CONTRACTOR to the extent required by the CONTRACT including FINAL PROPOSAL.

### 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/FINAL PROPOSAL but which is required for the satisfactory functioning of EQUIPMENT and realization of PERFORMANCE GUARANTEES shall be provided by CONTRACTOR without any extra cost.
- 1.2.8.2.3 CONTRACTOR shall ensure that the modern practices in the manufacture of high grade EQUIPMENT are followed notwithstanding any omission in the specifications.
- 1.2.8.2.4 The supplies including fittings, accessories, etc. shall be in strict compliance to the 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 under Clause -1.2.6. These documents shall include but not limited to technical documents, final drawings, preservation instructions, operation and maintenance manuals, test certificates, spare parts catalogues, AS BUILT DOCUMENTS, etc. in a bound book for all rotating EQUIPMENT and in a folder for other EQUIPMENT, before despatch of EQUIPMENT under intimation to OWNER.
- 1.2.8.2.7 The documents, required for statutory approvals once submitted during construction period by CONTRACTOR shall be firm and final and not subject to subsequent changes. CONTRACTOR shall be responsible for any payment of penalty as imposed by the Statutory Agencies consequent to furnishing of the incorrect data/drawings.
- 1.2.8.2.8 All dimensions and weights shall be in metric system.
- 1.2.8.2.9 EQUIPMENT to be supplied and WORK to be carried out under CONTRACT shall conform to and comply with the provision of relevant Regulations/Acts (of both) as may be applicable in the State of Rajasthan in India to the type of EQUIPMENT/ WORK carried out and necessary certificates shall be furnished.
- 1.2.8.2.10 CONTRACTOR shall provide cross sectional drawings wherever applicable to identify the spare part numbers and their location, e.g. the size of bearings/ seals, their make and number shall be furnished.



- 1.2.8.2.11 EQUIPMENT supplied under CONTRACT shall conform to the standards as specified in Clause -1.2.5.1.
- 1.2.8.3 CONTRACTOR shall furnish unpriced copy of Purchase Orders for equipments and major items as per the list to be mutually agreed (Priced copy of Purchase Orders 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,
- Lubrication schedule from VENDOR,
  - Mechanical specifications and equipment data sheets for review by OWNER for ALL EQUIPMENTS before manufacture is started,
  - Shop fabrication drawings from vendor,
  - Characteristic curves for pumps and compressors, etc. from vendor,
  - Certified drawings including civil scope drawing and loading data, pertinent bulletin, installation, operation and maintenance manuals and test certificates received from vendor,
  - Final revised vendor's drawings including one reproducible, as described in Technical Specifications, before PRELIMINARY ACCEPTANCE. Any changes necessary during commissioning period can be incorporated in the as-built drawing and will be submitted within 2 months from the issuance of PRELIMINARY ACCEPTANCE CERTIFICATE.
- 1.2.8.5 CONTRACTOR shall provide services of vendor's specialist for installation and commissioning of EQUIPMENT whenever necessary.
- 1.2.8.6 CONTRACTOR shall be responsible for the accuracy and completeness of PURCHASE ORDER. Any comments by PROJECT MANAGER shall not relieve CONTRACTOR of such responsibility.
- 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 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 FINAL PROPOSAL.
- 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. 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.



- 1.2.8.7.3 The inspection and tests may be conducted at the premises of CONTRACTOR or SUBCONTRACTOR/ 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 without any additional cost to the OWNER.
- 1.2.8.7.5 OWNER's right to inspect and wherever necessary, comment about EQUIPMENT after its arrival at SITE or its participation in tests in respect of any EQUIPMENT shall in no way be limited or waived by reason of EQUIPMENT having previously been inspected, tested and passed by OWNER or INSPECTOR/representative prior to its shipment/despatch.
- 1.2.8.7.6 INSPECTOR shall follow the progress of the manufacture of EQUIPMENT under CONTRACT to ensure that the requirements outlined in CONTRACT are not being deviated from with respect to Schedule and Quality.
- 1.2.8.7.7 CONTRACTOR shall allow INSPECTOR to visit, during working hours, the workshops relevant to execution of CONTRACT during the contractual period and INSPECTOR will have the right to inspect EQUIPMENT at all stages of manufacture right from identification of material up to its shipment/despatch, to the extent that the delivery schedule shall not be delayed, with prior notice to CONTRACTOR in writing.
- 1.2.8.7.8 In order to enable INSPECTOR to obtain entry visa in time, CONTRACTOR shall notify OWNER two months before assembly, testing and packing of main EQUIPMENT and if requested assist INSPECTOR in getting visa in the shortest possible time.
- 1.2.8.7.9 CONTRACTOR shall place at the disposal of INSPECTOR free of charge all tools, instruments and other apparatus necessary for the inspection and/or testing of EQUIPMENT. INSPECTOR is entitled to prohibit the use and despatch of EQUIPMENT that has failed to comply with the characteristics/specifications of EQUIPMENT during test and inspection.
- 1.2.8.7.10 CONTRACTOR shall ensure that the permission for inspection/test is granted by its SUB-CONTRACTOR/VENDOR.
- 1.2.8.7.11 In respect of the inspection, CONTRACTOR shall advise in writing of any delay in the programme at the earliest possible date, describing in detail what has caused the delay and the proposed corrective action.
- 1.2.8.7.12 All tests and trials in general of EQUIPMENT shall be witnessed by INSPECTOR. Therefore, CONTRACTOR shall confirm to OWNER by E-mail/fax 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.



1.2.8.7.13 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. No material shall be dispatched without dispatch clearance issued by inspecting officer/waiver of inspection/material dispatch clearance (MDCC) by the OWNER.

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 living, lodging and airfare/rail fare incurred in connection with INSPECTOR shall be borne by OWNER.

In case of the EQUIPMENT, MATERIALS and /or WORKS fail to pass the inspection performed by OWNER or by INSPECTOR and re-inspection is to be carried out, then any cost be incurred by OWNER or by INSPECTOR for carrying out such re-inspection shall be borne and paid by CONTRACTOR, any delay due to failure of such reinspection shall be to the account of CONTRACTOR and shall not become a reason for extension of time.

1.2.8.7.15 Nothing in Clause -1.2.8.7.2 to 1.2.8.7.14 shall in any way relieve CONTRACTOR from any guarantee/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.

1.2.8.7.16 Arrangements for all inspections required by Statutory Authorities (local) and as specified in Technical Specifications/FINAL PROPOSAL shall be made by CONTRACTOR. Certain category of EQUIPMENT/piping fall under the jurisdiction of Indian Boiler Regulations (IBR), irrespective of the fact whether these are proprietary in nature or not, certification from an internationally recognised agency approved by IBR is considered necessary to enable local IBR authorities to allow their installation and operation. In such cases, inspection and certification from such authorities will also have to be arranged by CONTRACTOR. CONTRACTOR shall also submit, as may be required by IBR authorities, necessary design calculations from respective fabricators and/or manufacturers of such EQUIPMENT.

1.2.8.7.17 Rejections, Removal of Rejected EQUIPMENT and Replacement

1.2.8.7.17.1 Preliminary inspection at SUB-CONTRACTOR's / vendor's works by INSPECTOR shall not prejudice OWNER for commenting on EQUIPMENT including its specifications on final inspection at SITE or claim under warranty provisions.



- 1.2.8.7.17.2 If EQUIPMENT is not of specification or fail to perform specified duties, OWNER shall be entitled to reject EQUIPMENT or part thereof and ask for modification, repair or free replacement within reasonable time subject to the relevant provisions in the CONTRACT.
- 1.2.8.7.17.3 In the event of such rejection, OWNER shall be entitled to use EQUIPMENT in a reasonable and proper manner for a time reasonably sufficient to enable it to obtain replacement from CONTRACTOR. After free replacement of such rejected EQUIPMENT by CONTRACTOR, 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, Owner shall 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 and Documents

- 1.2.8.9.1 Deleted.
- 1.2.8.9.2 Delivery schedule shall include time for submission of documents/drawings for review/approval, incorporation of comments, if any, and final review of drawings by PROJECT MANAGER. Within 14 (fourteen) DAYS after receipt by PROJECT MANAGER of any document requiring OWNER's review, PROJECT MANAGER shall either return one copy thereof to CONTRACTOR as it is, if PROJECT MANAGER has no comments or with its comments and reasons thereof.
- 1.2.8.9.3 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.



1.2.8.9.4 In case of delayed delivery beyond the stipulated delivery period, for reasons not attributable to OWNER, FORCE MAJEURE and suspension of WORK by OWNER, even though normal extension of GUARANTEED COMPLETION DATE time is allowed by OWNER, all extra costs on account of changes of statutory regulations/Acts or increase in price on any other account including any price variation, shall not apply to TOTAL CONTRACT PRICE and the same shall be borne by CONTRACTOR.

#### 1.2.8.10 Despatch, Transportation/Shipping

1.2.8.10.1 CONTRACTOR shall be responsible for despatch of EQUIPMENT by sea/rail/ road/air after proper packing and protection. The consignment shall be despatched after inspection by OWNER unless otherwise agreed to in writing however such inspection shall not constitute waiver of the CONTRACTOR's obligations, responsibilities for the EQUIPMENT including care, safety and preservation in any way and manner and the CONTRACTOR's responsibility and obligation in this behalf shall continue till PRELIMINARY ACCEPTANCE OF PLANT.

1.2.8.10.2 Generally, on-Deck shipment shall not be made without prior permission of OWNER. However, in case of towers, reactors, vessels and other large-sized EQUIPMENT, CONTRACTOR may, at its own discretion, make on-deck shipment, without OWNER's prior permission. In case of damage to such EQUIPMENT, during delivery or at any stage before PRELIMINARY ACCEPTANCE OF PLANT, CONTRACTOR shall be responsible for repair/replacement of EQUIPMENT.

1.2.8.10.3 Deleted

#### 1.2.8.10.4 Property in EQUIPMENT

1.2.8.10.4.1 CONSTRUCTION EQUIPMENT used by the CONTRACTOR and its SUBCONTRACTORS 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.

#### 1.2.8.10.4.2 Regarding surplus Materials, the Clause 62 of GCC shall be applicable.

1.2.8.10.4.3 The care and custody responsibility of CONTRACTOR for EQUIPMENT shall terminate upon PRELIMINARY ACCEPTANCE of PLANT.

#### 1.2.8.10.5 Assembly Marks and Name Plates

1.2.8.10.5.1 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.



- 1.2.8.10.5.2 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.
- 1.2.8.10.5.3 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.

**1.2.8.10.6 Despatch/Shipping notice**

1.2.8.10.6.1 CONTRACTOR shall notify OWNER by fax/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.

**1.2.8.10.7 Heavy Lift Consignment (HLC) or Over Dimensional Consignments (ODC).**

1.2.8.10.7.1 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 Eway Bills and other related provisions under the GST laws for movement of packages / Consignments.

1.2.8.10.7.2 Deleted

1.2.8.10.7.3 CONTRACTOR shall make his own arrangements for movement of all consignments including ODC.

1.2.8.10.7.4 Deleted

1.2.8.10.7.5 CONTRACTOR confirms that it has surveyed the route for transportation of ODC 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 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 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.

**1.2.8.10.8 Marking**

1.2.8.10.8.1 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

A/c (Contractor)

- a) CONTRACT /PO NO.: \_\_\_\_\_
- b) Equipment Description and Item Nos. : \_\_\_\_\_
- c) Package :\_\_\_\_\_ of \_\_\_\_\_
- d) Gross / Net Weight (Kgs.) : \_\_\_\_\_
- e) Dimension L x W x H cms. : \_\_\_\_\_
- f) WARNING MARKS (FRAGILE, ATTENTION, TOP, KEEP DRY ETC.)
- g) Forwarding No. : \_\_\_\_\_
- h) Part shipment/full shipment/final shipment : \_\_\_\_\_
- i) Each package shall bear a symbol contained in the package as follows:

'A' Storage in a closed storehouse.

'B' Storage under a shed.

'C' Storage in the open.

- 1.2.8.10.8.2 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).
- 1.2.8.10.8.3 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.
- 1.2.8.10.8.4 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.

**1.2.8.10.9 Packing List**

- 1.2.8.10.9.1 CONTRACTOR will include in each package an item-wise packing List, Invoice No. and associated drawings.
- 1.2.8.10.9.2 The packing list and any other documents shall be put in a closed polyethylene envelope and included in each package.
- 1.2.8.10.9.3 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".

- 1.2.8.10.10 Deleted
- 1.2.8.10.11 Deleted
- 1.2.8.10.11.1 OWNER requires ocean transportation by International repute carriers viz. Conference line vessels or by Indian flag Vessels.
- 1.2.8.10.11.2 Deleted
- 1.2.8.10.11.3 Deleted
- 1.2.8.10.11.4 Deleted
- 1.2.8.10.11.5 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 along with the applicable taxes, if any, shall be borne by CONTRACTOR.
- 1.2.8.10.12 Deleted
- 1.2.8.10.12.1 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. Copies shall also be sent to OWNER.
- 1.2.8.10.12.2 Insurance for transit risks and other risks shall be covered by CONTRACTOR.

#### **1.2.9 Spares, Special Maintenance Tools, Lubricants, Chemicals and Consumable**

- 1.2.9.1 CONTRACTOR shall procure and supply commissioning spares, special maintenance tools and fixtures for EQUIPMENT, lubricants, chemicals and consumable in sufficient quantity for COMMISSIONING and maintenance of PLANT, as described in FINAL PROPOSAL. The commissioning spares, special maintenance tools, lubricants, chemicals and consumable procured and supply shall be optimum, so as not to fall short during COMMISSIONING. 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 Commissioning Spares and Consumable**

- 1.2.9.2.1 CONTRACTOR shall supply spares and consumable required for construction, PRECOMMISSIONING, COMMISSIONING, start-up and testing of PLANT. The cost of spares and consumable shall be included in TOTAL CONTRACT PRICE.



#### 1.2.9.3 Special Maintenance Tools

1.2.9.3.1 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 TOTAL CONTRACT PRICE.

#### 1.2.9.4 Deleted

#### 1.2.9.5 Deleted

#### 1.2.9.6 Chemicals

CONTRACTOR shall supply all chemicals for first filling and make-up required up to PRELIMINARY ACCEPTANCE OF PLANT. The cost of these chemicals shall be included in the TOTAL CONTRACT PRICE.

#### 1.2.9.7 Lubricants

1.2.9.7.1 CONTRACTOR shall supply lubricants in sufficient quantity for the first filling and makeup required up to PRELIMINARY ACCEPTANCE of PLANT. The cost of lubricants shall be included in the TOTAL 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 Mandatory Spares

CONTRACTOR shall provide Mandatory Spares as per Volume-II of Technical Document. Notwithstanding anything contained in this CONTRACT, the charges for Mandatory Spares shall be included in CONTRACT PRICE. CONTRACTOR shall furnish the list of recommended spares. The recommended spares shall be optimum so as not to cause any short fall or excessive inventory. The quantity of recommended spares to be procured shall be mutually decided by OWNER and CONTRACTOR. CONTRACTOR shall indicate to its Supplier(s) that it will evaluate the bids for EQUIPMENT including the cost of Mandatory Spares and recommended spares to ensure that the prices quoted by bidders for Mandatory Spare and recommended spares are reasonable and competitive.

#### 1.2.9.9 Construction Tools

CONTRACTOR shall arrange at their own cost special construction aids, tools, tackles and fixture, required for construction of PLANT.

#### 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 SUBCONTRACTOR/ VENDOR on whom PURCHASE ORDER for EQUIPMENT covered under CONTRACT has been placed and will further ensure with its SUBCONTRACTOR/ VENDOR that, OWNER if so desired, shall have the right to place order for operational 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 of first class quality 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 shall be clearly indicated.
- 1.2.9.10.5 Spare parts shall be packed for long storage under tropical climatic conditions in suitable cases, clearly marked as to their intended purpose.
- 1.2.9.10.6 Notwithstanding anything provided elsewhere, all surplus materials shall be dealt as follows:
- a) Any balance surplus MATERIALS including scrap shall belong to the CONTRACTOR upon completion of the WORKS.
  - b) For taking out balance 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 PROJECT MANAGER and OWNER in this regard.

#### 1.2.10 Warranties 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 incorporates all recent improvements in design and materials unless provided otherwise in CONTRACT. CONTRACTOR further warrants that EQUIPMENT supplied under this CONTRACT shall be of first quality 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 12 months for all EQUIPMENT from the date of PRELIMINARY ACCEPTANCE.
- 1.2.10.1.3 The warranty shall be valid for the period as described under Clause - 1.2.10.1.2 from the date of PRELIMINARY ACCEPTANCE and shall be governed by Clause 17 of SPECIAL CONDITIONS OF CONTRACT. Should



any DEFECTS be noticed in design, material and/or workmanship within the said warranty period, PROJECT MANAGER shall inform CONTRACTOR and CONTRACTOR shall immediately on receipt of such intimation depute their personnel within 10 DAYS to investigate the causes of DEFECTS and arrange rectification / replacement / modification of the defective EQUIPMENT at SITE without any cost to OWNER, within a reasonable period. If CONTRACTOR fails to take proper corrective action to replace/ repair defective Equipment satisfactorily within a reasonable period, OWNER shall be free to take such corrective action as may be deemed necessary at CONTRACTOR's risk and cost, after giving notice to CONTRACTOR. OWNER shall promptly notify CONTRACTOR in writing of any claims arising under this warranty.

- 1.2.10.1.4 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 risks to transit to and from shall be borne by CONTRACTOR.
- 1.2.10.1.5 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 SECURITY CUM PERFORMANCE BANK GUARANTEE shall be suitably extended for the same. The value of the SECURITY CUM PERFORMANCE BANK GUARANTEE during the extended warranty period shall be 10 (Ten) percent of the cost of such repaired/replaced EQUIPMENT or its parts.
- 1.2.10.1.6 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.
- 1.2.10.1.7 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 taxes and duties etc. shall be borne by the CONTRACTOR. In case, the cost of such repair/replacement/WORK has been incurred by OWNER, CONTRACTOR shall reimburse the same immediately on demand by OWNER.
- 1.2.10.1.8 Damages to EQUIPMENT deriving from incomplete, erroneous instructions issued by CONTRACTOR will be considered CONTRACTOR's fault and will



be treated according to the provision of warranty clause. Normal wear and tear shall not come under purview of this clause.

#### 1.2.10.2 Spare Parts Warranty

The Contractor shall warrant that all spare supplied will be new and in accordance with the Contract Documents and will be free from defects in design, material and workmanship and shall further guarantee asunder:

- a) For any item of spares ordered or to be ordered by the OWNER for the plant which are manufactured as a continuous operation together with the corresponding main equipment/component, the Defect Liability Period will be twelve (12) months from the scheduled date of commercial operation of main equipment/plant under the Contract. 'Commercial Operation' shall mean the conditions of operation in which the complete equipment covered under the Contract is officially declared by the OWNER to be available for continuous operation at different loads upto and including rated capacity. Such declaration by the OWNER, however, shall not relieve or prejudice the Contractor any of his obligations under the Contract. In case of any failure in the original component/equipment due to faulty designs, materials and workmanship, the corresponding spare parts, if any, supplied will be replaced without any extra cost to the OWNER unless a joint examination and analysis by the OWNER and the Contractor of such spare parts prove that the defect found in the original part that failed, can safely be assumed not to be present in spare parts. Such replaced spare parts will have the same Defect Liability as applicable to the replacement made for the defective original part/component provided that such replacement for the original equipment and the spare replaced are again manufactured together. The discarded spare parts will become the property of the Contractor as soon as they have been replaced by the Contractor.
- b) For the item of spares ordered or to be ordered by the OWNER for the plant, which with the written approval of the OWNER, are not manufactured as a continuous operation will be warranted for 7000 hrs of trouble free operation if used within a period of eighteen(18) months reckoned from the date of delivery at site. However, if such spare parts are put to use after eighteen (18) months of the delivery at Site then the guarantee of such spares will stand valid till the expiry of thirty six (36) months from the scheduled date of Commissioning of equipment/plant covered under the contract or 7000 hrs of trouble free operation after such spares are put in service, whichever is earlier.

#### 1.2.11 Performance Guarantee of PLANT / EQUIPMENT

- 1.2.11.1 CONTRACTOR guarantees that the performance of PLANT supplied under CONTRACT shall be strictly in conformity with the specifications and shall perform the duties and have consumption, production and other guarantees set forth in CONTRACT.
- 1.2.11.2 If the performance of PLANT and/or any of EQUIPMENT fails to be as guaranteed and set forth in CONTRACT, CONTRACTOR shall investigate the



causes and provide without any additional cost to OWNER, design, engineering, MATERIALS and services and EQUIPMENT within a reasonable period to prove guarantees. CONTRACTOR's liability in this respect shall be unlimited, in accordance with the provisions of CONTRACT.

- 1.2.11.3 Deleted.

#### 1.2.12 Government Clearances, Permits and Certificates

- 1.2.12.1 CONTRACTOR shall procure at its expenses, all necessary APPLICABLE PERMITS, CTE/CTO, 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 connection with CONTRACT.
- 1.2.12.2 CONTRACTOR shall furnish necessary data/specifications/drawings etc. Of EQUIPMENT likely to be imported to OWNER for obtaining import licence / necessary Government Clearances, for the same. CONTRACTOR shall also furnish necessary technical information, data, drawing, etc. as and when required to OWNER for submission to Government/Statutory Agencies.

#### 1.2.13 Network Schedule

- 1.2.13.1 OWNER would be using a computerised time and cost monitoring system and CONTRACTOR shall provide necessary input data for the same. CONTRACTOR shall prepare within 30 (thirty) days from EFFECTIVE DATE OF CONTRACT and provide to OWNER a PROJECT MASTER SCHEDULE indicating the important milestones of activities relating to WORK from EFFECTIVE DATE OF CONTRACT to the date of FINAL ACCEPTANCE. This PROJECT MASTER SCHEDULE shall be discussed with and approved by OWNER. Based on the approved PROJECT MASTER SCHEDULE, CONTRACTOR shall also prepare network schedules for activities relating to WORK. CONTRACTOR shall obtain the details of progress of various activities of WORK from SUB-CONTRACTOR and vendor wherever required and update the network schedules and PROJECT MASTER SCHEDULE incorporating the progress achieved by CONTRACTOR, SUB-CONTRACTOR and vendor and submit the same to PROJECT MANAGER on monthly basis.
- 1.2.13.2 CONTRACTOR shall clearly indicate any delay in WORK in the above schedules and shall inform PROJECT MANAGER the action taken to achieve the GUARANTEED COMPLETION DATE.

#### 1.2.13.3 Time Schedule Network/Bar Chart

- 1.2.13.3.1 Within 30 (thirty) DAYS from EFFECTIVE DATE OF CONTRACT, CONTRACTOR shall submit to PROJECT MANAGER its time schedule regarding delivery of documentation, supply and manufacture of



EQUIPMENT, time schedule for placement of purchase order and SUB-CONTRACT, etc.

- 1.2.13.3.2 The time schedule will be in the form of a network and a bar chart clearly indicating all main or key events regarding documentation, supply of raw materials, manufacturing, testing and delivery of equipment, civil works, erection, commissioning, testing etc.
- 1.2.13.3.3 The original issue and subsequent revisions of such time schedule shall be sent to OWNER in two copies (of which one shall be a reproducible/soft copy). The time schedule network/bar chart shall be updated at least every month during the period of CONTRACT.

**1.2.13.4 Progress of WORK**

- 1.2.13.4.1 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 25<sup>th</sup> of every Month.
- 1.2.13.4.2 The progress shall be expressed in percentages for all activities.
- 1.2.13.4.3 The first issue of the progress report shall be forwarded together with the time bar chart.
- 1.2.13.4.4 OWNER shall also review the physical/actual progress of WORK on the basis of CONTRACTOR's time schedule documentation.
- 1.2.13.4.5 Irrespective of such review, CONTRACTOR shall advise OWNER at the earliest possible date of any anticipated delay in the progress.
- 1.2.13.4.6 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 SUBCONTRACTOR/ vendor.
- 1.2.13.4.7 Deleted.

**1.2.14 Transportation and Storing of EQUIPMENT**

- 1.2.14.1 CONTRACTOR shall be responsible for proper packing, transportation from vendor's workshop to port or railway station (whether by road, rail, ship or aircraft), handling and clearances at port or railway station including loading and unloading, customs clearance, carriage to SITE, unloading at SITE, warehousing, coding and tagging, storage including proper preservation, etc. of EQUIPMENT. Any special clearance, lifting, handling, loading/unloading, and transport arrangements for over dimensional consignments shall also be done by CONTRACTOR. CONTRACTOR shall ensure timely delivery of EQUIPMENT. CONTRACTOR shall 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. 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. Foot print Area required for fabrication to be mentioned in BID by CONTRACTOR.

#### **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 MECHANICAL COMPLETION and PRELIMINARY ACCEPTANCE of PLANT. CONTRACTOR shall organise these activities in appropriate sequence and use proper methods giving due regard to the requirements of safety, quality, sound engineering practice, compliance with relevant Codes and Regulations, and for achieving PRELIMINARY ACCEPTANCE of PLANT on or before GUARANTEED COMPLETION DATE.

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 authorised representatives present who shall have free access to the work at all times. If an OWNER's representative notifies the CONTRACTOR's representative of any deficiency in any work or in the supervision thereof, the CONTRACTOR shall make every effort to carry out such instructions consistent with best industry practice. The CONTRACTOR shall so far as reasonably feasible employ skilled workers who are Certified Tradesmen in the field(s) of their relative activities(s).

- 1.2.15.2 CONTRACTOR shall submit and adhere to the completion schedule of construction leading to MECHANICAL COMPLETION. Post MECHANICAL COMPLETION the CONTRACTOR shall consult the OWNER for the schedule of activities up to PRELIMINARY ACCEPTANCE and shall adhere to the completion schedule thus approved by the OWNER. In case PRELIMINARY ACCEPTANCE of the plant is delayed for reasons attributed to OWNER, the CONTRACTOR shall be compensated for the time and cost as mutually agreed with OWNER.

- 1.2.15.3 In case of delay in completion beyond the stipulated completion period as specified under Clause 1.2.15.2 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**



CONTRACTOR shall certify that all civil works, reinforced concrete, structures, permanent buildings and foundations has been designed in accordance with stipulations of relevant BIS Codes. Any Civil Work carried out by the Contractor not meeting the requirements of relevant Technical Specifications for Civil/Structural/Architectural works covered elsewhere in bid documents, relevant Indian Standard Codes and Contract stipulations, the same will be considered as Inferior quality Civil works by the Owner. The Contractor shall dismantle/demolish such inferior quality Civil works and reconstruct the same including supply of material, labour, etc. complete up to the satisfaction of the Owner/Company at no extra cost to the Owner. No extension in the time will be granted by the Owner for any inferior quality Civil works and Penalties thereupon due delay of work, as stipulated in relevant sections of the bid documents, will be applicable.

#### **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.
- 1.2.16.3 In case of any safety related violations by the CONTRACTOR, appropriate penalties shall be levied as per the extant HSE policy of OWNER.

#### **1.2.17 PRE-COMMISSIONING Services of PLANT**

- 1.2.17.1 CONTRACTOR shall render and be responsible for pre-commissioning activities leading to MECHANICAL COMPLETION. These activities will include relevant checking, adjustment, testing, calibration, running in and trial runs of individual items of EQUIPMENT, and other similar jobs. OWNER shall provide experienced/trained and suitable operating and maintenance personnel who will perform their tasks under the supervision and direction of CONTRACTOR.
- 1.2.17.2 CONTRACTOR shall provide experienced personnel as required for carrying out the PRE-COMMISSIONING activities with OWNER's personnel.
- 1.2.17.3 CONTRACTOR shall provide SUB-CONTRACTOR's / VENDOR's specialists wherever required. Suitable provision for such services shall be made by CONTRACTOR in PURCHASE ORDER/SUB-CONTRACT.

#### **1.2.18 Mechanical Completion**



CONTRACTOR shall be responsible for completing the design, engineering, procurement, inspection and expediting, arranging for transportation of EQUIPMENT, construction and PRE-COMMISSIONING for making PLANT ready for acceptance of feed stock before the MECHANICAL COMPLETION.

#### **1.2.19 Commissioning Services of PLANT**

- 1.2.19.1 CONTRACTOR shall be responsible for COMMISSIONING after PRECOMMISSIONING activities have been completed giving due regard to safety of EQUIPMENT according to sound international practice. OWNER shall provide experienced trained operating and maintenance personnel who shall work under the supervision and direction of CONTRACTOR. The COMMISSIONING activities shall include the following:
- Introduction of raw materials, utilities, lining-up of various sections of PLANT leading to production of ammonia and urea.
  - Stabilising PLANT and stepping up production to full plant capacity.
  - Demonstrating and Conducting sustained load test and Guarantee Test as per Volume-II, Technical.

- 1.2.19.2 CONTRACTOR shall provide engineers as required to commission PLANT. CONTRACTOR shall be responsible to provide supervision personnel for operation of PLANT until PRELIMINARY ACCEPTANCE and OWNER will operate the PLANT under the supervision and instructions of CONTRACTOR. During the sustained load test and the guarantee test, the range of operating conditions shall be within the limits of the design conditions and shall meet the requirements of safety and compliance with relevant Codes and Regulations.

#### **1.2.20 Performance Guarantee Test**

- 1.2.20.1 CONTRACTOR shall successfully complete PERFORMANCE TEST as early as possible after MECHANICAL COMPLETION.
- 1.2.20.2 CONTRACTOR shall, when PLANT is stabilized at full plant capacity to the satisfaction of OWNER, shall carry out PERFORMANCE TEST and prove Guarantees.

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 Rajasthan in India. FINAL PROPOSAL shall be based on the codes, and regulations applicable on date of submission of Final Priced BID (Revised Price bid, if any). In the event of change in any codes, laws or regulation applicable to PLANT 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 -3.0.

#### **1.2.24 Statutory Obligations**

- 1.2.24.1 CONTRACTOR shall comply with the requirements of all 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.
- 1.2.24.2 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).
- 1.2.24.3 The CONTRACTOR shall ensure that the SUB-CONTRACTOR shall comply with the Statutory Requirements, as applicable, for the execution of this CONTRACT.

#### **1.2.25 Progress Monitoring and Reporting**

- 1.2.25.1 CONTRACTOR shall develop a suitable system for monitoring and reporting progress on the various activities up to PRELIMINARY ACCEPTANCE. CONTRACTOR shall submit PROJECT MASTER SCHEDULE and detailed Network Schedule covering the activities and milestones starting from EFFECTIVE DATE OF CONTRACT until PRELIMINARY ACCEPTANCE, as described under Clause -1.2.13. These schedules shall include the activities of CONTRACTOR, SUB-CONTRACTOR and vendor. CONTRACTOR shall monitor progress continuously and submit to PROJECT MANAGER 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 PROJECT MANAGER as may be required by any other Government Authority or any other agency such as Financing Institution etc.

- 1.2.26 Deleted

#### **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 SUBCONTRACTOR/ 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 GUARANTEED COMPLETION DATE and any other activities leading to PRELIMINARY ACCEPTANCE by OWNER.

### 1.2.28 Co-ordination

1.2.28.1 CONTRACTOR shall render all necessary assistance to PROJECT MANAGER required for overall co-ordination of all activities connected with WORKS. For this purpose, CONTRACTOR and PROJECT MANAGER shall agree on a meeting as soon as practicable after EFFECTIVE DATE OF CONTRACT, 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) CONTRACTOR shall also supply PROJECT MANAGER any additional information required on the above matter during the performance of process design and basic engineering design. In the event, PROJECT MANAGER pursuant to its responsibilities of overall coordination 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 PROJECT MANAGER 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.

**1.2.30 CONTRACTOR's Representative and Key Personnel**

- 1.2.30.1 CONTRACTOR shall with prior consent of PROJECT MANAGER appoint a CONTRACT MANAGER to manage the execution of WORK and he shall be CONTRACTOR's authorized Representative in India. 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 in the name of CONTRACTOR and shall receive all notices/correspondence that OWNER serves on CONTRACTOR.
- 1.2.30.2 CONTRACTOR shall be responsible for the work performed by CONTRACT MANAGER and CONTRACTOR's personnel and shall under no circumstances be relieved of its responsibilities and obligations under CONTRACT on account of acts or omissions of CONTRACT MANAGER and personnel.
- 1.2.30.3 The Key Personnel shall hold the staff positions as indicated in CONTRACT. CONTRACTOR shall use reasonable efforts to ensure that such Key Personnel will be engaged in the execution of WORK continuously until their role is completed unless prior release is approved by OWNER, such approval not to be unreasonably withheld or delayed. Replacement of or addition to Key Personnel shall only be made with persons having qualifications and experience equal to or better than those replaced or added to, and shall be similarly subject to OWNER's prior approval. In the event, any person identified in CONTRACT decides to leave the employment of CONTRACTOR, CONTRACTOR shall use reasonable efforts to retain the services of such person until his portion of WORK is complete. CONTRACTOR further agrees not to remove from WORK Key Personnel, which OWNER considers to be necessary for the proper performance of WORK without the prior written approval of OWNER.

**1.2.31 General Warranties**

- I. CONTRACTOR shall perform WORK in full compliance with its FINAL PROPOSAL and all other terms and conditions set forth herein and shall achieve the performance parameters as mentioned in the CONTRACT.
- II. 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.
- III. 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.



- IV. The completed PLANT shall be free of DEFECTS and Deficiencies and shall be designed, constructed and engineered, in compliance with the Scope of Work.
- V. PLANT shall be designed, engineered, constructed, tested, completed and delivered based on international standards ,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 GUARANTEED COMPLETION DATE.
- VI. 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.
- VII. Adherence to the Operations Manual shall allow safe start-up, operation, maintenance and shut-downs of the completed PLANT, in accordance with CONTRACTOR's guidelines and will not impair any warranty or guarantee of EQUIPMENT incorporated or to be incorporated into PLANT.

#### **1.2.32 Additional Tests**

- 1.2.32.1 Except for tests required as per the provision of CONTRACT, OWNER may at any time prior to FINAL ACCEPTANCE OF PLANT request re-testing or additional testing of any EQUIPMENT, incorporated or to be incorporated into PLANT, or WORK if OWNER believes the results of earlier tests are not accurate or do not establish the true condition of EQUIPMENT or WORK being tested.
- 1.2.32.2 If a portion of WORK or any EQUIPMENT, incorporated or to be incorporated into PLANT, fails any additional test or retest requested by OWNER pursuant to Clause- 1.2.32.1, then CONTRACTOR shall correct or replace, or cause its SUBCONTRACTOR/ VENDOR to correct or replace, such item or portion so as to pass additional testing or re-testing and otherwise meet or conform to such requirements. No changes to time schedule or increase in the CONTRACT PRICE shall be granted with respect to such additional testing. CONTRACTOR shall solely bear any cost (Including any tax costs) resulting thereof (including the cost of any required uncovering and recovering of WORK). Neither the failure by OWNER to discover Defects and Deficiencies, nor any payment to CONTRACTOR in respect thereof shall prejudice the rights of OWNER thereafter to require and obtain from CONTRACTOR the satisfactory performance of WORK hereunder. OWNER shall not be deemed to have accepted any WORK as a result of any additional testing.

- 1.2.32.3 Deleted

#### **1.2.33 General**

- 1.2.33.1 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.



1.2.33.2 CONTRACTOR shall arrange insurance pursuant to Clause 28.0 of GCC, at its own cost.

1.2.33.3 CONTRACTOR shall provide necessary information, documentation, and assistance for obtaining any approvals from Financial Institutions or any other agencies or authorities.

## 2.0 OWNER'S OBLIGATIONS

OWNER shall be responsible for fulfilling all obligations as specified under the following heads:

### 2.1 Deleted

### 2.2 Overall Co-Ordination

The objective of overall co-ordination is to organise orderly execution of WORK, bring about requisite integration amongst the various project activities of executing agencies, to achieve the technical quality, cost objective of WORK and 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 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 Volume-II, Technical Documents 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 SUBCONTRACTOR'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 PROJECT MANAGER under the CONTRACT. The PROJECT MANAGER 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 PROJECT MANAGER and the CONTRACT MANAGER.



## 2.4 Government Clearances

All other approvals/clearances shall be obtained by CONTRACTOR. CONTRACTOR shall provide necessary services and assistance in obtaining Government clearances to be obtained in the name of OWNER.

## 2.5 Facilities for CONTRACTOR's Personnel

OWNER shall assist CONTRACTOR in obtaining Visas and other PERMITS from the appropriate authorities for CONTRACTOR's and SUB-CONTRACTOR's / vendor's expatriates to enter and stay in India as necessary for performance of WORK. OWNER shall also provide facilities to CONTRACTOR's expatriates in accordance with the provisions described in Clause-2.8.

## 2.6 Deleted.

## 2.7 Feed stock and Utilities

OWNER shall make available the feedstock and utilities subject to limit specified in CONTRACT and take over all products at BATTERY LIMIT as specified in CONTRACT.

## 2.8 Site Facilities

OWNER shall provide the following SITE facilities:

- (i) Nominate its personnel for general co-ordination of site activities.
- (ii) General security services. CONTRACTOR shall be responsible for safety and security of all EQUIPMENT and MATERIALS, its personnel and construction equipments.
- (iii) Construction Power & Construction Water shall be provided free of cost by OWNER at one point inside the plant premises.
- (iv) OWNER shall not provide any accommodation and facilities for travelling to and from SITE to the place of residence to the personnel of CONTRACTOR, deputed at SITE for performing WORK under CONTRACT.
- (v) OWNER shall not provide any accommodation and facilities for travelling to and from SITE to the place of residence to the personnel of SUB-CONTRACTOR and VENDOR.
- (vi) Area for making shed/covered storage for storing EQUIPMENT
- (vii) Area for CONTRACTOR's site office without any additional cost. Any construction for office etc. shall be to the CONTRACTOR's account.

## 2.9 DELETED

## 3.0 DELETED



#### 4.0 ACCEPTANCE OF PLANTS AND FACILITIES

CONTRACTOR's liabilities for the Performance Guarantees given for the PLANT and Facilities in respect of capacity, consumption, product quality and pollution level shall be discharged only when the PERFORMANCE AND GUARANTEE TESTS as stipulated in Volume-II, Technical Documents of NIT have been successfully carried out as per acceptance criteria specified below or alternatively, Liquidated Damages as stipulated in Clause 31 of GCC have been paid by the CONTRACTOR and OWNER has issued PRELIMINARY ACCEPTANCE CERTIFICATE.

#### 5.0 PLANT ACCEPTANCE CRITERIA

Subject to fulfilling PERFORMANCE AND GUARANTEE TESTS as per Volume-II, Technical Documents of NIT and Clause 18.0 of SCC, OWNER shall be in readiness to accept the PLANTS. CONTRACTOR shall take all steps to fulfil the provisions of the CONTRACT for OWNER to issue PRELIMINARY ACCEPTANCE CERTIFICATE.

#### 6.0 ISSUANCE OF PRELIMINARY ACCEPTANCE CERTIFICATE

Within 30 (thirty) DAYs from completing successfully PERFORMANCE & GUARANTEE TESTS by the CONTRACTOR, and CONTRACTOR fulfilling all the obligations under the provision of the CONTRACT, OWNER shall issue PRELIMINARY ACCEPTANCE CERTIFICATE to CONTRACTOR. If OWNER does not issue the certificate, OWNER will provide written notice stating the reasons for refusing to issue the certificate within 60 days of request. On issue of this Certificate by OWNER, CONTRACTOR shall become entitled to receive all 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 CONTRACT. The necessary permissions from Government of India/ Rajasthan 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/ Rajasthan and shall also strictly adhere to safety regulations of OWNER.

**8.0** **DELETED**

**9.0 MODE OF CONTRACTING**

**9.1** Notwithstanding anything stated elsewhere in the CONTRACT documents, the CONTRACT is awarded on lump sum turnkey basis with single source responsibility.

**9.2** The CONTRACT shall be in all respect being construed and governed in accordance with the Indian/GoR laws.

**9.3** It is clearly understood that the total consideration for the CONTRACT has been broken up into various components only for the convenience of payment of advance under the CONTRACT and for the measurement of deviation or modification under the CONTRACT(s).

**10.0 BID PRICES**

**10.1** CONTRACTOR shall quote Lumpsum price/Unit Rate Basis as per format Attachment-4.0, SCHEDULE OF PRICES, for entire scope of work as per provisions of the bidding documents.

**10.2** The TOTAL CONTRACT PRICE shall remain firm and fixed and shall be valid during currency of the Contract and shall not be subject to variation/escalation on any account except as otherwise specifically provided in the CONTRACT.

**10.3** The TOTAL CONTRACT PRICE shall be derived from SCHEDULE OF PRICES comprising the total of the price of Equipments/Materials, price of Services and prices for Civil & Structural Work.

**10.4** CONTRACTOR to note that breakup of lump sum price is for reference only and total price payable under the CONTRACT shall be restricted to TOTAL CONTRACT PRICE. The price evaluation shall be based on the criteria mentioned in ITB Section.

**The above TOTAL CONTRACT PRICE shall be considering entire Contract as "Works Contract Service".**

**10.5** The quoted price shall be deemed to be inclusive of all taxes, statutory levies, and duties including but not limited to municipal taxes, royalties, Custom duty and customs related duties, **Excluding GST**, irrespective of whether same is categorically specifically indicated or not. Prices, taxes, duties including GST on any transaction between CONTRACTOR and their Sub-Contractor/supplier shall be included in the TOTAL CONTRACT PRICE quoted by the CONTRACTOR.

**10.6** The price quoted shall be Lumpsum price/Unit Rate Basis as the case may be, for the entire scope of work, whether specifically mentioned or not.



- 10.7** Obligation of the CONTRACTOR is not limited to the quantities that the CONTRACTOR may either indicate in the breakup of lump sum prices along with his bid or in further detailed breakup of Lump sum price/Unit Rate Basis furnished after award of Work. CONTRACTOR shall carry out entire scope of Work/ Supplies/Services as detailed in various sections of bidding documents within the quoted Lump sum Price.
- 10.8** Lump sum price/Unit Rate Basis shall be deemed to be inclusive of the cost of any other supplies / work(s)/ services not specifically mentioned in the Bidding Document but are essentially required for the efficient, trouble free operation of the complete package, irrespective of whether the above unspecified supplies / work(s) / services are specifically mentioned in the Bidders bid or not.
- 10.9** The CONTRACTOR shall carefully examine the various clauses / sections of the Bidding Document inclusive of Scope of WORK, General Conditions of Contract, Special Conditions Of Contract, and Tender Specifications, Technical and Commercial amendments, if any etc. The CONTRACTOR shall include in his prices any sum he may consider necessary to cover the fulfilment of the various clauses contained therein. The items of work described and LSTK price stated shall be inclusive of everything necessary to complete the said item of work within the contemplation of the CONTRACT.
- 10.10** Spares for Start-up/Commissioning and Mandatory spares and any other Tools and Tackles as required are in CONTRACTORS scope and deemed to be included in their quoted TOTAL CONTRACT PRICE, irrespective of whether such spares / items are categorically mentioned or not in the CONTRACTORS bid. No claim on this issue shall be entertained at later date after award of work and at any stage during the faithful execution of the CONTRACT.
- 10.11** It shall be the sole responsibility of the CONTRACTOR to duly observe and faithfully perform and fulfil all obligations of all laws, rules, regulations, orders and formalities during the entire period / currency of the CONTRACT, applicable to Goods and Service Tax (GST), Custom duty etc, on the import, manufacture, sale and / or supply of any material(s)/ equipment to the OWNER and faithful performance of the Works Contract Service under the CONTRACT. The CONTRACTOR shall keep the OWNER and its Project Management Consultant (PMC) indemnified from and against any and all claims, demands, prosecutions, actions, proceedings, penalties, damages, demurrages and / or other levies whatsoever made or levied by any Court, Tribunal or the Customs or other Authorities with respect to any alleged breach or infractions of any applicable laws, rules, regulations, orders or formalities concerning the same and from the consequence thereof. In view of GST regime, CONTRACTOR shall quote the Prices Considering Input Tax credit (ITC).
- 10.12** The price of Works Contract Service shall be deemed to cover various factors including but not limiting to cost of materials / equipments / services, overheads, bidding cost, financing cost, profits, mobilization & demobilization cost etc, as applicable. Unless the Scope expressly excludes certain provision from the CONTRACTOR's scope in the Bidding document / CONTRACT, no additional



payment on any such head expressly not mentioned herein in the bidding document / contract shall be entertained at later date.

**10.13** OWNER will issue forms/documents periodically (as may be required under GST regime) wherever applicable on all interstate sale of materials by the CONTRACTOR to enable the CONTRACTOR to comply with and avail benefits of GST.

**11.0 CURRENCIES OF BID AND PAYMENT**

**11.1** BIDDER to quote prices in INR.

**11.2** The LUMP SUM PRICE quoted by the CONTRACTOR shall be gross of Indian Income Tax including withholding tax (if any), and the LUMPSUM PRICE(S) shall be deemed to include Indian Income Tax including withholding tax (if any).

**12.0 PRICES, TAXES AND DUTIES AND OTHER LEVIES**

**12.1** 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 responsible to pay on behalf of the OWNER any and all duties, taxes, levies and cesses including education cess etc lawfully payable on MATERIALS imported into India or within any local limits for permanent incorporation in the WORK(S), and on materials sold and supplied to the OWNER pursuant to the CONTRACT.
- (ii) The CONTRACTOR shall within the price of services and scope of services be responsible to pay on behalf of the OWNER any and all duties, taxes, levies and cesses including education cess etc, lawfully payable on any goods or EQUIPMENT imported into India or within any local limits for use in the performance of the WORK(S), and on services performed pursuant to the CONTRACT.
- (iii) The CONTRACTOR shall be liable for and shall pay any and all Indian fees, taxes, duties, levies and cesses including education cess etc., assessable against CONTRACTOR in respect of or pursuance to the CONTRACT. However, GST payment by the CONTRACTOR to the Tax Authority shall be made by the Owner to the CONTRACTOR at actual limited to the Amount indicated in the Bid.
- (iv) 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.

**12.2 Taxes, Duties and Levies in Foreign Countries**



The CONTRACTOR shall accept full and exclusive liability at his own cost for the payment of any and all taxes, duties, cesses and levies howsoever designated, as are payable to any government, local or statutory authority in any country as are now in force or as are hereafter imposed, increased or modified and as are payable by the CONTRACTOR, his agents, SUB-CONTRACTORS and Suppliers and its/their respective employees for or in relation to the performance of this CONTRACT. The CONTRACTOR shall be deemed to have been fully informed with respect to all such liabilities and shall further be deemed to have consideration and included the same in his bid and the LUMPSUM PRICE shall not be varied in any way on this account.

### 12.3 Tax Indemnity

It will be the duty of the CONTRACTOR to duly observe and perform all laws, rules, regulations, orders and formalities applicable to GST, any applicable cess GST, Customs Duty and other taxes on the manufacture, sale, import and/or supply of any material to OWNER and/or applicable tax and levies 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, demurrgages 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.

- 12.4 All the applicable taxes, duties etc. on supply of materials, services and otherwise required for execution of CONTRACT on Lumpsum price/Unit Rate Basis as quoted in Attachment-4.0, Schedule of Prices(SP) shall be included in the TOTAL CONTRACT PRICE except GST. GST amount paid by the Contractor shall be reimbursed by the Owner limited to amount indicated in the CONTRACT.
- 12.5 The CONTRACTOR confirms that other than GST, it has included all taxes, duties, levies etc., as applicable at prevailing rates as on the date of submission of bids/revised price bid, if any, in its CONTRACT PRICE. 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.
- 12.6 Within the contractual period, any differential tax liability arising on account of statutory variation in India in percentage of taxes, duties shall be paid by OWNER to CONTRACTOR or vice versa and the same may be reflected therefore in CONTRACT PRICE on submission of documentary evidence. However, in case of delay in PRELIMINARY ACCEPTANCE OF PLANT due to reasons attributable to CONTRACTOR, any increase in percentage of taxes/duties over and above those specified and quoted by the Bidder in Attachment-4.0, Schedule of Prices during the delayed period shall be to CONTRACTOR's account and shall not be reimbursed by OWNER.
- 12.7 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.

**12.8** Deleted

**12.9** Deleted

**12.10** Deleted

**12.11** Deleted

**12.12 INCOME TAX**

**12.12.1** TOTAL 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 certificate to CONTRACTOR. It is 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.

**12.12.2** 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.

**13.0 STATUTORY VARIATION IN TAXES AND DUTIES**

**13.1** If any new taxes or duties (including any increase in rate of any existing taxes or duties) are levied in India after the date of submission of bids on any payments due to the CONTRACTOR under the CONTRACT other than tax on income, wealth or profits of the CONTRACTOR, the OWNER shall reimburse the CONTRACTOR the amount of such taxes or duties lawfully paid and borne by the CONTRACTOR against proof of payment. However, this is applicable within the GUARANTEED COMPLETION DATE only and shall not be reimbursed by OWNER during the delayed contractual project completion attributable to CONTRACTOR'S account.

**13.2** If any existing taxes or duties are withdrawn or the rate is decreased after the date of submission of the bids on any payments due to the CONTRACTOR under the CONTRACT other than tax on income, wealth or profits of the CONTRACTOR, the OWNER shall receive the benefit of the reduced rate equivalent to the amount of such taxes or duties. This is applicable within the GUARANTEED COMPLETION DATE and also during the delayed contractual Project completion.

**13.3** In case of delayed completion beyond the GUARANTEED COMPLETION DATE 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 increase in price on any other account including price variation clause, if any, 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.

#### 14.0 TERMS OF PAYMENT

The Owner shall make progressive payment as and when they are due as per the payment schedule. The invoices along with the documents listed in the relevant clauses of the terms of payment shall be submitted by the Contractor to the consignee after verification of the same the payment shall be released by RVUN.

The invoices in quadruplicate along with the documents listed in the relevant clauses of terms of payment shall be submitted by the Contractor to The Chief Engineer/Project Manager, KSTPS at Kota, Rajasthan, which after verification from concerned Engineer-In-Charge shall be forwarded to the CCOA (KSTPS) Kota for the payment towards supply, erection, testing and commissioning of equipment & spares. The distribution of the invoice shall be 1 copy to Field/RRVUNL, 1 copy to Accounts Dept. / RRVUNL, 1 copy to RRVUNL/HQ, 1 copy to CE/Project Manager. No interest shall be paid on delayed payments (if any).

#### 14.1 PAYMENT TOWARDS SUPPLY OF EQUIPMENT

(a) 90% (Ninety percent) of the Ex-Works Price of each equipment along with 100% taxes & duties, freight and insurance shall be paid on pro-rata basis against receipt of equipment at Site and physical verification by the Owner/ Site Incharge appointed by the Owner, or his authorised representative. The Contractor shall submit the following documents along with the invoice to claim the above payments to the consignee:

- |   |  |                       |
|---|--|-----------------------|
| 1 | Invoice  | 1 original + 2 copies |
| 2 | Packing slip for each consignment included in  | 3 copies invoice.     |
| 3 | Original GST Invoice / Gate Pass in case of indigenous ex-works supply   | 1 original+2 copies   |
| 4 | Pre-despatch clearance certificate by Owner's Third Party Inspection agency/RVUN, wherever applicable or Supplier's certificate confirming that TPI/RVUN inspection is not applicable. | 1 original + 2 copies |
| 5 | Copy of Railway Receipt (RR) in case of rail transport OR Goods receipt Note (GR) in case of road transport  | 1 original + 2 copies |
| 6 | Received delivery challan acknowledged by Owner  | 1 original + 2 copies |
- (b) Balance 10% (Ten Percent) of the Ex-Works price of each equipment on completion of the Facilities, including all associated auxiliaries and ancillary works of entire Cooling Water System Package, Guarantee Test and issuance of completion certificate and Operational Acceptance Certificate by the Project Manager appointed by the Owner on Final Take Over of the Cooling Water System



**Note:**

- (i) The basis of pro-rata payments under sub-clause No 14.1.1 (a) onwards shall be the Billing Breakups mutually discussed & agreed at the contract stage, for which suitable proposals shall be submitted by the contractor.
- (ii) If the Contractor chooses to ship the equipment in shipper's containers, then the custom duty levied on such containers shall not be borne by the Owner and shall be payable by the Contractor himself.

**14.2 PAYMENT TOWARDS ERECTION, TESTING AND COMMISSIONING (ETC), CIVIL, STRUCTURAL & ARCHITECTURAL WORKS.**

**(A) PAYMENT TOWARDS ERECTION, TESTING AND COMMISSIONING (ETC),**

- a) 90% (Ninety percent) for ETC (except Civil, Structural & Architectural Works portion) works along with 100% applicable taxes & duties on pro-rata basis.

The Contractor shall submit the following documents along with the invoice to claim the above payments to the consignee

- i) Invoice 1 original + 2 copies.
- ii) Certificate certifying the completion of work claimed in invoice Three (3) copies
- b) Balance 10% (Ten Percent) for ETC (except Civil, Structural & Architectural Works portion) works on completion of the Facilities, including all associated auxiliaries and ancillary works of entire Cooling Water System Package, Guarantee Test and issuance of completion certificate and Operational Acceptance Certificate by the Project Manager appointed by the Owner on Final Take Over of the Cooling Water System

**Note:**

- (i) The basis of pro-rata payments under sub-clause No 14.2.A (a) onwards shall be the 'Billing Breakups' mutually discussed & agreed at the contract stage, for which suitable proposals shall be submitted by the contractor.

**(B) PAYMENT TOWARDS CIVIL, STRUCTURAL & ARCHITECHTURAL WORKS.**

Since lump-sum prices have been sought for Civil, Architectural & Structural steel works, price break-up for (i) Civil & Architectural Works & (ii) Structural Steel Works shall be submitted by the contractor for the approval of RRVUNL with proper justification and to facilitate payments as per payment terms stated here under. The owner's decision in this regard shall be final & binding on the Contractor.



**(i) Civil & Architectural Works Portion (including Construction Materials but Excluding Structural Works)**

- a) 90% (Ninety percent) of the Contract price for Civil Works portion of Installation Services along with applicable taxes & duties on pro-rata basis.

The Contractor shall submit the following documents along with the invoice to claim the above payments to the consignee

- i) Invoice 1 original + 2 copies.  
ii) Certificate certifying the completion of work claimed Three (3) copies in invoice
- b) Balance 10% (Ten Percent) of the Contract price for Civil Works portion of Installation Services on completion of the Facilities, including all associated auxiliaries and ancillary works of entire Cooling Water System Package, Guarantee Test and issuance of completion certificate and Operational Acceptance Certificate by the Project Manager appointed by the Owner on Final Take Over of the Cooling Water System.

**Note:**

- (i) Progressive payments linked with Civil & Architectural Works portion shall only be made after the issue of certificate by the Owner's Project Manager/Site In-charge, one for the quantum of work completed and the other by the Owner's Project Manager Field Quality surveillance representative for the successful completion of quality check points involved in the quantum of work billed.
- (ii) The basis of pro-rata payments under sub-clause No 14.2. B (i) (a) onwards shall be the 'Billing Breakups' mutually discussed & agreed at the contract stage, for which suitable proposals shall be submitted by the contractor.

**(ii) Structural Steel works portion, Including Cost of Materials, Fabrication & Erection**

- (a) **Fifty Percent (50%)** of the Contract price for Civil Works portion of **Structural Steel works portion, Including Cost of Materials, Fabrication & Erection** Services along with applicable taxes & duties upon receipt of steel materials at site on pro-rata tonnage basis on production of invoices along with Material Receipt Certificate issued by the Owner's Site Incharge/consignee and physical verification & certification by the Project Manager of having received & proper storage of the material by contractor.
- (b) **Eighteen Percent (18%)** of price component of the Structural Steel works on prorata basis on certification by the Owner's Site In-charge for the quantum of fabrication work completed and successful completion of quality check points involved in the quantum of work.



- (c) **Twelve percent (12%)** of price component of the Structural Steel works on erection of structural steel on pro-rata basis on certification by the Owner's Site In-charge for the quantum of erection work completion and on successful completion of quality check points involved in the quantum of work.
- (d) **Ten percent (10%)** of price component of the Structural Steel works on final alignment, bolting and/or welding etc. including primer coats of painting on prorata basis on certification by the Owner's Site In-charge or the quantum of work completed and on successful completion of quality check points involved in the quantum of work.
- (e) Balance 10% (Ten Percent) of the Contract price for Civil Works portion of **Structural Steel works portion, Including Cost of Materials, Fabrication & Erection** Services on completion of the Facilities, including all associated auxiliaries and ancillary works of entire Cooling Water System Package, Guarantee Test and issuance of completion certificate and Operational Acceptance Certificate by the Project Manager appointed by the Owner on Final Take Over of the Cooling Water System.

**Note:**

- (i) The basis of pro-rata payments under sub-clause No 14.2.B (ii) (a) onwards shall be the 'Billing Breakups' mutually discussed & agreed at the contract stage, for which suitable proposals shall be submitted by the contractor.

#### **14.3 PAYMENT TOWARDS SUPPLY OF MANDATORY SPARES**

- a) 90% of price of mandatory spares inclusive of 100% taxes & duties and inland transportation & insurance charges shall be paid against the following documents.

The Contractor shall submit the following documents along with the invoice to claim the above payments to the consignee

- |   |                        |
|---|------------------------|
| i) Invoice  | 1 original + 2 copies. |
| ii) Packing Slip  | Three (3) copies.      |
| iii) Copy of Railway Receipt (RR) in case of rail transport and material receipt certificate (MRC) from Owner's site authority in case of road Transport                      | Three (3) Copies       |
| iv) Receipt of Material & on physical verification by Owner.  | 1 original+2 copies    |
| b) Balance 10% of the price of mandatory spares shall be paid against a bank guarantee of equivalent amount and valid till 180 days beyond the completion of warranty period. |                        |

#### **14.5 PAYMENT RELATED TO ERECTION/CIVIL/STRUCTURAL WORKS**

- (i) Bidder shall maintain a single designated ESCROW account in any Scheduled/Nationalised Bank of India under intimation to Owner. All



payments related to Erection/Civil/ Structural works by the Owner due under the contract to the Contractor shall be released into above-mentioned ESCROW account set up as per the Tri-Partite Escrow Agreement between Owner, Contractor and Escrow Bank. The payment shall be disbursed in accordance with the mechanism set out in the Contract and Escrow Agreement. The purpose of the Escrow Account would be to ensure that payments received under the contract are solely used for implementation of the Contract. Under Tripartite Escrow Agreement, the Escrow Bank will agree to ensure that amounts received in the ESCROW Account are utilized for making payments only to suppliers of goods and services, statutory authorities, establishment expenses etc. as may be required in the performance of the contract.

- (ii) All expenses/charges for opening/operation (including Annual Fee) of the Escrow Account shall be paid by the Bidder.
- (iii) The draft agreement as per Annexure-1.26 shall be followed for executing Escrow Account Agreement. The Detailed Operative Procedure and Terms and Conditions of Escrow Account (Schedule III of draft agreement) shall be finalized between the Owner, Contractor and the Escrow Bank within 15 days of the placement of award.

#### **14.6 PAYMENT OF GST**

100% of paid GST Amount shall be reimbursed to the CONTRACTOR at actual limited to the amount indicated in the CONTRACT. Bidder shall also furnish the details of the rates of applicable GST on the SCHEDULE-1 of BOQ, under the Contract per the attached format in Annexure 1.33.

**14.7** Bidder must furnish the monthly Payment Schedule as per the attached format in Annexure 1.09.

**14.8** All invoices shall be submitted in duplicate to PROJECT MANAGER by the Bidder. The payment (except for FINAL BILL) shall be released within 45 days of submission of undisputed invoice. However, no interest shall be paid in case of delay of payment of any invoice.

#### **14.9 Instruction for INVOICING & Payment Documentation**

Invoicing shall be in compliance with the stipulations of the LOI/Contract Agreement and the following instructions. Contractor is liable for all costs arising from noncompliance with the instructions. As far as possible, description of Works in invoice shall match the description in Work Order.

**Invoice for payment shall be addressed to Owner/ Project Manager. The invoices shall be issued in the name of:**

**CHIEF ENGINEER(O&M)  
KOTA SUPER THERMAL POWER STATION  
SAKATPURA, KOTA, RAJASTHAN**

The invoice shall contain the following information:



- i. LOI No/Contract Agreement no/Work Order No.
- ii. Item no., quantity and complete description
- iii. Item-wise net price (unit and total) of the works where applicable.
- iv. Net amount payable by deducting advance payment already invoiced, if any, and the guarantee retention amount, if any, from the total value of the Works being invoiced. The signed invoices, original and copy shall be made on Contractor's letter head and shall be duly signed. Invoices for progress payment(s) shall state the information under (i), (ii) and (iii). Invoices for guarantee retention money shall state the information under (i) to (iv).

#### 14.9.1 Progress Payment

##### Supply Payment

The following documents shall be sent to the OWNER/ PROJECT MANAGER :

- Invoice in original and two (2 copies) duly certified by Owner/Consultant
  - Packing List (2 copies)
  - Test Certificate (4 copies)
  - Railway Receipt/Lorry Receipt (2 copies)
  - Insurance Certificate (2 copies) or copy of MCE Policy
  - Indemnity Bond as per Annexure1.27
  - Third Party Inspection Release Note or Inspection Certificate as per QAP approved by OWNER/PROJECT MANAGER or waiver certificate issued by OWNER/ PROJECT MANAGER (2 copies).
  - Acceptance Report in one (1) original plus two (2) copies from the beneficiary to the effect that equipment/material are received without any damaged conditions and are complete with respect to Specification/quantity mentioned in the Bill(s) of Material, duly certified by Owner/Consultant – Installation Services and Civil works payment:
- 1) Invoice for \_\_\_\_\_ in original and two (2) copies duly certified by Owner / Consultant.
  - 2) Performance certificate in one (1) original plus two (2) copies from the beneficiary to the effect that progress achieved is equal to progress invoiced, duly certified by Owner/Consultant.

#### 14.10 Submission of Final Bill

The final bill complete in all respect shall be submitted after certified completion of work. The bill should be accompanied with the following documents:

- i. Job completion certificate.
- ii. No claim certificate on RVUN's prescribed proforma.
- iii. Site clearance certificate.
- iv. Performance guarantee duly amended, as required, to cover the Defect Liability period.
- v. Indemnity certificate towards labours payment and all other statutory payments.



No claim shall be entertained after receipt of final bill. Settlement of final bill shall be made within 1 (one) month period subject to furnishing of all required documents / clarification and extension of time, if any, by RVUN's competent authority.

#### **15.0 BILLING SCHEDULE**

The CONTRACTOR shall provide a billing schedule based on agreed payment terms within 30 days from the EFFECTIVE DATE OF CONTRACT for approval by the OWNER. The CONTRACTOR shall raise invoice in the prescribed format with all the required information within the due date in terms of the provisions of GST laws. The invoices shall be supported by necessary documents as may be required by the OWNER.

#### **16.0 DELETED**

#### **17.0 LIABILITY FOR DEFECTS**

**17.1** If at any time before the PRELIMINARY ACCEPTANCE or during the DEFECTS LIABILITY PERIOD stated below, the PROJECT MANAGER:

- (a) Decides 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 reasonably predictable make good the DEFECTS 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 PROJECT MANAGER, submit his proposals for making good any DEFECT to the PROJECT MANAGER for his approval. Subject to Clauses 17.4, 17.8 and 17.9 hereof, the DEFECTS LIABILITY PERIOD shall be a period of 12 months from the date of PRELIMINARY ACCEPTANCE.

**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 (which is not covered under DEFECT LIABILITY) made good by the CONTRACTOR, the work done by the CONTRACTOR shall be the subject of CHANGE ORDER.

**17.3** The sustained load test is to be carried out before the PERFORMANCE & GUARANTEE TEST. The performance guarantees are demonstrated only through the PERFORMANCE & GUARANTEE TEST carried out before the achievement of the PRELIMINARY ACCEPTANCE CERTIFICATE. Bidder if available to 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 PROJECT MANAGER may require the CONTRACTOR to repeat any appropriate performance test for the purpose of establishing that the



DEFECT has been made good. The CONTRACTOR shall be responsible for the cost of any repeat inspection or test in the event of an inspection or test failure.

- 17.4** If in the course of making good any DEFECT which arises during the DEFECTS 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 DEFECTS LIABILITY PERIOD).
- 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 hereof 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 hereof 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 PROJECT MANAGER 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 hereof 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 PROJECT MANAGER and the CONTRACTOR may agree the amount to be paid by the CONTRACTOR, or in the absence of agreement the PROJECT MANAGER shall decide such amount as may be reasonable. Such amount shall be:
- deducted from any money that would otherwise be payable under the CONTRACT; or
  - paid by the CONTRACTOR to the OWNER
- 17.8** If the PLANT cannot be used because of a DEFECT to which this Clause 17 hereof applies, the DEFECTS LIABILITY PERIOD, or if applicable the extended DEFECTS LIABILITY PERIOD, shall be extended by a period equal to the period during which it cannot be used. Similarly the DEFECTS LIABILITY PERIOD, or if applicable the extended DEFECTS 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.
- 17.9** If any part of the PLANT has a working life, which is specifically notified by the CONTRACTOR under this CONTRACT, to be less than 12 months, the DEFECTS LIABILITY PERIOD for such part shall be the working life so stated.
- 18.0** **PERFORMANCE TESTS**
- 18.1** Before the start of performance test, the CONTRACTOR is required to carry out the sustained load test as detailed elsewhere in the NIT. The specific guarantees



under the CONTRACT in respect of the performance of the PLANT made by the CONTRACTOR which is verifiable by performances tests shall be governed by this Clause 18 hereof.

- 18.2** If the CONTRACT provides for the performance of the PLANT to be tested in sections or in parts, Sub-clause 18.3 to 18.7 hereof shall apply as if a reference to the PLANT were a reference to a section or a part.
- 18.3** The performance tests to be carried out on the PLANT shall those specified in Volume-II, Technical Document of NIT, PERFORMANCE AND GUARANTEE TEST. If any unspecified test is subsequently proposed, the CONTRACTOR and the PROJECT MANAGER shall discuss whether such tests should be carried out. If they agree that the test should be carried out, the PROJECT MANAGER shall order the test as a CHANGE ORDER.
- 18.4** The performance test shall be carried out by the OWNER in the presence of CONTRACTOR as soon as is practicable using suitably trained and experienced employees and in accordance with the manuals provided by the CONTRACTOR and such other instruction as the CONTRACTOR may give in the course of carrying out such tests. If any instruction conflicts in any way with or significantly adds to the manuals, the CONTRACTOR shall issue it in the form of an amendment. The performance test shall be carried out as far as practicable under the conditions, if any, detailed in the specification forming part of the CONTRACT, which sets out the technical definition of the PLANT.
- 18.5** The CONTRACTOR shall give a notice to the PROJECT MANAGER his readiness to carry out the performance tests after completion of sustained load test, including a proposal for the time at which the tests would commence. The CONTRACTOR shall then confirm, at least seven DAYS before the commencement of the performance tests.
- 18.6** Every performance test shall be carried out to completion unless the PROJECT MANAGER or the CONTRACTOR shall order it to be stopped because its continuance would be unsafe or unacceptable to either Party.
- 18.7** The result of the performance tests shall be compiled and evaluated jointly by the OWNER or the PROJECT MANAGER and by the CONTRACTOR.
- 19.0 FINAL ACCEPTANCE CERTIFICATE**
- 19.1** Subject to Sub-clause 17.8 and 19.2 hereof 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 or a Section in accordance with Clause 17 hereof (Liability for Defects), whichever is later, the PROJECT MANAGER shall issue a certificate (a 'FINAL ACCEPTANCE CERTIFICATE') to the CONTRACTOR stating that the PLANT or Section and any related work have finally been completed and the date of that completion.
- 19.2** If Sub-clause 17.4 hereof continues to apply to any part of the PLANT, the PROJECT MANAGER shall as soon as Sub-clause 19.1 hereof is otherwise satisfied, issue a FINAL ACCEPTANCE CERTIFICATE for the remainder of the PLANT or Section in which the repair or part is included, provided that such repair



or part is then free from DEFECTS which the CONTRACTOR is bound to make under Clause 17 hereof. Such repair or part shall then be treated as if it were a separate Section and shall be the subject of separate FINAL ACCEPTANCE CERTIFICATE.

- 19.3** Deleted.
- 19.4** 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 that part of the PLANT and made good all DEFECTS therein in all respects in accordance with his obligations under the CONTRACT. Where there is more than one FINAL ACCEPTANCE CERTIFICATE the last to be issued shall be identified as being the last FINAL ACCEPTANCE CERTIFICATE. No FINAL ACCEPTANCE CERTIFICATE shall be conclusive as stated above if it or any other FINAL ACCEPTANCE CERTIFICATE was issued in reliance upon any fraudulent act, misrepresentation or concealment.
- 20.0** **DELETED**
- 21.0** **DELETED**



**VOLUME-I : COMMERCIAL**

**ATTACHMENT – 4.0**

**BOQ  
[SCHEDULE OF PRICES (SP)]**

**FOR**

**NIT FOR COOLING WATER SYSTEM  
FOR KSTPS KOTA**

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## NIT FOR COOLING WATER SYSTEM. FOR KSTPS KOTA Unit 5

<a href="#">Validate</a>	<a href="#">Print</a>	<a href="#">Help</a>	<a href="#"><u>ItemRateBoQ</u></a>
Tender Inviting Authority: Dy.ChiefEngineer(TD),RVUN,Jaipur			
Name of Work: Cooling Water System - Package for Unit-5, KSTPS Kota Rajasthan, India			
Tender No: TNC- / 2022-23 (FCE-1117155-ME-DOC-SPC-3000-033)			
Name of the Bidder/ Bidding Firm / Company :			
<b><u>PRICESCHEDULE</u></b>			
(This BOQ template must not be modified/replaced by the bidder and the same should be uploaded after filling the relevant columns, else the bidder is liable to be rejected for this tender. Bidders are allowed to enter the Bidder Name and Values only )			
<b>Note:</b> We understand that			
1 We have considered all Taxes & Duties as applicable on a day seven (7) days prior to the last date for submission of bid, as amended, which shall be payable by employer in accordance with the provisions of Bidding documents			
2. The Taxes & Duties indicated below shall also be considered for evaluation purposes			
3. Taxes & Duties, shall be reimbursed at actual within the ceiling limits indicated below			
4. Reimbursement of Taxes & Duties and variation there on, shall be made as per the declaration given by the bidder in the Form of Bid.			
5. Our prices indicated below are inclusive of any Royalties or Seigniorage Fee or Cess or other charges payable on the quarried or mined metal, minerals, or minor minerals, as per the relevant clause of the contract.			
6. We understand that all consumables i.e. Chemicals, Lubricants etc. and all spares required for carrying out the activities upto Preliminary Acceptance of the Cooling Water System shall be deemed to be included in the price quoted by us.			



**Rajasthan Rajya Vidyut Utpadan Nigam Ltd**

1x210 MW KSTPS Kota (Units- 5)

Commercial & General Conditions for Cooling Water System

NUMBER #	TEXT #	TEXT #	NUMBER #	NUMBER	NUMBER	DATE	NUMBER #	TEXT #
Sl. No.	Item Description	Units	BASIC RATE In Figures To be entered by the Bidder Rs. P	Amount of IGST/CGST/ SGST (In INR) To be entered by the Bidder	Any Other Taxes/Duties/ Levies (In INR) To be entered by the Bidder		TOTAL AMOUNT	TOTAL AMOUNT In Words
1	2	3	4	5	6		7	8
1	<b>SUPPLY OF EQUIPMENT / MATERIALS</b>							
1.1	Main Equipment: Lump sum Supply Prices of complete Mechanical, Electrical and Control & Instrumentation items for Commercial & General Conditions for Cooling Water System - Kota Unit 5 package.							
1.11	Equipment	L.S					<b>0.00</b>	INR Zero Only
1.12	Piping	L.S					<b>0.00</b>	INR Zero Only
1.13	Electricals	L.S					<b>0.00</b>	INR Zero Only
1.14	Instrumentation	L.S					<b>0.00</b>	INR Zero Only
1.15	Chemicals upto preliminary Acceptance of Plant	L.S					<b>0.00</b>	INR Zero Only
1.16	Misc.	L.S					<b>0.00</b>	INR Zero Only



**Rajasthan Rajya Vidyut Utpadan Nigam Ltd**

1x210 MW KSTPS Kota (Units- 5)

Commercial & General Conditions for Cooling Water System

NUMBER #	TEXT #	TEXT #	NUMBER #	NUMBER	NUMBER	DATE	NUMBER #	TEXT #
Sl. No.	Item Description	Units	BASIC RATE In Figures To be entered by the Bidder Rs. P	Amount of IGST/CGST/ SGST (In INR) To be entered by the Bidder	Any Other Taxes/Duties/ Levies (In INR) To be entered by the Bidder		TOTAL AMOUNT	TOTAL AMOUNT In Words
1	2	3	4	5	6		7	8
1.17	Lumpsum Supply Prices for MANDATORY SPARES ( As specified in General Technical Specifications)	L.S					0.00	INR Zero Only
2	SERVICES - (including Insurance, transportation, installation, erection, commissioning etc.)	L.S					0.00	INR Zero Only
3	CIVIL AND STRUCTURAL WORKS	L.S					0.00	INR Zero Only
<b>Total in Figures</b>							0.00	INR Zero Only
<b>Quoted Rate in Words</b>		<b>INR Zero Only</b>						



## ANNEXURE-1.01

## EXPERIENCE CRITERIA

Bidder shall furnish their Experience details with reference to the work, which pre-qualify them in line with Experience Criteria mentioned under Clause 8.0 of "Instructions to Bidders"  
(MARK ✓ FOR APPLICABILITY IN BOX OF DETAILS) -----

## 1.0 EXPERIENCE AS CONTRACTOR (refer ITB Clause 8.1.1)

SL.	DESCRIPTION	DETAILS
1.	Name of Project, Location (Executed by Bidder)	
2.	Description of work	
3.	Name of Owner, Postal Address, Phone / Fax No. / E-mail	
4.	Name of Consultant / Postal Address, Phone / Fax No. / E-mail.	
5.	Project Status <ul style="list-style-type: none"><li>• Date of Award</li><li>• Scheduled Mechanical completion date.</li><li>• Actual Mechanical completion date</li><li>• Actual Project completion date (handover)</li><li>• Delay in months (if any)</li><li>• Reasons for delay (if any)</li></ul>	
6.	Scope of work executed by Bidder's organization <ul style="list-style-type: none"><li>• Land Development Works -----</li><li>• Civil, Structural Works -----</li></ul>	
7.	Completion Status	Specify Date Act. Sch.
7.1	LD imposed/ Bonus claimed	- Completion Date • Whether completion certificate enclosed YES NO YES/NO ; if yes, brief the reason:
8.0	Document Furnished	
8.1	Copy of work order / Contract Agreement Enclosed	YES NO
8.2	Documentary proof from the End User/OWNER regarding satisfactory performance indicating the period of completion.	YES NO

**2.0 EXPERIENCE AS CONTRACTOR (refer ITB Clause 8.1.2)**

SL. NO.	DESCRIPTION	PROJECT – 1, 2 etc. (Separate sheets for each Project)
1.	Project name and description	
2.	(a) Awarded contract value (INR) (b) Final executed contract value (INR)	
3.	Name of Owner (a) Name and address of Owner's contact person (b) Telephone and Fax No. (c) Mobile No. (d) Email No.	
4.	(a) Date / month / year of award / commencement of Project (b) Date / month / year of Scheduled Completion of the Project. (c) Date / month / year of Actual Completion of the Project.	
5.	Document Furnished	YES/NO
5.1	Copy of work order / Contract Agreement enclosed	
5.2	Completion/Acceptance certificate identifying the successful commissioning of project.	

Bidder hereby declares that the above filled in information are true to the best of it's knowledge and in case it is found incorrect, RVUN shall have the full right to reject the bid / terminate the contract and take any action as per applicable laws for breach of contract including forfeiture of Bid Security/Performance Bank Guarantee.

**Note :**

1. Bidder shall furnish the experience details as above of Projects which they consider suitable for their pre-qualification. OWNER reserve the right not to evaluate any other Project details.
2. Bidder to note that this exhibit form shall be filled as per the Proformas as stated, along with wherever applicable, copies of work order and completion certificates.
3. **Bidder to note that non-submission of relevant supporting documents may lead to rejection of their bid.** It is to be ensured that all relevant supporting documents shall be submitted alongwith the bid in the first instance itself. Pre-qualification may be completed based on the details so furnished without seeking any subsequent additional information.

For and on behalf of .....

Stamp &amp; Signature : .....

Name : .....

Designation : .....

Date : .....



## ANNEXURE-1.02

### FINANCIAL CRITERIA

- 1.0 ANNUAL TURNOVER :** In line with Financial Criteria mentioned under Clause 8.2 of "Instructions to Bidders".

SL. NO.	FINANCIAL YEAR	TURNOVER IN INR
1	FY:2021-2022	
2	FY:2020-2021	
3	FY:2019-2020	

Whether copies of balance sheet and annual turnover statements for the above three financial years submitted YES / NO

Bidder hereby declares that the above filled in information are true to the best of it's knowledge and in case it is found incorrect, RVUN shall have the full right to reject the bid / terminate the contract and take any action as per applicable laws for breach of contract including forfeiture of Bid Security/Performance Bank Guarantee.

**Note:**

- Bidder to note that non-submission of relevant supporting documents may lead to rejection of their bid.** It is to be ensured that all relevant supporting documents shall be submitted alongwith the bid in the first instance itself. Pre-qualification may be completed based on the details so furnished without seeking any subsequent additional information.

For and on behalf of .....

Stamp & Signature : .....

Name : .....

Designation : .....

Date : .....



**ANNEXURE-1.03**

**TENDER ACCEPTANCE LETTER**  
**(To be given on Company Letter Head)**

**Date:**

**To,**

Sub: Acceptance of Terms & Conditions of Tender.

NIT No: TNC- /2022-23

Name of Tender/Work:-

Dear Sir,

1. I/We have downloaded/obtained the tender document(s) for the above mentioned 'Tender/Work' from the web site(s) namely:

\_\_\_\_\_ as per your advertisement, given in the above mentioned website(s).

2. I/ We hereby certify that I/ we have read the entire terms and conditions of the tender documents (including all documents like annexure(s), schedules(s), etc.,), which form part of the contract agreement and I / we shall abide hereby by the terms / conditions/ clauses contained therein.
3. The corrigendum(s) issued from time to time by your department/ organization too has also been taken into consideration, while submitting this acceptance letter.
4. I / we hereby unconditionally accept the tender conditions of above mentioned tender document(s) corrigendum(s) in its totality / entirely.

5. We hereby declare, that:

- (i) We are eligible and possess the necessary professional, technical, financial and managerial resources and competence required by the Bidding Document issued by the Procuring Entity;
- (ii) We have fulfilled our obligation to pay such of the taxes payable to the Central Government or the State Government or any local authority, as specified in the Bidding Document;
- (iii) We are not insolvent, in receivership, bankrupt or being wound up, not have our affairs administered by a court or a judicial officer, not have our business activities suspended and are not the subject of legal proceedings for any of the foregoing reasons;
- (iv) We do not have, and our directors and officers not have, been convicted of any criminal offence related to our professional conduct or the making of false statements or misrepresentations as to our qualifications to enter into a procurement



contract within a period of three years preceding the commencement of this procurement process, or not have been otherwise disqualified pursuant to debarment proceedings;

- (v) We do not have a conflict of interest as specified in the Rajasthan Transparency in Public Procurement Act, the Rajasthan Transparency in Public Procurement Rules and this Bidding Document, which materially affects fair competition;
  - (vi) We have complied and shall continue to comply with the Code of Integrity as specified in the Rajasthan Transparency in Public Procurement Act, the Rajasthan Transparency in Public Procurement Rules and this Bidding Document, till completion of all our obligations under the Contract.
  - (vii) I/We have carefully read and understood the terms and conditions of the tender and agree to abide by these. I/We have carefully noted that my/our offer, if contain any counter condition or additional conditions in the tender document/price bid/forwarding letter or any other enclosure of tender document will be liable for rejection by the department. I/w shall have no claim whatsoever against this rejection of offer. It is certified that I have not given any condition in price bid. If any condition is found the same may be treated as withdrawn. I/we also certify that at present we are not debarred/banned from business/suspended/removed from registration by any of the government department viz. central and state government organization/undertaking etc.
6. We have read the contents of the Banning Practices of RRVUNL attached with this Bidding document and agree to abide by this Practices as per RTPP Rules. Further, in terms of requirement under Banning Practices we hereby declare the following:
- a) We have not been Banned/Blacklisted/ debarred/ suspended/ removed from registration, as on date of submission of bid by Government of India or any other procuring Entity in India or in any other country during the last three years.
  - b) We have not employed any public servant dismissed/removed or person convicted for an offence involving corruption or abetment of such offences.
7. We further declare that if at any point subsequent to award of Contract, the declarations given above are found to be incorrect, RRVUNL shall have the full right to forfeiture of Bid Security/ terminate the Contract and take any action as per applicable laws for breach of contract including forfeiture of Performance Bank Guarantee.

Yours Faithfully,

Date

Place:

(Signature of the Bidder, with Official Seal)



**ANNEXURE-1.04**

**GUARANTEED CONSUMPTION FIGURES  
OF  
COOLING WATER SYSTEM**

Sr. No	Raw Material/ Utilities	Unit Price in Rs	Consumption per day (24 hrs) for required capacity as per specification	Total Work cost Rs per day (24 hrs)
a	b	c	d	e=cXd
<b>COOLING WATER SYSTEM: Bidder shall furnish the following details in reference to Technical Specification</b>				
1	Power, KWh	7.00	_____KWh/day	<b>Rs.....</b>
<b>Total Guaranteed Works Cost per day i.e.(In Words):</b>				

**Note:**

1. Bidder shall necessarily indicate the daily consumption figures as well as Work Cost, in above table without fail, against all the given fields.

For and on behalf of : .....

Stamp & Signature : .....

Name : .....

Designation : .....

Date : .....



**ANNEXURE-1.05**

**NO DEVIATION CERTIFICATE**

**(Self Declaration on Bidder's Letter Head as per below performance)  
DECLARATION**

1. With reference to our Bid Proposal No. ..... dated ..... for ..... at Kota, Rajasthan, against TNC- /2022-23, we hereby confirm that we comply with all terms, conditions and specifications of the Bidding Documents read in conjunction with Amendments(s) / Clarification(s) / Addenda / Errata (if any) issued by the Owner prior to opening of Techno- Commercial Bids and the same has been taken into consideration while making our Techno- Commercial Bid & Price Bid and **we declare that we have not taken any deviation / exceptions in this regards.**
  
2. We further confirm that any deviation variation or additional conditions etc or any mention, contrary to the Bidding Documents and its Amendments(s) / Clarification(s) / Addenda / Errata (if any) as mentioned at 1.0 above found anywhere in our Techno – Commercial Bid and / or price Bid, implicit or explicit, shall stand unconditionally withdrawn, without any cost implication whatsoever to the Owner, failing which the Bid Security shall be forfeited.

For and on behalf of : .....

Stamp & Signature : .....

Name : .....

Designation : .....

Date : .....



## ANNEXURE-1.06

## DETAILS OF SIMILAR WORKS EXECUTED

## NAME OF THE PROJECT: BIDDER TO FILL

Sr. No	FULL POSTAL ADDRESS OF CLIENT AND NAME OF OFFICER IN-CHARGE WITH PHONE/CELL NO AND E-MAIL	DESCRIPTION OF THE WORK	VALUE OF CONTRACT	DATE OF COMMENCEMENT OF WORK	SCHEDULED COMPLETION PERIOD	ACTUAL COMPLETION DATE	REMARKS

**Note :** 1) Description of work should be in detail.

2) Please also indicate the major problems if any, faced during construction of works.

STAMP & SIGNATURE OF BIDDER : \_\_\_\_\_

NAME OF BIDDER : \_\_\_\_\_

DATE : \_\_\_\_\_



## ANNEXURE-1.07

## CURRENT COMMITMENTS

Sr. No	DESCRIPTION OF WORK	FULL POSTAL ADDRESS OF CLIENT & NAME OF OFFICER IN CHARGE	CONTRACT VALUE	DATE OF COMMENCEMENT OF WORK	SHEDULED COMPLETION PERIOD	% AGE COMP. AS ON DATE	EXPECTED DATE OF COMPLETION	REMARKS

STAMP &amp; SIGNATURE OF BIDDER : \_\_\_\_\_

NAME OF BIDDER : \_\_\_\_\_

DATE : \_\_\_\_\_



## ANNEXURE-1.08

## CONTENT OF BID &amp; CHECK LIST

Bidder is requested to fill this check list and ensure that all details /documents have been furnished under relevant section as called for in the Bidding Document duly filled in, signed & stamped.

Please tick the box and ensure compliance:

**TECHNICAL AND COMMERCIAL BID:****PART-I : COVER-1: (Refer Clause 8.0 of Instructions to Bidders)**

Sr.No.	DESCRIPTION	SUBMITTED
i)	Scanned copy of details of payment made through electronic fund transfer towards Tender Cost, EMD and Scanned copy of DD for processing Fee.	-----

**PART-I COVER-2 :**

Sr. No.	DESCRIPTION	SUBMITTED
i)	Letter of submission	-----
ii)	Pre Qualification Criteria in favour of <b>Experience Criteria</b> as per <b>Annexure-1.01</b> along with Copies of Work Orders, Certificates from End User/OWNER and completion certificates in support of prequalification requirement.	-----
iii)	Pre Qualification Criteria in favour of <b>Financial criteria</b> as per <b>Annexure-1.02</b> along with copies Annual audited Report for the last three financial years. Annual Reports shall be a verifiable statement of annual accounts certified by a Chartered Accountant or Public Accountant in the form of printed annual reports or similar document.	-----
iv)	A declaration shall be submitted as per Annexure-1.13 to the effect that Bidder have or had not been <b>banned or blacklisted/del-listed</b> by any PSU/ Govt Organizations, etc.	-----
vi)	Photocopy of Integrity Pact	
vii)	Declaration- Tender Acceptance Letter as per Annexure-1.03	
viii)	Guaranteed Consumption figures of Cooling Water System i.e Power in Kwh/day as per Annexure-1.04	
ix)	No Deviation Certificate as per Annexure-1.05	
x)	Details of Similar Works Executed as per Annexure-1.06	
xi)	Current Commitments of the Bidder as per Annexure-1.07	



SL	DESCRIPTION	SUBMITTED
xii)	Contents of Bid and Check List as per Annexure-1.08	
xiii)	Deployment Schedule of Supervisory Personnel as per Annexure-1.22	
xiv)	Deployment Schedule of Construction Equipment / Declaration For Minimum Deployment Of Construction Equipments as per Annexure-1.23	
xv)	Details of Equipment Proposed to be used for this work as per Annexure-1.24	
xvi)	Work Completion Schedule / Time Schedule as per Annexure-1.25	
xvii)	ESCROW Agreement Format as per Annexure-1.26	
xviii)	Power of Attorney of Bid Signatory from the Competent Authority	
xix)	Details of misc. Supply of equipments and materials as per Annexure-1.12 (if quoted in Schedule-1 of BOQ)	
xx)	EFT Details as per Annexure-1.18	
xxi)	Financial Capability of Bidder as per Annexure-1.20	
xxii)	Bidder not under Liquidation, Court Receivership or Similar Proceedings as per Annexure-1.21	
xxiii)	Three (03) Nos copies complete Tender Document with all technical and commercial amendments/addendums if any issued, duly signed and stamped on each page as a token of having received and read all parts of the bidding document and having accepted and considered the same in preparing their bid as per Annexure-1.15.	
xxiv)	Any other information required in the Bidding Documents or considered relevant by the Bidder.	
xxv)	Litigation History as per Annexure-1.28	
xxvi)	Additional Conditions of the Contract as per Annexure-1.30	
xxvii)	FORM-I, Memorandum of Appeal as per Annexure-1.31	
xxviii)	Bid Security Declaration as per Annexure-1.32	
xxix	Details of GST rates as per Annexure-1.33	

For and on behalf of : .....

Stamp &amp; Signature : .....

Name : .....

Designation : .....

Date : .....



## ANNEXURE-1.09

## MONTHLY PAYMENT SCHEDULE

## MONTHLY PAYMENT SCHEDULE

SL NO.	PROPOSED PROJECT SCHEDULE	INDIAN CURRENCY (INR) (%)	REMARKS
1.	MONTH-1		
2.	MONTH-2		
3.	MONTH-3		
4.	MONTH-4		
5.	MONTH-5		
6.	MONTH-6		
7.	MONTH-7		
8.	MONTH-8		
9.	MONTH-9		
10.	MONTH-10		
11.	MONTH-11		
12.	MONTH-12		
13.	MONTH-13		
14.	MONTH-14		
..			
..			
..	TOTAL	100%	

**Note:**

1. The above payment schedule shall be considered for reference purpose only and not for evaluation.
2. The "S- curve" shall represent the break-up of the LSTK/Package price & should include all the taxes & duties including all the applicable GST, duties & CESS payable on reverse charge basis.
3. Bidder to indicate the % in respective column of Monthly Payment schedule while submitting the Techno-commercial un-priced Bid.

For and on behalf of : .....

Stamp &amp; Signature : .....

Name : .....

Designation : .....

Date : .....



**ANNEXURE-1.10**

**PROFORMA OF BANK GUARANTEE FOR EARNEST  
MONEY DEPOSIT (EMD)/ BID SECURITY**

Bank Guarantee No. ....

Date.....

To

The Chief Engineer (TD),  
RVUN, Jaipur,  
Room no. 501, 5th floor,  
Dreamax Plaza,  
Sahkar Marg,  
Jaipur- 302005

Dear Sirs,

In accordance with Invitation for Bids vide TNC- /2022-23 under your Bid Document No.

....., M/s.....(\*\*\*)..... having its Registered/Head Office at ..... (hereinafter called the 'Bidder') wish to participate in the said bid for [Name of Package] .....

As an irrevocable bank guarantee against Bid Security for an amount of .....  
(\*) ..... valid for ..... days from ..... (\*\*). required to be submitted by the Bidder as a condition precedent for participation in the said bid which amount is liable to be forfeited on the happening of any contingencies mentioned in the Bidding Documents.

We, the ..... [Name & address of the Bank]  
.....having our Head Office at.....  
(#) ..... guarantee and undertake to pay immediately on demand by ..... [Name of the Owner] (hereinafter called the 'Owner')  
..... the amount of ..... (\*).....without any reservation, protest, demand and recourse. Any such demand made by the 'Owner' shall be conclusive and binding on us irrespective of any dispute or difference raised by the Bidder.

This Guarantee shall be irrevocable and shall remain valid upto .....(@)..... If any further extension of this guarantee is required, the same shall be extended to such required period on receiving instructions from M/s .....(\*\*\*) .....[Bidder's Name]..... on whose behalf this guarantee is issued.



In witness where of the Bank, through its authorised officer, has set its hand and stamp on this.....day of.....20.....  
at.....

WITNESS :

.....  
(Signature)

.....  
(Signature)

.....  
(Name)

.....  
(Name)

.....  
(Official Address)

.....  
(Designation with Bank Stamp)

Authorised Vide .....

Power of Attorney No.....

Date.....

NOTE : The BG should be on Non-Judicial stamp paper/e- stamp paper of appropriate value as per Stamp Act prevailing in Rajasthan State where the BG is submitted (i.e. 0.25% of Amount secured (Max. of Rs. 25000=00) or as per the Stamp duty made applicable by Govt. of Rajasthan time to time from any scheduled/ nationalized bank in India to ensure the execution of the contract as per respective clauses. The Stamp Paper/e-stamp paper shall be purchased in the name of Bank issuing the guarantee.



**ANNEXURE-1.11**

**PROFORMA FOR SECURITY CUM PERFORMANCE SECURITY OF THE CONTRACT**  
(On appropriate Stamp Paper of Rs. 25000=00)

To,

The Chief Engineer  
RVUN, Jaipur,  
Room no. 501, 5th floor,  
Dreamax Plaza,  
Sahkar Marg,  
Jaipur- 302005.

THIS DEED OF GUARANTEE is made this day.....M/O.....Year 2023 between the Chief Engineer(TD), RVUN,Jaipur (hereinafter called the owner which expression shall unless excluded by or repugnant to the context includes his successors and assigns) of the one part and the (BG Executing Bank Name).....having its registered office (Fill Address) with e-mail, phone no. & Branch Office (Fill Address) (herein after called the Bank) (which expression shall unless excluded by or repugnant to the context includes its successors and assigns) of the other part.

**WHEREAS** M/s ..... Name with Complete Address (hereinafter called the Contractor) agreed to supply material/equipment/work to the Chief Engineer (TD), RVUN, Jaipur against Work Order No.....dated..... (hereinafter referred to as the Contract.)

**AND WHEREAS** as per the terms of the contract, it was provided that the Contractor should furnish a Bank Guarantee..... % of the total contract value by way of security for supplying free of cost any material that may be required due to defects arising from faulty materials, design and workmanship, so as to make it meet the guarantee and requirements of the contract.

**AND WHEREAS** at the request of the Contractor, the Bank has agreed to execute these presents.

**NOW THIS INDENTURE WITNESS AND IT IS HEREBY AGREED AND DECLARED BY**  
the and between the parties herein to as follows-

1. The Bank hereby guarantees to the Chief Engineer(TD), RVUN, Jaipur the fulfillment by the Contractor of the various obligations imposed on them under the aforesaid contract including the obligation of the Contractor to timely supply materials of the good quality and workmanship and the Bank further guarantees to the RVUN that the Contractor shall substitute and supply free of cost any materials that may be required due to defects arising from faulty material design and workmanship and the Bank undertakes to indemnify and keep the Chief Engineer(TD), RVUN, Jaipur indemnified to the extent of Rs. ..... (in words Rupees ..... ) against any loss or damage that may be caused to or suffered by the RVUN by reason of any failure by the Contractor to timely supply materials of good quality, design and workmanship as aforesaid and undertake to pay to the Chief Engineer(TD), RVUN, Jaipur on demand a sum not exceeding Rs. ..... (Rupees ..... ) in the



event of the Contractor failing or neglecting to perform and discharge the aforesaid duties and obligations on their part to be observed and performed under the said contract.

The decision of the Chief Engineer(TD), RVUN, Jaipur as to whether the Contractor have failed or neglected to perform or discharge their duties and obligations as aforesaid and as to the amount payable to the Chief Engineer(TD), RVUN, Jaipur by the Bank herein shall be final and binding on the Bank.

2. The guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the contract and it shall continue to be enforceable till the obligation to the RVUN under or by force of the contract have been fully and properly discharged by the said Contractor, subject however, to the condition that the RVUN will have no right under this guarantee beyond 06 months after completion of defect liability period and on fulfillment of all contractual obligation by Contractor, provided further that if any, claim arises by virtue of this guarantee before the aforesaid, date, the same shall be enforceable against this Bank notwithstanding the fact the same is enforced after the aforesaid date.
3. The guarantee herein contained shall not be affected by any change in the constitution of the Contractor/ Bank.
4. The Chief Engineer(TD), RVUN, Jaipur shall have the fullest liberty without affecting the guarantee to postpone for any time and from time to time any of the power exercisable by the Nigam against Contractors and either to enforce or forebear from enforcing any of the terms and conditions of the said contract and the Bank shall not be released from its liability under this guarantee and exercise of the RVUN of the liberty with reference to the matter aforesaid or by the reasons time being given to the Contractor or by any other forbearance, act or omission of the part of the RVUN to the Contractor or by other matter or thing whatsoever which under the law relating to the sureties shall but for this provision have the effect of so releasing the Bank from such liability.
5. The Bank agrees to extend this guarantee for a specified period as desired by owner in response to the owner written request, provided that such request is presented to the bank before the expiry of guarantee.
6. Chief Engineer means Chief Engineer / Addl. Chief Engineer (TD) or any other officer exercising the powers of Chief Engineer / Addl. Chief Engineer (TD) RVUN Ltd.
7. The Bank further undertake not to revoke this guarantee during its currency except with the previous consent of the ChiefEngineer(TD),RVUN,Jaipur in writing.
8. All disputes arising under the said guarantee between the Bank and the Nigam or between the Contractor and the Nigam pertaining to the guarantee, shall be subject to the jurisdiction of Courts in Jaipur alone.
9. Notwithstanding anything, contained herein before, the Bank's liability under this guarantee is restricted to Rs.....(Rupees.....) and the guarantee shall remain in force up to ..... unless demand or claim in writing is



presented on the Bank within six months from that date i.e .....(Grace Period), the bank shall be released and discharged from all liabilities there under. However, the validity of the BG shall be extended by bank as & when required by Owner.

10. We further undertake to pay this amount to the Chief Engineer(TD), RVUN, Jaipur without demur forthwith merely on demand from the Owner. Any such demand on Bank shall be conclusive.
11. IN WITNESS W HERE OF THE BANK HAS executed these presents the day and year written above.

Yours faithfully,

(EXECUTANT)

Signed by the above named bank in presence of (Name and address):.

(Attested by Notary Public, First Class Magistrate or directly confirmed by the Executing Bank)

**Note: The above Bank Guarantee will be on “non- judicial stamp paper of required rate as per stamp duty act of GoR i.e. 0.25% of amount secured (Maximum of Rs. 25000/-) or as per the stamp duty made applicable by Government of Rajasthan time to time, from any Nationalized/scheduled Bank in India to ensure the execution of the contract as per respective clauses.**



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**ANNEXURE-1.12**

**DETAILS OF MISC. SUPPLY OF EQUIPMENTS AND MATERIALS IF QUOTED IN  
BOQ( SCHEDULE-I)**



**ANNEXURE-1.13**

**PROFORMA FOR BLACK-LISTED**

**(Affidavit On Non Judicial Stamp for Meeting the PQR mentioned at Clause 8.0 of Instruction to Bidder(ITB))**

**(To Be Stamped In Accordance With The Stamp Act To Be Notarized By A Notary Public)**

Affidavit of Shri \_\_\_\_\_ S/o \_\_\_\_\_ aged about \_\_\_\_\_ R/o \_\_\_\_\_  
I, the above named deponent, do hereby solemnly affirm and declare in terms of requirement of clause 8.0 of Instruction to Bidder as under: -

1. That I am working as \_\_\_\_\_ (Designation) in \_\_\_\_\_ (Name and address of the bidder) since \_\_\_\_\_.
2. That I am duly authorized by \_\_\_\_\_ (name of the bidder) to submit this affidavit on its behalf.
3. That Bidder is submitting a bid vide our Proposal No.....dated..... in response to RVUN NIT Ref. No.\_TNC-...../2022-23 dt. \_\_\_\_\_ for .....(name of work)
4. That Bidder has not been Banned/Blacklisted/ debarred/ suspended/ removed from registration, as on date of submission of bid by Government of India or any other procuring Entity in India or in any other country during the last three years.
5. That the documents furnished by the Bidder are true including the contents thereof.
6. That if at any point of time the declaration given above are found to be incorrect, RVUN shall have the full right to reject the bid / terminate the contract and take any action as per applicable laws for breach of contract including forfeiture of Bid Security/Performance Bank Guarantee.
7. **DEPONENT Verification:**  
Verified at \_\_\_\_\_ on \_\_\_\_\_ day of \_\_\_\_\_ 20 that the contents of my above affidavit are true to best of my knowledge. No part of it is false and nothing material or relevant has been concealed therefrom.

**DEPONENT**  
(Bidder)



**ANNEXURE-1.14**

**FORMAT OF CONTRACT AGREEMENT**

**(On Rajasthan State Govt. Non-Judicial Stamp Paper of 0.15% of Total Contract Price as per applicable stamp duty at the time of Execution of Contract Agreement)**

This indenture made at .....On.....this .....day of the Month of .....of the Year.....between

(A) The Chairman Cum Managing Director Rajasthan Rajya Vidyut Utpadan Nigam a company incorporated under the company Act, 1956 having its registered office at Vidhyut Bhawan, Jyoti Nagar, Janpath, Jaipur-302005 in the state of Rajasthan (Herein after referred to as the purchaser) which expression unless the context does not permit includes his successors and assignees) of the one part and

(B) (To be used in case of Limited Companies)  
M/s..... Private/ Public Limited Company incorporated in .....under the as Companies Act .....and having its registered office at .....(complete address) and branch office at .....(address)

(B) (To be used in case of partnership concerns)

M/s.....a partnership firm Consisting of the following partners namely :-

(S. No.) (Occupation)	(Name)	(Age)	(Residence)
--------------------------	--------	-------	-------------

1.

2.

(B) (To be used in case of Proprietorship firm) M/s .....(Name of Contractor) having its office at.....(address)

(Hereinafter referred to as Contractors / Suppliers which expression unless the Context does not permit includes their respective successors, heirs, executors, administrators, legal representative and permitted assignees of the second part, Now hereby set their hands to execute this contract agreement witness as follows :-

1. The Contractor/Suppliers, do by these presents agree to supply to the purchaser/owner and to execute the.....(name of work) for .....(name of Plant) and the Purchaser/Owner does agrees to purchase from Supplier/Contractor the material and get executed from the contractor, the work as specified in the Work order No. RVUN/CE(Civil-Environment)- ..... / F. .... /D. .... /Dated appended and on the terms & conditions in the said order. The General terms & conditions of the contract appended hereto are considered a part of this agreement. The contractor will also bound to fulfill all the conditions mentioned in the Work order/GCC/SCC/Bid documents and amendments thereof.
2. The works to be made under this agreement shall be as per terms and conditions of the above order and as per the specification for TN. No. ....
3. The Contractor have deposited Rs. ..... ( In words Rs..... Only) in the form of BG/cash/ Demand draft/BC No. ..... Dated.....drawn in favour of .....with the owner as Security for due performance of this



- agreement or deposited EMD shall be converted into Security Deposit as per relevant clause of Work Order/GCC/SCC/Bid Documents.
4. The Specifications of the materials to be supplied/work to be executed under this agreement shall be as set forth in the schedule referred to above Work order/bid documents and as per specification mentioned in TN No. .... for.....(Name of Work)
  5. (a) The Suppliers/ contractor are to deliver the material F.O.R. ....  
.....packed in good condition.  
Free delivery at consignee Stores / Site by Road, Transport, duly packed in good condition conforming to specification.
  - (b) GST/any other taxes, duties or charges etc. which may be payable would be the purchaser's liability and if incurred would be to his account where it is specifically exclusive as applicable within stipulated delivery period.
  - (c) If so required by the purchaser, the Contractors will book the consignments by Rail / Road to any destination stipulated by the purchaser.
  - (d) If the Purchaser so requires, the Contractor shall arrange to dispatch the consignments by ship from port of ..... or such other port..... To a port in India or such other port as may be directed by the purchaser/ Owner.
  - (e) In case the consignments are to be insured to cover risks in transit, such insurance charges, will be extra would be to the purchaser's account provided it is not included in the price as per Work order.
  - (f) The purchaser shall reimburse to the Contractors all such freight or other expenditure, if any that may be incurred by the Contractors in this behalf under Sub-clause (b), (c) (d) and (e) of this clause by payment from time to time on receipt of the bills from the Contractors supported by receipt or acknowledgement for Contractors receipt provided these are payable under Work Order.
6. The Contractor is also bound to fulfill all the terms & conditions mentioned in the GCC/SCC/Work Order/ Bid Documents
  7. In case of dispute as to whether any materials supplied or any work done are or are not in accordance with specifications set forth in the Work Order/GCC/SCC, the decision of the Chief Engineer / Addl. CE (TD), RVUN, Jaipur Shall be final and binding on both the parties.
  8. The delivery shall be effected and completed within a period as specified at Clause..... of the Work Order. The first installment of supplies will begin by.....
  9. Payment of the prices for the material supplied under this agreement shall be made as per relevant clause of the Work order as admissible.
  10. The deposit made by the Suppliers/Contractor under clause (3) will be released to the supplier/ Contractor after due execution of this contract by them.
  11. If the Suppliers/contractor fail wholly or in part to fulfill this agreement, the purchaser/ owner shall be entitled at this discretion to retain the whole any part of the deposit made by the suppliers/contractor under clause (3) and if the loss suffered by the purchaser/ owner exceeds the amount of said deposit they will be entitled to recover the said loss from the suppliers/ contractor in the manner as may be expedient
  12. If any sum remains due or becomes recoverable from the suppliers/contractor on account of the non fulfillment of this agreement or on account of any other reason, the suppliers/contractor shall pay the same immediately on demand. If the suppliers/contractor do not make such payment on demand, the purchaser/ owner



shall be entitled to recover the same from the supplier/ contractor as arrears of land revenue.

13. In witness of the due execution of this agreement the parties have here under set their hands the day and the year first above written

Signed and delivered in the presence of the witness.

1. Signature	2. Signature
Designation	For & on behalf of
By the Order & on behalf of the	Supplier/contractor
Chairman & Managing Director	M/s
Rajasthan Rajya Vidyut Utpadan	Status
Nigam Ltd.	

WITNESS :- With Address

(1)

(2)

WITNESS: With Address

(1)

(2)

**NOW IT IS HEREBY AGREED** as follows:

## **ARTICLE 1. CONTRACT DOCUMENTS**

1.1 The following documents shall constitute the Contract between the Owner and the Contractor, and each shall be read and construed as an integral part of the Contract:

- a) This Contract Agreement and the Appendices hereto as indicated below :
- b) Letter of Intent
- c) Amendment to the NIT document.
- d) Work Order
- e) Instruction to Bidders
- f) General Conditions of Contract
- g) Special Conditions of Contract
- h) General / Technical Specifications and Drawings
- i) The Price Bid (BOQ with Schedules) including Supplementary Price (*delete if not applicable*) submitted by the Contractor.
- k) SITE WORKING AND SAFETY CONDITIONS
- l) Integrity Pact (IP) signed between the Owner and the Bidder / Contractor

### **1.2 Order of Precedence**

If there are varying or conflict provisions made within any document forming part of the contract, the Engineer-in-Charge shall be the deciding authority with regard to the intention of the document.

### **1.3 Definitions**

Capitalized words and phrases used herein shall have the same meanings as are ascribed to them in the General Conditions of Contract.



## ARTICLE 2. CONTRACT PRICE AND PAYMENT TERMS

### 2.1 Contract Price

The Owner hereby agrees to pay to the Contractor the Contract Price in consideration of the performance by the Contractor of its obligations under the Contract. The Contract Price shall be the lump sum price [amount in words], [amount in figures] quoted by the bidder in his bid and incorporated in the letter of intent/formal work order for the entire scope of the contract shall be treated as the contract price, which includes taxes, duties as indicated in bid.in accordance with the terms and conditions of the Contract.

### 2.2 Payment Terms

Payment shall be made by the Owner to the Contractor as per the provisions of Bidding Documents.

## ARTICLE 3. EFFECTIVE DATE FOR DETERMINING TIME FOR COMPLETION

The Completion period of the Project shall be determined from the Effective Date of Contract.

## ARTICLE 4. NON-ASSIGNABILITY

The Contract and benefits and obligations thereof shall be strictly personal to the CONTRACTOR and shall not on any account be assignable or transferable by the CONTRACTOR.

## ARTICLE 5. GOVERNMENT OF RAJASTHAN 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 Rajasthan is not a party to this Agreement and has no liabilities, obligations or rights hereunder. It is expressly understood and agreed that the Owner is an Independent legal entity with power and authority to enter into contracts solely on its own behalf under the applicable laws of Rajasthan and the general principles of Contract Law. The Contractor expressly agrees, acknowledges and understands that the Owner is not an Agent, Representative or Delegate of the Govt. of Rajasthan. It is Further understood and agreed that the Government of Rajasthan is not and shall not be liable for any acts, omissions, commissions, breaches or other wrongs arising out of the Contract. Accordingly, the Contractor expressly waives, releases and foregoes any and all actions or claims, including cross claims, impleader claims or counter claims against the Government of Rajasthan arising out of this Contract and covenants not to sue the Government of Rajasthan as to any manner, claim, cause of action or thing whatsoever arising of or under this Contract.

## ARTICLE 6. APPENDICES

The Appendices listed in the attached list of Appendices shall be deemed to form an integral part of this Contract Agreement. Reference in the Contract to any Appendix shall mean the Appendices attached hereto, and the Contract shall be read and construed accordingly.



## ARTICLE 7. NO LIABILITY ON DIRECTOR AND EMPLOYEE

No Director, employee, consultant or agent of the OWNER or other person representing the OWNER or acting on behalf of the OWNER in or pursuant to the Contract or in the discharge of any obligation to the OWNER under the Contract or otherwise in relation to the Contract shall have any personal liability to the CONTRACTOR or any Sub-Contractor, agent, representative, director or employee of the CONTRACTOR or to any other person acting for or on behalf of the CONTRACTOR and the CONTRACTOR on its own behalf and on behalf of its Sub Contractors, directors, employees, agents and representatives hereby waives and disclaims any and all right of action which it or they may have whether under tort or Contract or otherwise against the OWNER or any director, employee, agent, consultant or representative of the OWNER for act of omission or commission done or omitted to be done.

## ARTICLE 8. WAIVER

No failure or delay by the OWNER in enforcing any right or remedy of the OWNER in terms of the CONTRACT or any obligation or liability of the CONTRACTOR in terms thereof, shall be deemed to be a waiver of such right, remedy, obligation or liability, as the case may be, by the OWNER and notwithstanding such failure or delay, the OWNER shall be entitled at any time to enforce such right, remedy, obligation or liability, as the case may be.

## ARTICLE 9. LANGUAGE OF CONTRACT AND COMMUNICATION

The language of the Contract shall be English and all communications, drawings, design, data, information, codes specifications and other document whatsoever supporting the bid or otherwise exchanged under the Contract shall be in English. In the event that any technical documentation is in any language other than English, the document should be translated and presented to the OWNER/Project Manager in English and English document/translated document shall be regarded as the only authentic document.

IN WITNESS WHEREOF the Owner and the Contractor have caused this Agreement to be duly executed by their duly authorized representatives the day and year first above written.  
Signed by for and on behalf of the Owner

[Signature]

[Title]

in the presence of \_\_\_\_\_  
Signed by for and on behalf of the Contractor

[Signature]

[Title]

in the presence of \_\_\_\_\_  
CONTRACT AGREEMENT  
dated the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_  
BETWEEN

[“the Owner”]  
and

[“the Contractor”]



---

ANNEXURE-1.15

**DECLARATION BY BIDDER REGARDING BIDDING DOCUMENT**

**SUBJECT: TENDER DOCUMENT FOR \_\_\_\_\_**

We \_\_\_\_\_ (Name of the Bidder) hereby represent that we have gone through and understood the Bidding Documents, NIT NO: TNC-...../2022-23 DATED \_\_\_\_\_ (including but not limited to) the Commercial & Technical Requirements/ Specifications in **Volume-I : Commercial** and **Volume-II : Technical** of the Bidding documents and amendments, if any, and that our Bid has been prepared accordingly in compliance with the requirements stipulated in the said documents.

We are submitting a copy of complete set of Bidding Documents, **Volume-I : Commercial** and **Volume-II : Technical** and Amendments, if any, as part of our Bid duly signed and stamped on each page in token of our acceptance. Further we undertake that in the event of award of work to us, all the parts shall be considered for constitution of Contract Agreement.

For and on behalf of : .....

Stamp & Signature : .....

Name : .....

Designation : .....

Date : .....



**ANNEXURE-1.16**

**FORMAT FOR INTEGRITY PACT**

**INTEGRITY PACT BETWEEN  
RVUN (HEREINAFTER REFERRED TO AS "THE OWNER")  
AND  
..... (HEREINAFTER REFERRED TO  
AS "THE BIDDER/CONTRACTOR")**

**PREAMBLE**

The Owner invites the bids from all eligible bidders and intends to enter into contracts for Project / Work \_\_\_\_\_, with the successful bidder(s), as per organizational systems and procedures. The Owner values full compliance with all relevant RTPP Rules and regulations, and the principles of economical use of resources, and of fairness and transparency in its relations with its Bidder(s) and/or Contractor(s).

**Compliance with the Code of Integrity**

Any Bidder participating in a procurement process shall -

- (a) not offer any bribe, reward or gift or any material benefit either directly or indirectly in exchange for an unfair advantage in procurement process or to otherwise influence the procurement process;
- (b) not misrepresent or omit that misleads or attempts to mislead so as to obtain a financial or other benefit or avoid an obligation;
- (c) not indulge in any collusion, Bid rigging or anti-competitive behavior to impair the transparency, fairness and progress of the procurement process;
- (d) not misuse any information shared between the procuring Entity and the Bidders with an intent to gain unfair advantage in the procurement process;
- (e) not indulge in any coercion including impairing or harming or threatening to do the same, directly or indirectly, to any party or to its property to influence the procurement process;
- (f) not obstruct any investigation or audit of a procurement process;
- (g) disclose conflict of interest, if any; and
- (h) disclose any previous transgressions with any Entity in India or any other country during the last three years or any debarment by any other procuring entity.

**Conflict of Interest:-**

The Bidder participating in a bidding process must not have a Conflict of Interest. A Conflict of Interest is considered to be a situation in which a party has interests that could improperly influence that party's performance of official duties or responsibilities, contractual obligations, or compliance with applicable laws and regulations.

A Bidder may be considered to be in Conflict of Interest with one or more parties in a bidding process if, including but not limited to:-



- (a) have controlling partners/ shareholders in common; or
- (b) receive or have received any direct or indirect subsidy from any of them; or
- (c) have the same legal representative for purposes of the Bid; or
- (d) have a relationship with each other, directly or through common third parties, that puts them in a position to have access to information about or influence on the Bid of another Bidder, or influence the decisions of the Procuring Entity regarding the bidding process; or
- (e) the Bidder participates in more than one Bid in a bidding process.  
Participation by a Bidder in more than one Bid will result in the disqualification of all Bids in which the Bidder is involved. However, this does not limit the inclusion of the same subcontractor, not otherwise participating as a Bidder, in more than one Bid; or
- (f) the Bidder or any of its affiliates participated as a consultant in the preparation of the design or technical specifications of the Goods, Works or Services that are the subject of the Bid; or
- (g) Bidder or any of its affiliates has been hired (or is proposed to be hired) by the Procuring Entity as engineer-in-charge/consultant for the contract.

**Seal & Signature of Bidder**

**NOTE:**

Bidders are requested to study the provisions of RTPP ACT 2012 and RTPP Rules 2013 and also note that Acts, Rules & Notification issued by Rajasthan Transparency in Public Procurement (RTPP) will be applicable for the above Works. Further, if there is any contradiction in the tender document from the same, then the Acts, Rules & Notification of RTPP Act will prevail.



## ANNEXURE-1.17

**GRIEVANCE REDRESSAL DURING PROCUREMENT PROCESS**

The designation and address of the First Appellate Authority is **Chairperson, Jaipur Discom**. The designation and address of the Second Appellate Authority is **Principal Secretary/Secretary, Energy Deptt, GoR, Jaipur**.

**1. Filing an appeal**

If any Bidder or prospective bidder is aggrieved that any decision, action or omission of the Procuring Entity is in contravention to the provisions of the Act or the Rules or the Guidelines issued there under, he may file an appeal to First Appellate Authority, as specified in the Bidding Document within a period of ten days from the date of such decision or action, omission, as the case may be, clearly giving the specific ground or grounds on which he feels aggrieved:

Provided that after the declaration of a Bidder as successful the appeal may be filed only by a Consultant who has participated in procurement proceedings:

Provided further that in case a Procuring Entity evaluates the Technical Bids before the opening of the Financial Bids, an appeal related to the matter of Financial Bids may be filed only by a Bidder whose Technical Bid is found to be acceptable.

**2. The officer to whom an appeal is filed under para (I) shall deal with the appeal as expeditiously as possible and shall Endeavour to dispose it of within thirty days from the date of the appeal.****3. If the officer designated under para (1) fails to dispose of the appeal filed within the period specified in para (2), or if the Bidder or prospective bidder or the Procuring Entity is aggrieved by the order passed by the First Appellate Authority, the Bidder or prospective bidder or the Procuring Entity, as the case may be, may file a second appeal to Second Appellate Authority specified in the Bidding Document in this behalf within fifteen days from the expiry of the period specified in para (2) or of the date of receipt of the order passed by the First Appellate Authority, as the case may be.****4. Appeal not to lie in certain cases:**

No appeal shall lie against any decision of the Procuring Entity relating to the following matters, namely:

- (a) Determination of need of procurement;
- (b) Provisions limiting participation of Bidders in the Bid process;
- (c) The decision of whether or not to enter into negotiations;
- (d) Cancellation of a procurement process;
- (e) Applicability of the provisions of confidentiality.

**5. Form of Appeal**

- (a) An appeal under para (1) or (3) above shall be in the annexed Form along with as many copies as there are respondents in the appeal.
- (b) Every appeal shall be accompanied by an order appealed against, if any, affidavit verifying the facts stated in the appeal and proof of payment of fee.



- (c) Every appeal may be presented to First Appellate Authority or Second Appellate Authority, as the case may be, in person or through registered post or authorized representative.
6. Fee for filing appeal
- (a) Fee for first appeal shall be rupees two thousand five hundred (Rs 2500/-) and for second appeal shall be rupees ten thousand (Rs 10000/-), which shall be non-refundable.
- (b) The fee shall be paid in the form of bank demand draft or banker's cheque of a Scheduled Bank in India payable in the name of concerned accounts authority or as specified in NIB/BDS.
7. Procedure for disposal of appeal
- (a) The First Appellate Authority or Second Appellate Authority, as the case may be, upon filing of appeal, shall issue notice accompanied by copy of appeal, affidavit and documents, if any, to the respondents and fix date of hearing.
- (b) On the date fixed for hearing, the First Appellate Authority or Second Appellate Authority, as the case may be, shall,-
- (i) hear all the parties to appeal present before him; and
- (ii) peruse or inspect documents, relevant records or copies thereof relating to the matter.
- (c) After hearing the parties, perusal or inspection of documents and relevant records or copies thereof relating to the matter, the Appellate Authority concerned shall pass an order in writing and provide the copy of order to the parties to appeal free of cost.
- (d) The order passed under sub-clause (c) above shall also be placed on the State Public Procurement Portal.



**ANNEXURE-1.18**

## **FORMAT FOR EFT DETAILS (ELECTRONIC FUND TRANSFER)**

**Bidder's Name and Address :**

To  
The Chief Engineer (TD),  
RVUN, Jaipur,  
Room no. 501, 5th floor,  
Dreamax Plaza,  
Sahkar Marg,  
Jaipur- 302005

Dear Sirs.

We hereby authorise the Employer to make all our payments through Electronic Fund Transfer System. The details for facilitating the payments are given below :

(TO BE FILLED IN CAPITAL LETTERS)

**1 NAME OF THE BENEFICIARY**

## 2. ADDRESS

**3. TELEPHONE NO. (WITH STD CODE)**

#### **4. BANK PARTICULARS**

(A) **BANK NAME**

10 of 10 pages



**(B) BANK TELEPHONE NO. (WITH STD CODE)**

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

**(C) BRANCH ADDRESS**

PIN CODE														

**(D) BANK FAX NO (WITH STD CODE)**

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

**(E) BRANCH CODE**

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

**(F) 9 DIGIT MICR CODE OF THE BANK BRANCH (ENCLOSE COPY OF A CANCELLED CHEQUE)**

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

**(G) IFSC Code OF THE BANK BRANCH**

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--



(H) BANK ACCOUNT NUMBER

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

(I) BANK ACCOUNT TYPE (TICK ONE)

SAVING	CURRENT	LOAN	CASH CREDIT	OTHERS
--------	---------	------	-------------	--------

IF OTHERS, SPECIFY

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

5. PERMANENT ACCOUNT NUMBER (PAN)

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

6. E-MAIL ADDRESS FOR INTIMATION REGARDING RELEASE OF PAYMENTS

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

I/W e hereby declare that the particulars given above are correct and complete. If the transaction is delayed or credit is not affected at all for reasons of incomplete or incorrect information, I/W e would not hold the Employer responsible.

DATE

SIGNATURE

--	--	--	--	--	--

(AUTORISED SIGNATORY)



Name:


OFFICIAL STAMP

**BANK CERTIFICATION:**

It is certified that above mentioned beneficiary holds a bank account no. .....  
with our branch and the Bank particulars mentioned above are correct.

DATE

SIGNATURE

--	--	--	--	--	--	--

AUTHORISED SIGNATORY)  
Authorization No. :

Name:


OFFICIAL STAMP



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**ANNEXURE-1.19**

**GENERAL GUIDELINES FOR GST**

**AS PER RELEVANT GST LAWS**



**ANNEXURE-1.20**

**FORMAT FOR FINANCIAL CAPABILITY OF THE BIDDER**

**FORMAT FOR CHARTERED ACCOUNTANT CERTIFICATE FOR FINANCIAL CAPABILITY OF THE BIDDER**

We have verified the Annual Accounts and other relevant records of M/s.....(Name of the bidder) and certify the following

**A. ANNUAL TURNOVER OF LAST 3 YEARS:**

Year	Amount (INR)
Year 1: 2021-22	
Year 2: 2020-21	
Year 3: 2019-20	

Name of Audit Firm: [Signature of Chartered Accountant]

Chartered Accountant Name:

Date: Designation:

Seal:

Membership no.

Instructions:

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.
3. For the purpose of this Tender document, (i) Annual Turnover shall be "Sale value/ Operating Income"
4. This certificate is to be submitted on the letter head of Chartered Accountant.



**ANNEXURE-1.21**

**FORMAT FOR BIDDER NOT UNDER LIQUIDATION, COURT RECEIVERSHIP OR  
SIMILAR PROCEEDINGS**

**(Self Declaration on Bidder's Letter Head as per below performa)**

**DECLARATION**

**To ,**

.....  
.....  
.....

**NIT NO. : RVUN/\_\_\_\_\_**

**SUBJECT : TENDER DOCUMENT FOR \_\_\_\_\_**

**Sir ,**

We hereby declare that M/s .....is not under liquidation, court receivership or similar proceedings as on date.

**Signature**

**Name :**

**Designation :**

**Seal of the Bidder.**



**ANNEXURE-1.22**  
**DEPLOYMENT SCHEDULE FOR SUPERVISORY PERSONNEL**

SL. NO.	DESCRIPTION	DEPLOYMENT SCHEDULE			TOTAL
		M1	M2	M3	
1.	PROJECT MANAGER				
2.	CONSTRUCTION MANAGER				
3.	PLANNING ENGINEER				
4.	ELECTRICAL ENGINEER				
5.	CIVIL & STRUCTURAL ENGINEER				
6.	SUPERVISORS				
7.	ADMINISTRATION MANAGER				
8.	WAREHOUSE PERSONNEL				
9.					
10.					
11.					
12.					
13.					
14.					

**NOTE : Bidder may add more personnel as per job assessment / experience**

**STAMP & SIGNATURE OF BIDDER :** \_\_\_\_\_

**NAME OF BIDDER :** \_\_\_\_\_

**DATE :** \_\_\_\_\_



ANNEXURE-1.23

**DEPLOYMENT SCHEDULE FOR CONSTRUCTION EQUIPMENT**

SL. NO.	DESCRIPTION	CAPACITY	DEPLOYMENT			SCHEDULE TOTAL
			M1	M2	M3	
1.	CRANES					
2.	DIESEL GENERATORS					
3.	WELDING MACHINE					
4.	TRACTORS					
5.	TRAILERS / TRUCKS					
6.	DUMPERS					
7.	EXCAVATORS					
8.	VIBRATOR					
9.	COMPACTORS					
10.	OTHER TOOLS & TACKLES					
11.						
12.						
13.						
14.						

**NOTE : Bidder may add more Equipments as per job assessment / experience.**

**STAMP & SIGNATURE OF BIDDER :** \_\_\_\_\_

**NAME OF BIDDER :** \_\_\_\_\_

**DATE :** \_\_\_\_\_



**ANNEXURE-1.24**

**DETAILS OF EQUIPMENT PROPOSED FOR TENDERED WORK**

**DETAILS OF PROPOSED EQUIPMENTS, TOOLS & TACKLES**

The bidder shall submit the details of construction equipments, Tools & tackles etc. in the following format, proposed to be deployed for this works.

**Sl. No.**

**EQUIPMENTS LIST REQUIRED TO BE DEPLOYED**

Description of the Equipment,	Make,	Year	capacity
-------------------------------	-------	------	----------

**STATUS OF EQUIPMENT**

Own by Contractor	If on Hiring (Give Detail Address)
-------------------	------------------------------------

**SCHEDULE DEPLOYMENT DATE AT SITE**

**SCHEDULED COMPLETION DATE OF WORK**

**REMARKS**

- Note :**
1. In case of equipment are to be hired, bidder shall indicate the source of hiring and enclosed and enclose the consent letter from such sources.
  2. Bidder shall clearly indicate the expected date of availability of owned / hired equipment.

**NOTE : Bidder may add Equipment as per job assessment / experience.**

SIGNATURE OF BIDDER : .....

NAME OF BIDDER : .....

COMPANY SEAL : .....



**ANNEXURE-1.25**

**WORK COMPLETION SCHEDULE / TIME SCHEDULE**

**1.0 COMPLETION PERIOD OF THE COOLING WATER SYSTEM. :**

Sr. No.	GUARANTEED PERIOD OF COMPLETION
1.	<b>PRELIMINARY ACCEPTANCE: 22 (Twenty Two) Months</b> from the Effective Date of Contract as per ITB Clause 6.0

**NOTE:**

- 1) Supplier/contractor shall submit, together with the Purchase order/contract confirmation, to Owner/Consultant, his time schedule regarding the documentation, supply and manufacture of Equipment and materials as well as information of his Subcontracts to be placed with their parties, including the dates on which Supplier/contractor intends to issue such Sub-contracts.
- 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 and Delivery.
- 3) The original issue and subsequent revisions of Supplier's time schedule and or Subcontractor's time schedules shall be sent to Consultant in two copies (of which one shall be reproducible) and two copies to Owner.
- 4) The time schedule network/bar chart shall be updated at least every month.

(Bidder's authorized person's Signature & Seal)



## ANNEXURE-1.26

## ESCROW AGREEMENT

(To be executed on Non- Judicial Stamp Paper of Appropriate Value)

**ESCROW AGREEMENT** (hereinafter referred to as this "**Agreement**") is entered into on this the \_\_\_\_\_ day of \_\_\_\_\_ 20\_\_\_\_ at \_\_\_\_\_.

**BETWEEN:**

M/S \_\_\_\_\_ a Company incorporated under the laws of \_\_\_\_\_ and having its principal place of business at \_\_\_\_\_ (hereinafter referred to as the "**Owner**", which expression shall, unless it is repugnant to the subject or context thereof, include its successors and assigns) of the **FIRST PART**;

AND

M/S \_\_\_\_\_ a Company incorporated under the laws of \_\_\_\_\_ and having its principal place of business at \_\_\_\_\_ (hereinafter referred to as the "**Contractor**", which expression shall, unless it is repugnant to the subject or context thereof, include its successors, transferees and permitted assigns) of the **SECOND PART**;

AND M/S \_\_\_\_\_, a body corporate incorporated under the laws of India and a banking company within the meaning of Section 5 (c) of the Banking Regulation Act, 1949 (10 of 1949) and having its registered office at \_\_\_\_\_ in its capacity as the Escrow Agent for the Contractor (hereinafter referred to as the "**Escrow Bank**", which expression shall, unless it be repugnant to the subject or context thereof, include its successors and permitted assigns) of the **THIRD PART**.

The Owner, the Contractor and the Escrow Bank are individually referred to as "**Party**" and collectively as "**Parties**".

**WHEREAS:**

- A. The Owner vide IFB No. \_\_\_\_\_ dated \_\_\_\_\_ ("Tender") had invited bids for \_\_\_\_\_ ("Package") for \_\_\_\_\_ ("Project").
- B. Accordingly, the said "Contractor", submitted its bid in response to the above mentioned NIT.
- C. Pursuant to the IFB and the bid submitted by the Successful Bidder / Contractor, the Owner issued the Notification of Award dated \_\_\_\_\_ bearing no. \_\_\_\_\_ ("Notification of Award") and executed Contract Agreement Reference No. \_\_\_\_\_ dated \_\_\_\_\_ (hereinafter called Contract).
- D. In terms of Clause \_\_\_\_\_ of the Contract/ General Conditions of Contract/ Special Conditions of Contract, the Contractor is required to open and maintain separately an Escrow Account with the Escrow Bank.



- E.** The Contractor have approached \_\_\_\_\_ Bank to act as an escrow agent and the \_\_\_\_\_ Bank has agreed to act as the Escrow Bank under this Escrow Agreement; and
- F.** Accordingly Parties are desirous of executing this Escrow Agreement to set out the manner and procedure for operation of the escrow account and other matters in connection therewith.
- G.** All payments due under the Contract related to Erection/Civil/Structural works will be released by the Owner to the Contractor in the Escrow Account. The Contractor is required to make payment to suppliers of goods and services, statutory authorities, establishment expenses etc as may be required in the successful performance of the Contract.
- H.** The Contractor is required to utilise the money collected in the Escrow Account in accordance with the waterfall mechanism set out in this Agreement.
- I.** In view of the aforesaid, the mutual covenants, and understandings set forth herein, the Parties wish to enter into this Agreement for setting out the terms and conditions to deal with all payments in accordance with the requirements set out in the Bid Document.

**NOW, THEREFORE**, in consideration of the premises herein set forth and other good and valid consideration, the receipt and adequacy of which are hereby expressly acknowledged, the Parties with the intent to be legally bound hereby agree as follows:

## 1. DEFINITIONS AND INTERPRETATION

### 1.1 DEFINITIONS

In this Agreement the following words and expressions shall, unless repugnant to the context or meaning thereof, have the meaning hereafter respectively assigned to them.

<b>Applicable Law</b>	: means all applicable statutes, laws, by – laws, rules, regulations, orders, ordinances, protocols, codes, guidelines, policies, notices, directions, judgments, decrees or other requirements or official directive of any governmental authority or court or other law, rule or regulation, approval from the relevant governmental authority, government resolution, directive, or other government restriction or any similar form of decision of, or determination by, or any interpretation or adjudication having the force of law in India.
<b>Business Day</b>	: means a day other than a Sunday or a bank holiday on which banks are normally open for business during banking business hours in Delhi, India.
<b>Contractor</b>	: shall have the meaning as ascribed to it in Second Part
<b>Owner</b>	: shall have the meaning as ascribed to it in First Part.



**ESCROW ACCOUNT :** SHALL MEAN THE ACCOUNT IN THE NAME AND STYLE OF  
“ \_\_\_\_\_ ” OPENED AND  
MAINTAINED BY THE CONTRACTOR IN TERMS OF SECTION-  
V, CLAUSE AS SPECIAL CONDITIONS OF CONTRACT NO. 47  
(GENERAL CONDITION OF CONTRACT CLAUSE NO. 12) WITH  
THE ESCROW BANK AND OPERATED IN TERMS OF THIS  
ESCROW AGREEMENT.

**Escrow Agreement :** shall mean this agreement, together with the schedules hereto, as  
may be amended, modified or supplemented from time to time, in  
accordance with its terms.

**Escrow Bank** : shall have the meaning as ascribed to it in Third Part.

**Notification of Award:** shall have the meaning as ascribed to it in Recital C.

**Package** : shall have the meaning as ascribed to it in Recital A.

**Project** : shall have the meaning as ascribed to it in Recital A.

**Tender** : shall have the meaning as ascribed to it in Recital A.

## 1.2 PRINCIPLE OF CONSTRUCTIONS

In this Agreement, unless the context otherwise requires:

- (a) reference to an Account includes a reference to any sub - account of that Account;
- (b) reference to an "amendment" includes a supplement, modification, novation, replacement or re-enactment and "amended" is to be construed accordingly;
- (c) a reference to "authorization" includes an authorization, consent, clearance, approval, permission, resolution, license, exemption, filing and registration;
- (d) a reference to "control" includes the power to direct by contract or otherwise;
- (e) unless the context otherwise requires, the singular includes the plural and vice versa;
- (f) a reference to a Schedule is, unless indicated to the contrary, a reference to a schedule to this Agreement;
- (g) the words "other", "or otherwise" and "whatsoever" shall not be construed *eiusdem generis* or be construed as any limitation upon the generality of any preceding words or matters specifically referred to;
- (h) references to the word "includes" or "including" are to be construed without limitation;
- (i) all references to agreements, documents or other instruments include (subject to all relevant approvals) a reference to that agreement, document or instrument as amended, supplemented, substituted, novated or assigned from time to time;
- (j) any reference to a public organization shall be deemed to include any successor to such public organization or any organization or functions or responsibilities of such public organization;
- (k) "year" "month" and "day" wherever used in this Agreement imply that of English calendar;
- (l) words and abbreviations, which have, well known technical or trade / commercial meanings are used in the Agreement in accordance with such meanings;
- (m) A reference to times and dates in this Escrow Agreement are references to times and dates in India.



- (n) Any date or period as set out in any clause of this Escrow Agreement may be extended with the written consent of the Parties.
- (t) The Schedules form an integral and operative part of this Escrow Agreement and references to this Escrow Agreement shall include references to the Schedules.

## 2. APPOINTMENT OF ESCROW BANK

Each of the parties acknowledges that the Escrow Bank has been appointed under this Escrow Agreement and that it shall discharge its functions in accordance with the terms of this Escrow Agreement. Escrow Bank hereby accepts the escrow arrangement hereby declared and provided upon the terms and conditions set forth in this Escrow Agreement.

## 3. ESTABLISHMENT OF THE ACCOUNTS

The Contractor has established with the Escrow Bank an account with its branch, the details of which are provided in **Schedule-II** hereto, titled the " \_\_\_\_\_ Account". The Contractor acknowledges and agrees that it shall maintain the Escrow Account.

## 4. OPERATING PROCEDURES

The Owner, the Contractor and Escrow Bank, have prior to execution of this Agreement agreed on the detailed terms and conditions and Operating Procedures for the Escrow Account (as set out in **Schedule-III**), provided however, in the event of any inconsistency between this Agreement and such mandates, terms and conditions or procedures, this Agreement shall prevail.

Based on the request from the Contractor, the Owner will approve the list of suppliers of goods and services, statutory authorities, establishment expenses etc. To whom payments could be made and the same shall be shared with the Escrow Bank from time to time.

All transfers and payments pursuant to this Agreement shall be in a manner consistent with the operating procedures.

The Escrow Bank shall submit to the Owner the usage of monies withdrawn from the Escrow Account together with a monthly statement from the Escrow Bank evidencing receipt and withdrawal of funds into and from the Escrow Account.

The Owner shall be entitled to verify the usage of funds withdrawn from the Escrow Account.

At any time the Owner is entitled to seek an account statement from the Escrow Bank and such evidence of usage of funds by the Contractor from the Escrow Account as required by the Owner.

## 5. OBLIGATIONS OF THE CONTRACTOR

Nothing contained in this Agreement shall affect the obligations of the Contractor under the Bid Documents or Contract Agreement as set out above.

The Contractor shall simultaneously deliver a copy to the Owner of any notice or document delivered to the Escrow Bank pursuant to this Agreement.



## 6. ESCROW BANK SERVICE CHARGES AND EXPENSES

The Contractor shall pay, on demand, all the usual and customary service charges, transfer fees, account maintenance, account acceptance, statement, investigation, funds transfer and any other charges as are levied by the Escrow Bank as mutually agreed and such other out of pocket expenses as are claimed by the Escrow Bank (collectively, the "**charges**") in connection with the Escrow Account. In addition the Contractor has agreed to pay one-time bank escrow service charges of Rs. \_\_\_\_\_ plus applicable service tax. Contractor shall deposit the one- time bank escrow service charges in to the Escrow Account within three Business Days of the opening of the Escrow Account and/ or shall deposit the charges from time to time of such demand by the Escrow Bank. In the event Contractor fails to make the timely payment to the Escrow Bank of the onetime bank escrow service charges and/or the charges, the Escrow Bank shall have the right to withdraw such amounts from the Escrow Account as is necessary for the payment of the one-time bank escrow service charges and charges, in which case Contractor shall replenish the Escrow Account with such amounts equivalent to the amounts withdrawn by the Escrow Bank within \_\_\_\_\_ Business Days of such withdrawal.

## 7. ESCROW BANK'S DUTIES AND LIABILITIES

- 7.1 The Escrow Bank shall have only those duties, obligations and responsibilities expressly specified in this Escrow Agreement and shall have no duties, obligations or responsibilities which are implied or inferred by law or otherwise.
- 7.2 The duties of the Escrow Bank under this Escrow Agreement are purely ministerial, administrative and non-discretionary in nature. Neither Escrow Bank nor any of its directors, officers, agents and employees shall, by reason of anything contained in this Escrow Agreement, be deemed to be a trustee for or have any fiduciary relationship with the parties. Where the Escrow Bank has acted in accordance with this Escrow Agreement, it shall be deemed to have acted as if instructed to do so by the Owner
- 7.3 The Escrow Bank shall not be required to expend or risk any of its own funds or otherwise incur any liability, financial or otherwise, in the performance of any of its duties under this Escrow Agreement.
- 7.4 The Escrow Bank shall not be precluded by virtue of this Escrow Agreement (and neither shall any of its directors, officers, agents and employees or any company or persons in any other way associated with it be precluded) from entering into or being otherwise interested in any banking, commercial, financial or business contacts or in any other transactions or arrangements with the parties or any of their affiliates provided such transactions or arrangements are not contrary to the provisions of this Escrow Agreement.
- 7.5 The Escrow Bank shall not be bound or affected, in its capacity as Escrow Bank, in any way by the Agreement or any agreement or contract between Parties to which the Escrow Agent is not a party. The Escrow Bank, in its capacity as an escrow bank, is deemed not to have any knowledge of any provision of the Agreement or any other document unless the substance of such provisions is explicitly set forth in this Escrow Agreement. The Escrow Bank shall not in any way be required to



determine whether or not the terms and conditions of the Agreement or any other agreement or contract between the Parties to which the Escrow Bank is not a party have been complied with. Furthermore, the Escrow Bank is deemed not to have any knowledge or notice of any fact or circumstance not specifically set forth in this Escrow Agreement.

- 7.6 The Escrow Bank may, in good faith, accept and rely on any notice, instruction or other document received by it under this Escrow Agreement as conclusive evidence of the facts and of the validity of the instructions stated in it and as having been duly authorised, executed and delivered and need not make any further enquiry in relation to it. The Escrow Bank may act in conclusive reliance upon any instrument or signature believed by it, acting reasonably, to be genuine and may assume, acting reasonably, that any person purporting to give receipt, instruction or advice, make any statement, or execute any document in connection with the provisions of this Escrow Agreement has been duly authorised to do so. The Escrow Bank shall be under no duty to inquire into or investigate the validity, accuracy or content of any such document,
- 7.7 The Escrow Bank shall not be liable to any person for any losses arising out of or in connection with the performance or non-performance of its obligations under this Escrow Agreement, except to the extent directly resulting from the wilful default or gross negligence of the Escrow Bank.
- 7.8 The Escrow Bank may execute any of its powers and perform any of its duties under this Escrow Agreement directly or through appointed agents or attorneys.
- 7.9 'Force Majeure Event' means any event (including but not limited to an act of God, fire, epidemics, natural calamities; riots, civil commotion or unrest, terrorism, war, strikes or lockouts; expropriation or other governmental actions; any changes in applicable law or regulation including changes in market rules, currency restrictions, devaluations or fluctuations; market conditions affecting the execution or settlement of transactions or the value of assets; and breakdown, failure or malfunction of any telecommunication and information technology systems beyond the control of any Party which restricts or prohibits the performance of the obligations of such Party contemplated by this Agreement. The Escrow Bank shall not be held liable for any loss or damage or failure to perform its obligations hereunder, or for any delay in complying with any duty or obligation, under or pursuant to this Agreement arising as a direct or indirect result of any Force Majeure Event.
- 7.10 The Escrow Bank may at its cost, consult with, and obtain advice from its lawyers or professional advisers over any question in relation to, and its duties under this Escrow Agreement. The Escrow Bank shall not incur any liability for taking any action or omitting any action in accordance with such advice.
- 7.11 The Escrow Bank does not have any proprietary or other interest in the Escrow Account, but is to serve as escrow holder only and having only possession thereof.
- 7.12 The Escrow Bank shall not be liable or responsible for obtaining any regulatory or governmental or other approval in connection with or in relation to the transactions contemplated herein and shall not be in any manner obliged to inquire or consider whether any regulatory or governmental approvals have been obtained.



- 7.13 The Escrow Bank shall not be obliged to supervise, control or perform any acts or responsibilities of the First Party or the Second Party or any other third party.
- 7.14 Any act to be done by the Escrow Bank shall be done only on a Business Day, during banking business hours, at \_\_\_\_\_, India and in the event that any day on which the Escrow Bank is required to do an act, under the terms of this Escrow Agreement, is a day on which banking business is not, or cannot for any reason be conducted, then the Escrow Bank shall do those acts on the next succeeding Business Day.
- 7.15 The Escrow Bank is under no duty to ensure that funds withdrawn from the Escrow Account are actually applied for the purpose for which they were withdrawn; neither the Escrow Bank nor any of its officers, employees or agents shall be required to make any distribution to the extent that the Escrow Amount is insufficient and shall incur no liability whatsoever from any non-distribution in such circumstances.
- 7.16 The Parties agree that the Escrow Bank shall not be, in any way, responsible or liable to the other Parties or any third person whosoever, for deduction or withholding of any taxes in relation to the transaction for which the Escrow Account has been established pursuant hereto and the contractor acknowledge and confirm that they shall be solely and absolutely liable for any and all deductions or withholdings and payments of taxes, levies, cesses and all other statutory dues in relation thereto. The Contractors confirm that they shall be, jointly and severally, liable for payment of all stamp duties payable in relation to this Agreement as well as any other instruments executed pursuant hereto and the Escrow Bank shall not be responsible or liable for the same, under any circumstances.
- 7.17 The Parties agree that Escrow Bank is acting in its capacity as an escrow agent only and shall not be deemed to act as an investment, legal or tax adviser to the Parties in the performance of its obligations under the Escrow Agreement.
- 7.18 Notwithstanding what is stated herein, in no event shall the Escrow Bank be liable for incidental, indirect, special, punitive or consequential damages caused to the Parties.

## 8. NOTICE OF BREACH

The Escrow Bank to the best of its knowledge undertakes to the Owner that it shall notify the Owner of any breach by the Contractor of any of the provisions of this Agreement.

## 9. INDEMNITY

The Contractor shall indemnify and keep indemnified the Parties for any and all liabilities, obligations, losses, damages, penalties, actions, judgments, suits, costs, expenses, claims or disbursements of any kind or nature whatsoever which may be imposed upon, incurred by or asserted against the Parties in any way in connection with or arising out of the negotiation, preservation or enforcement of any rights under, or in carrying out its duties under this Agreement, other than those arising as a result of the Escrow Bank's gross negligence or willful default. The Contractor shall indemnify and keep indemnified the Escrow Bank for any and all liabilities, obligations, losses, damages,



- (a) acting upon any request sent by facsimile, if such facsimile was found to be sent in an unauthorized manner; or
- (b) not acting upon any request if such facsimile was sent but not received by the concerned person of the Account Bank.

The obligations of the Contractor under this Agreement to indemnify and keep indemnified the parties shall survive the satisfaction, discharge or other termination of this Agreement and the resignation or removal of the Escrow Bank under this Agreement.

#### **10. CONFIDENTIALITY**

No Party may except as permitted by this Escrow Agreement, make public or disclose to any person any information about this Escrow Agreement.

The Obligations under this clause shall survive the termination or expiry of this agreement.

#### **11. ASSIGNMENT**

Save as provided in Clause\_\_\_\_of the General Conditions of the Contract of the Owner, the Contractor shall not assign or transfer any part of their respective rights or obligations under this Agreement without the prior consent of the Owner, provided that this shall not prevent Owner from assigning or transferring its rights under this Agreement.

Nothing in this Agreement shall give to any other Person (other than the Parties hereto and their successors and permitted assigns) any benefit or any legal or equitable right or remedy under this Agreement.

This Agreement shall be binding on and shall inure to the benefit of the Parties hereto and the respective successors and permitted assigns.

#### **12. NOTICES**

All notices or other communications to be given under this agreement shall be made in writing to:

**For the Owner:**

(Name of the Owner)\_\_\_\_\_

Attention (Designation of Employee)\_\_\_\_\_

Address

-----

Fax No. \_\_\_\_\_

Tel No. \_\_\_\_\_



**For the Contractor:**

(Name of the Contractor) \_\_\_\_\_

Attention (Designation of Employee) \_\_\_\_\_

Address

-----

Fax No. \_\_\_\_\_

Tel No. \_\_\_\_\_

**For the Escrow Bank:**

(Name of the Escrow Bank)

Attention (Designation of Employee) \_\_\_\_\_

Address

-----

Fax No. \_\_\_\_\_

Tel No. \_\_\_\_\_

**Change of Address**

Any Party may by notice change the addresses and / or addresses to which such notices and communications are to be delivered or mailed. Such change shall be effective when all the Parties have written notice of it.

**13. Omitted**

**14. WAIVER**

No failure or delay on the part of the Owner in exercising any right, power or privilege hereunder or under Contract shall impair any such right, power or privilege or operate as a waiver the Owner would otherwise have. No notice to or demand on the Contractor in any case shall entitle the Contractor to any other or further notice or demand in similar or other circumstances or constitute a waiver of the rights of the Owner to any other or further action in any circumstances without notice or demand.

**15. SEVERABILITY**

If any provision of this Agreement is held invalid, unenforceable or illegal, the offending provision shall be severed from this Agreement and the remaining parts of this Agreement shall remain in full force and effect.

**16. AMENDMENTS**

No amendment to this Agreement shall be binding unless in writing and signed by the Parties.



## 17. GOVERNING LAW

This Agreement shall be governed by and construed in accordance with Indian laws.

## 18. DISPUTE RESOLUTION

In the event of any difference or dispute arising out of the interpretation or application of the provisions of this Agreement, the Parties shall immediately consult each other with the view to expeditiously resolve such differences or disputes in a spirit of mutual understanding and co-operation.

## 19. JURISDICTION

The parties irrevocably submit to exclusive jurisdiction of the Courts of Jaipur in all matters arising under this Agreement.

## 20. REGULATORY APPROVALS

The Contractor shall procure and shall thereafter maintain and comply with all regulatory approvals required for the establishment and operation of the Accounts and the making of any deposits, transfers or withdrawals and for the performance of its obligations under this Agreement.

## 21. NOTIFICATION OF BALANCES

Within\_\_\_\_ days following the end of each calendar month, the Escrow Bank shall notify the Owner of the balance in the Account and furnish a statement of the deposits into and payment out of the Accounts at the close of business of such calendar month.

## 22. COUNTERPARTS, ANNEXURES, SCHEDULES

This Agreement may be executed in several counterparts, each of which shall be deemed an original, but all of which together shall constitute one and the same agreement.

## 23. MISCELLANEOUS

The Escrow Bank shall be responsible for maintaining a correct and complete record of all transactions, deposits, withdrawals or transfer of funds relating to the Accounts. The Escrow Bank shall not make any transfer or withdrawal from the Escrow Account except as provided for in this Agreement.



## SCHEDULE-I

1. First Part Details;
2. Second Part Details;
3. Third Part Details;



**SCHEDULE-II**

**DETAILS OF ESCROW ACCOUNT**

<b>Particulars and Address of the Branch Office of the Escrow Bank for the Escrow Account</b>	
<b>IFSC Code</b>	
<b>Account Name and Account Number of Escrow Account</b>	



**SCHEDULE-III**  
**TERMS & CONDITIONS AND OPERATING PROCEDURES**

**Deposits into Escrow Account**

- All the Payments due under the Contract will be released by the Owner to the Contractor in this Escrow Account as per Terms of Payment agreed in the Contract.

**Release/ Withdrawal of Funds from the Escrow Account**

- Based on the request from the Contractor, the Owner will approve the list of suppliers of goods and services, statutory authorities, establishment expenses etc. To whom payments could be made and the same shall be shared with the Escrow Bank from time to time for releasing the funds.

**Note:** Detailed Operating Procedure in this schedule, shall be finalised between Owner, Contractor & Escrow Bank at the time of signing of this Agreement.

**IN WITNESS WHEREOF** the Contractor has caused its Common Seal to be affixed hereto on the date first above written, the Owner, and the Escrow Bank have caused the same and the said counterparts to be executed by the hand of an authorized official.

**SIGNED AND DELIVERED BY .....** (Name  
of Owner), the within named **OWNER**,  
by the hand of \_\_\_\_\_ authorized  
representative of the Owner, who has been  
authorized to execute this Agreement.

**THE COMMON SEAL OF M/s\_\_\_\_\_**  
\_\_\_\_\_, the within named  
**CONTRACTOR**, has pursuant to the Resolutions  
of its Board of Directors passed in that behalf on \_\_\_\_\_  
here unto been affixed in the presence of MD and  
Company Secretary who has signed these  
presents in token thereof

**SIGNED AND DELIVERED BY**  
\_\_\_\_\_, the within  
named **ESCROW BANK**, by the hand of  
-----  
Its Authorised Representative.



## ANNEXURE-1.27

## PROFORMA OF INDEMNITY BOND FOR RECEIPT OF MATERIALS AT SITE

**FORM OF INDEMNITY BOND TO BE EXECUTED BY THE CONTRACTOR FOR SAFE CUSTODY OF THE EQUIPMENTS BROUGHT TO SITE IN INSTALLMENTS BY THE CONTRACTOR FOR PERFORMANCE OF THE CONTRACT AND AGAINST WHICH PAYMENT IS TO BE MADE ON RECEIPT AT SITE**

(On Non-Judicial stamp paper of appropriate value)  
**INDEMNITY BOND**

THIS INDEMNITY BOND is made this ..... day of ..... 20 ..... by ..... (Contractor's Name) a Company registered under the Companies Act, 1956/Partnership firm/Proprietary concern having its Registered Office at ..... (hereinafter called as 'Contractor' or "Obligor" "which expression shall include its successors and permitted assigns) in favour of ..... (Name of Owner), a Company incorporated under the Companies Act, 1956 having its Registered Office at ..... and its project at .....(hereinafter called "....." {Abbreviated name of the Owner} which expression shall include its successors and assigns) :

WHEREAS .....@ ..... has awarded to the Contractor a Contract for ..... vide its Letter of Intent/Contract No.....dated ..... and its Amendment No. .... and Amendment No. ....,(applicable when amendments have been issued) (hereinafter called the Contract") in terms of which .....(contractor)..... is required to keep in his safe custody various Equipments for execution of the Contract.

And WHEREAS by virtue of Clause No..... of the said Contract, the Contractor is required to execute an Indemnity Bond in favour in .....@ .....for the safe custody of Equipments/material for the purpose of performance of the Contract/Erection portion of the contract(hereinafter called the "Equipments")

NOW THEREFORE, This Indemnity Bond witnesseth as follows :

1. That in consideration of various Equipments as mentioned in the Contract, valued at(Currency and amount in figures)..... (Currency and amount in words) ..... brought to site by the contractor in instalments from time to time for the purpose of safe custody and performance of the Contract, the Contractor hereby undertakes to indemnify and shall keep .....@ indemnified, for the twice the value of the Equipments. The Contractor hereby acknowledges actual receipt of the initial instalment of the Equipment etc. at site as per details in the Schedule appended hereto. Further, the Contractor agrees to acknowledge actual receipt of the subsequent instalments of the Equipments etc. As required by .....@ .....in the form of Schedules consecutively numbered which shall be attached to this Indemnity Bond so as to form integral parts of this Bond.
2. That the Contractor is obliged and shall remain absolutely responsible for the safe transit/protection and custody of the Equipment at .....@ ..... project site against all risks whatsoever till the Equipments are duly used/erected in accordance with the terms



of the Contract and the plant/package duly erected and commissioned in accordance with the terms of the Contract, is taken over by .....@..... . The Contractor undertakes to keep .....@..... harmless against any loss or damage that may be caused to the Equipments.

3. The Contractor undertakes that the equipments shall be used exclusively for the performance/execution of the Contract strictly in accordance with its terms and conditions and no part of the equipment shall be utilised for any other work of purpose whatsoever. It is clearly understood by the Contractor that non-observance of the obligations under this Indemnity Bond by the Contractor shall inter-alia constitute a criminal breach of trust on the part of the Contractor for all intents and purpose including legal/penal consequences.
4. That .....@..... is and shall remain the exclusive owner of the Equipments free from all encumbrances, charges or liens of any kind, whatsoever. The Equipments shall at all times be open to inspection and checking by the Project Manager or other Owners/agents authorized by him in this regard. Further, .....@..... Shall always be free at all times to take possession of the Equipments in whatever form the Equipments may be, if in its opinion, the equipments are likely to be endangered, misutilised or converted to uses other than those specified in the Contract, by any acts of omission or commission on the part of the Contractor or any other person or on account of any reason whatsoever and the Contractor binds himself and undertakes to comply with the directions of demand of .....@..... to return the Equipments without any demur or reservation.
5. That this Indemnity Bond is irrevocable. If at any time any loss or damage occurs to the Equipments or the same or any part thereof is misutilised in any manner whatsoever, then the Contractor hereby agrees that the decision of the Project Manager of .....@..... as to assessment of loss or damage to the Equipment shall be final and binding on the Contractor. The Contractor binds itself and undertakes to replace the lost and/or damaged Equipments at its own cost and/or shall pay the amount of loss to .....@..... without any demur, reservation or protest. This is without prejudice to any other right or remedy that may be available to .....@..... against the Contractor under the Contract and under this Indemnity Bond.
6. NOW THE CONDITION of this Bond is that if the Contractor shall duly and punctually comply with the terms and conditions of this Bond to the satisfaction of .....@....., THEN, the above Bond shall be void, but otherwise, it shall remain in full force and virtue.

IN WITNESS WHEREOF, the Contractor has hereunto set its hand through its authorized representative under the common seal of the Company, the day, month and year first above mentioned.

**SCHEDULE-1**

Particulars of the Equipments	Quantity	Particulars of Despatch title Documents	Value of the Equipments	Signature of Attorney in token of receipt
		RR/GR/ Bill of lading Carrier No & Date		

(Please number subsequent schedules)

For and on behalf of .....

(Contractor's Name)

WITNESS :1. Signature .....

Signature .....

2. Name .....

Name .....

3. Address .....

Designation of .....

Authorised representative \*

2. 1. Signature .....

(Common Seal)

(In case of Company)

2. Name .....

3. Address .....

\* Indemnity Bond are to be executed by the authorised person and (i) in case of contracting Company under common seal of the Company or (ii) having the Power of Attorney issued under common seal of the company with authority to execute Indemnity Bond, (iii) In case of (ii), the original Power of Attorney if it is specifically for this Contract or a photostat copy duly notarized of the Power of Attorney if it is General Power of Attorney and such documents should be attached to Indemnity Bond.

@ Fill in abbreviated name of Owner



## ANNEXURE-1.28

## LITIGATION HISTORY

To  
Concerning Procuring Entity

Sir(s),

The details in respect of history of litigation or arbitration in the last 10 years of our Company are furnished below:

Year	Award `for' or `against' the Bidder	Name of the Party, Disputed Amount in Rs. Cause of Litigation and Crore matter in dispute

Date	Signature of Authorized Signatory ...
Place	Name of the Authorized Signatory... Designation ...
	Name of the Organization Seal ...

Note:

1. Continuation sheets of like size and format may be used as per Bidder's requirements and shall be annexed to these schedules.
2. Bidder should provide information on any history of litigation or arbitration in the last ten years.



**ANNEXURE-1.29**

**LETTER OF AUTHORIZATION/BOARD RESOLUTION/POWER OF ATTORNEY FOR  
INDIVIDUAL TO SIGN ON BEHALF OF THE BIDDER**

**To**

The Dy. Chief Engineer (TD),  
RVUN, Jaipur,  
Room no. 502, 5th floor,  
Dreamax Plaza,  
Sahkar Marg,  
Jaipur- 302005

**Sir(s),**

**Sub: Name of Work against NIT No. TN-...../2022-23**

**The Letter of Authorization/Board Resolution/Power of Attorney in respect of the following, authorizing them to sign the Bid Proposal and negotiate and furnish information as and when called by owner, is enclosed herewith:**

**1.**

**2.**

Date	<b>Signature of Authorized Signatory ...</b>
Place	<b>Name of the Authorized Signatory...</b>
	<b>Designation ...</b>
	<b>Name of the Organization</b>
	<b>Seal ...</b>



## ANNEXURE-1.30

### ADDITIONAL CONDITIONS OF CONTRACT

#### 1. Correction of arithmetical errors

Provided that a Financial Bid is substantially responsive, the procuring Entity will correct arithmetical errors during evaluation of Financial Bids on the following basis:-

- (i) If there is a discrepancy between the unit price and the total price that is obtained by multiplying the unit price and quantity, the unit price shall prevail and the total price shall be corrected, unless in the opinion of the Procuring Entity there is an obvious misplacement of the decimal point in the unit price, in which case the total price as quoted shall govern and the unit price shall be corrected;
- (ii) If there is an error in a total corresponding to the addition or subtraction of subtotals, the subtotals shall prevail and the total shall be corrected; and
- (iii) If there is a discrepancy between words and figures, the amount in words shall prevail, unless the amount expressed in words is related to an arithmetic error, in which case the amount in figures shall prevail subject to (i) and (ii) above.
- (iv) If the Bidder that submitted the lowest evaluated Bid does not accept the correction of errors, its Bid shall be disqualified and its Bid Security shall be forfeited.

#### 2. Procuring Entity's Right to Vary Quantities

- (i) At the time of award of contract, the quantity of Goods, works or services originally specified in the Bidding Document may be increased or decreased by a specified percentage, but such increase or decrease shall not exceed fifty percent(50%), of the quantity specified in the Bidding Document. It shall be without any change in the unit prices or other terms and conditions of the Bid and the conditions of contract.
- (ii) If the Procuring Entity does not procure any subject matter of procurement or procures less than the quantity specified in the Bidding Document due to change in circumstances, the Bidder shall not be entitled for any claim or compensation except otherwise provided in the Conditions of Contract.
- (iii) In case of procurement of Goods or services, additional quantity may be procured by placing a repeat order on the rates and conditions of the original order. However, the additional quantity shall not be more than 50% of the value of Goods of the original contract. If the Contractor fails to do so, the Procuring Entity shall be free to arrange for the balance supply by limited Bidding or otherwise and the extra cost incurred shall be recovered from the Supplier/contractor.

#### 3. Dividing Quantities Among More than one Bidder at the time of Award

(In case of procurement of Goods)

As a general rule all the quantities of the subject matter of procurement shall be procured from the Bidder, whose Bid is accepted. However, when it is considered that the quantity of the subject matter of procurement to be procured is very large and it may not be in the capacity of the Bidder, whose Bid is accepted, to deliver the entire quantity or when it is considered that the subject matter of procurement to be procured is of critical and vital nature, in such cases, the quantity may be divided between the Bidder, whose Bid is accepted and the second lowest Bidder or even more Bidders in that order, in a fair, transparent and equitable manner at the rates of the Bidder, whose Bid is accepted.



**ANNEXURE-1.31**

**FORM NO. I**

[See rule 83]

**MEMORANDUM OF APPEAL UNDER THE RAJASTHAN TRANSPARENCY IN PUBLIC  
PROCUREMENT ACT, 2012**

Appeal No .....of .....  
Before the .....(First/Second Appellate Authority)

- a. Particulars of appellant:
  - (I) Name of the appellant:
  - (II) Official address, if any:
  - (III) Residential address:
- b. Name and address of the respondent(s):
  - (i)
  - (ii)
- c. Number and date of the order appealed against and name and designation of the officer / authority who passed the order (enclose copy), or a statement of a decision, action or omission of the Procuring Entity in contravention to the provisions of the Act by which the appellant is aggrieved:
- d. If the Appellant proposes to be represented by a representative, the name and postal address of the representative:  
-----
- e. Number of affidavits and documents enclosed with the appeal:
- f. Grounds of appeal:  
-----

.....(Supported by an affidavit)

- g. Prayer:  
-----

Place .....  
Date .....

Appellant's Signature:

**Note :**

1. Continuation sheets of like size and format may be used as per Bidder's requirements and annexed to this Schedule.
2. The deviations and variations, if any, shall be brought out separately for each of the item.



**ANNEXURE-1.32**

**RAJASTHAN GOVERNMENT CIRCULAR**

 राजस्थान सरकार	<b>राजस्थान राजपत्र</b> <b>विशेषांक</b>	<b>RAJASTHAN GAZETTE</b> <b>Extraordinary</b>
	<b>साधिकार प्रकाशित</b>	<b>Published by Authority</b>
	आश्विन 30, शुक्रवार, शाके 1943-अक्टूबर 22, 2021 <i>Asvina 30, Friday, Saka 1943- October 22, 2021</i>	

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उप-खण्ड (I)

राज्य सरकार तथा अन्य राज्य-प्राधिकारियों द्वारा जारी किये गये (सामान्य आदेशों, उप-विधियों  
आदि को सम्मिलित करते हुए) सामान्य कानूनी नियम।

**FINANCE (G&T) DEPARTMENT**

**NOTIFICATION**

**Jaipur, October 22, 2021**

**G.S.R.364** .-In exercise of the powers conferred by section 55 of the Rajasthan Transparency in Public Procurement Act, 2012 (Act No. 21 of 2012), the State Government hereby makes the following rules further to amend the Rajasthan Transparency in Public Procurement Rules, 2013, namely:-

**1. Short title and commencement.**- (1) These rules may be called the Rajasthan Transparency in Public Procurement (Fourth Amendment) Rules, 2021.

(2) They shall come into force from the date of their publication in the Official Gazette.

**2. Insertion of new rule 75A.**- After the existing rule 75 and before the existing rule 76 of the Rajasthan Transparency in Public Procurement Rules, 2013, the following new rule 75A shall be inserted, namely:-

**"75A. Additional Performance Security.**- (1) In addition to Performance Security as specified in rule 75, an Additional Performance Security shall also be taken from the successful bidder in case of unbalanced bid. The Additional Performance Security shall be equal to fifty percent of Unbalanced Bid Amount. The Additional Performance Security shall be deposited in lump sum by the successful bidder before execution of Agreement. The Additional Performance Security shall be deposited through e-Glass, Demand Draft, Banker's Cheque, Government Securities or Bank Guarantee.

**Explanation :** For the purpose of this rule,-

- (i) Unbalanced Bid means any bid below more than fifteen percent of Estimated Bid Value.
- (ii) Estimated Bid Value means value of subject matter of procurement mention in bidding documents by the Procuring Entity.
- (iii) Unbalanced Bid Amount means positive difference of eighty five percent of Estimated Bid Value minus Bid Amount Quoted by the bidder.



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राजस्थान राज-पत्र, अक्टूबर 22, 2021

भाग 4 (ग)

(2) The Additional Performance Security shall be refunded to the contractor after satisfactory completion of the entire work. The Additional Performance Security shall be forfeited by the Procuring Entity when work is not completed within stipulated period by the contractor. Provision for 'Unbalanced Bid' and 'Additional Performance Security' shall be mentioned in the Bidding Documents by the Procuring Entity."

[No. F.2(1)FD/G&T(SPFC)/2017]  
By Order of the Governor,

Vimal Kumar Gupta,  
Joint Secretary to the Government.

राज्य केन्द्रीय मुद्रणालय, जयपुर।



**ANNEXURE-1.33**

**BIDDER TO FURNISH THE DETAILS OF THE RATES OF APPLICABLE GST ON THE  
SCHEDULE-1 OF BOQ,**

Sr. No.	Name of Item	HSN/SAC Code	Rate of GST
1.			
2.			
3			



## ANNEXURE-1.34

## RAJASTHAN GOVERNMENT CIRCULAR

 राजस्थान सरकार	राजस्थान राजपत्र विशेषांक	RAJASTHAN GAZETTE Extraordinary
	साधिकार प्रकाशित	Published by Authority
	अग्रहायण 27, शुक्रवार, शाके 1942- दिसम्बर 18, 2020 <i>Agrahayana 27, Friday, Saka 1942-December 18, 2020</i>	

भाग 4 (ग)

उप-खण्ड (I)

राज्य सरकार तथा अन्य राज्य-प्राधिकारियों द्वारा जारी किये गये (सामान्य आदेशों, उप-विधियों आदि को सम्मिलित करते हुए) सामान्य कानूनी नियम।

FINANCE (G&amp;T) DEPARTMENT

NOTIFICATION

Jaipur, December 18, 2020

**G.S.R.230** .-In exercise of the powers conferred by section 55 of the Rajasthan Transparency in Public Procurement Act, 2012 (Act No. 21 of 2012), the State Government hereby makes the following rules further to amend the Rajasthan Transparency in Public Procurement Rules, 2013, namely:-

**1. Short title and commencement.**- (1) These rules may be called the Rajasthan Transparency in Public Procurement (Second Amendment) Rules, 2020.

(2) They shall come into force from the date of their publication in the Official Gazette.

**2. Amendment of rule 42.**- The existing proviso to sub-rule (2) of rule 42 of the Rajasthan Transparency in Public Procurement Rules, 2013, hereinafter referred to as the said rules, shall be substituted by the following, namely:-

"Provided that, during the period commencing from the date of commencement of the Rajasthan Transparency in Public Procurement (Second Amendment) Rules, 2020 to 31.12.2021, in lieu of bid security a Bid Security Declaration shall be taken."

**3. Amendment of rule 75.**- In rule 75 of the said rules,-

(i) the existing proviso to sub-rule (2) shall be substituted by the following, namely:-

"Provided that, during the period commencing from the date of commencement of the Rajasthan Transparency in Public Procurement (Second Amendment) Rules, 2020 to 31.12.2021, the performance security shall be taken as under:-

- (a) 2.5%, or as may be specified in the bidding documents, of the amount of supply order in case of procurement of goods and services and 3% of the amount of work order, in case of procurement of works;
- (b) 0.5% of the amount of quantity ordered for supply of goods, in case of Small Scale Industries of Rajasthan; and
- (c) 1% of the amount of supply order, in case of sick industries, other than Small Scale Industries, whose cases are pending before the Board of Industrial and Financial Reconstruction (BIFR); and



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राजस्थान राज-पत्र, दिसम्बर 18, 2020

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- (ii) in sub-rule (3), the existing proviso to clause (f) shall be substituted by the following, namely:-

"Provided that, during the period commencing from the date of commencement of the Rajasthan Transparency in Public Procurement (Second Amendment) Rules, 2020 to 31.12.2021, in case of procurement of works, the successful bidder at the time of signing of the contract agreement, may submit option for deduction of performance security from his each running and final bill @ 3% of the amount of the bill."

[No. F.2(1)/FD/G&T-SPFC/2017]

By Order of the Governor,

Vimal Kumar Gupta,  
Joint Secretary to the Government.

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Government Central Press, Jaipur.



 सरकार द्वारा दिलाई गई	<b>राजस्थान राजपत्र</b> <b>विशेषांक</b>	<b>RAJASTHAN GAZETTE</b> <b>Extraordinary</b>
	<b>साधिकार प्रकाशित</b>	<b>Published by Authority</b>
	पौष 22, बुधवार, शाके 1943-जनवरी 12, 2022 <i>Pausa 22, Wednesday, Saka 1943- January 12, 2022</i>	

भाग 4 (ग)

उप-खण्ड (I)

राज्य सरकार तथा अन्य राज्य-प्राधिकारियों द्वारा जारी किये गये (सामान्य आदेशों, उप-विधियों आदि को सम्मिलित करते हुए) सामान्य कानूनी नियम।

#### FINANCE (G&T) DEPARTMENT

#### NOTIFICATION

Jaipur, January 12, 2022

G.S.R.398 .-In exercise of the powers conferred by section 55 of the Rajasthan Transparency in Public Procurement Act, 2012 (Act No. 21 of 2012), the State Government hereby makes the following rules further to amend the Rajasthan Transparency in Public Procurement Rules, 2013, namely:-

1. **Short title and commencement.**- (1) These rules may be called the Rajasthan Transparency in Public Procurement (Amendment) Rules, 2022.  
 (2) They shall come into force from the date of their publication in the Official Gazette.

2. **Amendment of rule 75.**- In rule 75 of the said rules,-

- (i) in proviso to sub-rule (2), for the existing expression "31.12.2021", the expression "31.03.2023" shall be substituted; and
- (ii) in proviso to clause (f) of sub-rule (3), for the existing expression "31.12.2021", the expression "31.03.2023" shall be substituted.

[No. F.2(1)FD/G&T(SPFC)/2017]

By Order of the Governor,

Vimal Kumar Gupta,  
 Joint Secretary to the Government.

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Government Central Press, Jaipur.



**ANNEXURE-1.35**

**DECLARATION REGARDING COMPLIANCE OF GOVERNMENT CIRCULARS  
(To be given on Company Letter Head)**

To,

Sub: Declaration regarding compliance of Government Circulars

NIT No: TNC- /2022-23

Name of Tender/Work: .....

Dear Sir,

- 1) We hereby confirm that we have read and understood the ITB clause no. 44 regarding "Testing of imported Equipments/ items" and certify our compliance to Order No 25-11/6/2018-PG, dated 02/07/2020, issued by Ministry of Power, Government of India and its subsequent amendments/revisions, with dispatch of equipment/ item.
- 2) We hereby confirm that we have read and understood the ITB Clause no. 45 regarding "Restrictions on procurement from a Bidder of a country which shares a land border with India" and certify our compliance to PPD GOI order No. 6/18/2019- PPD Dt. 23.07.2020 or Govt. of Rajasthan, Finance (G&T) Dept. Order No. F.2(1)FD/G&T-SPFC/2017 Jaipur Dt. 15.01.2021.
- 3) We further declare that if it is established that we have provided any false information in pursuance of the aforesaid ITB clauses, while competing for this contract, then our bid shall be rejected and bid security shall be forfeited. Further, if at any point subsequent to award of contract it is established that we have not complied with terms of above ITB clauses, during execution of contract, this would be sufficient ground for immediate termination of the contract, and shall be dealt accordingly.

Yours Faithfully,

Date

Place: \_\_\_\_\_ (Signature of the Bidder, with Official Seal)



# **RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD**

**Cooling Water System Package  
for  
Kota Super Thermal Power Station  
Unit # 5 (1 x 210 MW)  
Kota, Rajasthan, India**

[DOC. No. FCE-1117155-ME-DOC-SPC-3000-033]

## **VOLUME II TECHNICAL SPECIFICATION**

**FICHTNER Consulting Engineers (India) Private Limited**  
Chennai-Bengaluru, India



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**VOLUME II**  
**SECTION 1**  
**GENERAL TECHNICAL SPECIFICATION**

**1.0 INTENT OF SPECIFICATION**

- 1.1** The specification is intended to cover the design, engineering, manufacture, assembly / reassembly, constructional features, test at manufacturer's works, forwarding (duly packed for transportation), transportation delivery to site, unloading, handling, storage and in plant transportation at site, complete execution of necessary and allied Civil / Mechanical / Process works, Electrical, Instrumentation works, complete services of erection, testing at site, successful commissioning, handing over the following system in flawless operating condition to the Owner.
- Circulating Cooling water system with cooling tower for 1 x 210 MW (5<sup>th</sup> unit) of the Kota Super Thermal Power Station (KTPS)
  - Cooling Tower Makeup water system and CW Treatment system for 1 x 210 MW (5<sup>th</sup> unit) of the Kota Super Thermal Power Station (KTPS).
  - Side stream filtration system for 2 x 195 MW(6<sup>th</sup> and 7<sup>th</sup> unit)
  - Verification and modification of existing cooling tower treatment program and acid dosing system for 2 x 195 MW (6<sup>th</sup> and 7<sup>th</sup> unit) considering increasing the COC to six (6).
- 1.2** Construction, supplies and services shall be rendered in conformity with proven design principles, taking into account the current technology. The requirements of the contract must be fulfilled in its entirety. The supplies and services shall be rendered inclusive of all appliances and interconnecting arrangements with other supplies, necessary for installation of all accessories, needed for proper and reliable continuous operation and for satisfactory maintenance and repair.
- 1.3** In so far as data on the execution of supplies and services as contained in drawings, but none in specification and vice versa, such data shall be deemed to be contained in both. Contradictions, if any, between drawings and specifications and within various sections of the specification shall be brought to the attention of the Owner / Consultant by the Bidder and the correct requirement shall be obtained before submission of the bid.
- 1.4** All materials & equipment supplied under this contract shall be new and unused.

**2.0 DESCRIPTION OF SYSTEM**

Rajasthan Rajya Vidyut Utpadan Nigam Ltd (RRVUNL) is operating Thermal Power Plant with capacity of 1 x 210 MW (5<sup>th</sup> unit) & 2 x 195 MW (6<sup>th</sup> and 7<sup>th</sup> unit) in Kota, Rajasthan.

Unit-5 and Unit-6 of Kota Thermal Power Station (KTPS) comes under the category "TPPs (units) installed before 31<sup>st</sup> December, 2003" and Units Smaller than 500MW capacity units.



Unit-7 of Kota Thermal Power Station (KTPS) comes under the category “TPPs (units) installed after 1<sup>st</sup> January, 2004, up to 31<sup>st</sup> December, 2016”, and “for units having capacity of <500MW” as mentioned in the MOEF&CC gazette notification.

### **Compliance to MOEF & CC gazette notification:**

For Unit 5, following system measures shall be planned to meet the MOEF &CC stipulated norms.

- Circulating cooling water system with Cooling tower
- ETP RO Plant for Cooling tower blowdown water treatment (Owner's scope)

For Unit 6 & 7, the following system measures shall be planned to reduce plant-specific consumption and to meet the MOEF &CC stipulated limit.

- Increase the COC of the cooling towers to 6
- Installation of side stream filtration system
- ETP RO Plant for Cooling tower blowdown water treatment (Owner's scope)

### **Cooling tower makeup water system**

Make-up water requirement for Unit-5 Cooling tower shall be taken from the Existing Clarifier-1.

#### **Circulating cooling water system with cooling tower**

##### **i. Condenser cooling water CW system**

The CW system is a recirculating system using Induced Draft Cooling Tower. The CW pumps for Unit-5 shall be located in space available in the existing CW Pump house of Unit-6. The CW water is pumped from the existing CW pump house and passes through the condenser, the hot water from the condenser outlet shall be conveyed to the cooling tower and return to the forebay of the existing CW pump house by means of gravity flow. This cold water will be then recycled back to the system by the CW pumps. The CW system shall operate at six (6) cycle of concentration (COC). The system basically consists of one cooling tower, common CW forebay, CW pump sump and cooling water pumps.

The proposed Cooling tower shall be located in the existing storage shed area near Unit#6 cooling tower. The storage shed in that location shall be relocated to accommodate the cooling tower and the outlet channel.

Refer 3.2.2 (c) below for more details.

CT blowdown water shall be tapped from CW supply line and shall be sent to Effluent collection tank in ETP RO Plant.

##### **ii. Auxiliary cooling water (ACW) System**

The ACW water system will supply cooling water required for secondary side of plate heat exchangers (PHE) of Turbine & Boiler Auxiliaries for the unit. The ACW pumps for Unit-5 shall be located in the space available in existing CW pump house. The ACW water shall be pumped from the CW pump house by ACW pumps and passed through PHE. The hot water from the PHE outlet return



pipe shall be connected to the condenser return hot water header of the CW system.

### **CW treatment system for Unit # 5**

To prevent / minimize the scaling / fouling and microbiological fouling in the cooling water system, the following system shall be provided for unit # 5

#### **1) CW chemical treatment**

Chemical treatment system like acid dosing system, scale inhibitor, corrosion inhibitor and bio dispersant dosing system shall be provided for the proposed cooling tower to control the scaling and fouling.

#### **2) Chlorine dosing system**

Chlorine di-oxide dosing system shall be provided for the proposed cooling tower to control the bio-fouling.

#### **3) Side stream filtration**

Side stream filtration (SSF) system shall be provided to control the fouling in cooling tower and condenser. The CW water shall be tapped from CW supply line and shall be sent to SSF for treatment.

#### **4) Cooling Tower**

The type of cooling tower shall be induced draft cooling tower.

#### **5) Sludge disposal system**

The sludge from the following sources shall be taken to Effluent collection tank in ETP RO Plant.

- a. Cooling tower sludge
- b. SSF sludge

### **CW Treatment system for Unit # 6 and Unit # 7**

The existing CW treatment system consists of Acid dosing system; scale inhibitor dosing system and corrosion inhibitor dosing system. The dosing system are sized considering COC of 5.

The P&ID for the existing system is attached in Vol-II, Attachments.

The scope of services shall include the verification of existing CW treatment facilities and check the adequacy of the system with respect to increasing the COC to 6 and installation side stream filtration system.

There is no Side stream filtration system is available in the existing cooling towers of Unit # 6 and Unit # 7. The new Side stream filtration (SSF) system shall be provided for both the units to control the fouling in cooling tower and condenser. The CW water shall be tapped from respective unit CW supply line and shall be sent to SSF



for treatment. The back wash waste from SSF filter shall be transferred to Effluent collection tank in ETP RO Plant.

### **3.0 SCOPE OF WORK AND SERVICES**

#### **3.1 GENERAL**

The equipment and works to be provided under this specification shall be as detailed below Scope of works includes, materials, execution as per codes, specification, best engineering practices and to the satisfaction of the Owner for all Civil / Structural, Mechanical, Electrical, Control & Instrumentation works & training of the O&M personnel.

The scope shall include detailed design of the system, complete manufacture including testing, providing engineering drawings, data, operation manual etc. for the owner's approval, packing and transportation from the manufacturers works to the site, receipt storage preservation and conservation of equipment at the site, erection testing and commissioning of all the equipment, reliability tests, performance acceptance tests on completion of commissioning all the equipment & furnishing spares.

System shall be complete in all respects with all mechanical, civil, structural, electrical, control and instrumentation works.

#### **3.2 SCOPE OF WORK**

##### **3.2.1 Mechanical**

The scope shall include design, engineering, supply, installation, testing and commissioning, performance testing and handing over of, but not limited to, the following:

###### **3.2.1.1 CW & ACW System**

- CW and ACW Pumps
  - a) Two (2) nos. (2W) CW pumps of Vertical type for 1x210MW unit (Unit-5).
  - b) Two (2) nos. (1W+1S) ACW pumps of Vertical type for 1x210MW unit(Unit-5).
  - c) Two (2) nos. (1 W + 1 S) Simplex type basket strainers for ACW system for 1 x 210 MW (Unit#5).

The detailed specifications, MoC for strainers shall be considered as follows:

- a) The strainers shall have basket type straining elements permitting easy removal and replacement.
- b) The open area ratio (i.e. straining area to the inlet area ratio) shall be at least 6:1.



- c) The strainer shall have screen of stainless steel (AISI-304) construction with wire diameter of about 0.25 mm and open area of about 50%. Strainer screen shall be of 80 mesh or higher.
- d) Strainer body shall be made of Mild steel.
- e) Each strainer shall be provided with a pair of counter flanges and associated bolts nuts and gaskets. Material of counter flanges shall be of tested quality steel conforming to IS-2062. All strainers shall also be provided with oil drip plates beneath them for collection of oil.
- f) Bolts and nuts shall be as per IS-1363. Gaskets shall be minimum 3 mm thick  
The following accessories are required for all the pumps:
  - a) Pump motor coupling with coupling guard.
  - b) Self-contained lubrication system
  - c) Vent with isolation Cock
  - d) Non-reverse ratchet
  - e) Companion flanges along with fasteners and gaskets
  - f) Foundation bolts, base plates, sole plates, bolt, nuts, washers, supports, cover, shim plates, lifting lug, eye bolt, anchor bolts (if required) etc.
  - g) All necessary painting including corrosion protection.
  - h) Supply of lubricants till commissioning and handing over of equipment.
  - i) Discharge line pressure gauge with isolation valve.
  - j) Start-up and commissioning spares, Mandatory spares and recommended spares.

The existing CW pump house is housed with 3 Nos. (2W+1S) CW pumps & 2Nos. (1W+1S) ACW pumps for Unit-6 and space provision for additional 2 Nos. CW pumps & 2 Nos. ACW pumps for Unit-5. The proposed CW and ACW pumps for Unit-5 shall be located in the space available in existing CW Pump house. The existing crane shall be utilized for handling the proposed CW/ACW pumps and motors and other equipment in the CW pump house.

A common discharge header for all CW pumps (Unit-5&6) is available outside the CW pump house with blind flanges for Unit-5 CW System. A common standby pump shall be considered for Unit-5 & 6 and hence interconnection butterfly valves shall be supplied & installed by bidder in the common header.

A common discharge header for all ACW pumps (Unit-5&6) is available outside the CW pump house with blind flanges for Unit-5 ACW system. Interconnection



butterfly valve between Unit-5 & 6 ACW system shall be supplied & installed by bidder in the common header.

Stop log gate and coarse screens for the proposed CW/ACW pumps in the existing CW/ACW pump sump bay are not required. However, stop log gates & screen is required at Cooling Tower Outlet Channel.

- Coarse screen for each CW and ACW pump sump bay. Bidder shall visit the site to analysis the quantum of works involved.
- Stop log gate for isolation of CW and ACW pump sump bay. Bidder shall visit the site to analysis the quantum of works involved.

The details of existing CW & ACW System of Unit#6 as specified by RRUVNL are brought out in Vol-II, Attachments.

- One (1) no. Induced Draft counter flow cooling tower for 1 x 210 MW unit (Unit-5) complete with hot water distribution basin with nozzles, cold water basin and outlet channel, sludge pit, staircases and cage with ladders at both ends of the tower from ground level to its top deck and all other equipment and accessories as specified hereinafter and its data specification sheets:
  - i. Fans each complete with drive shaft, lubrication system, gear box, coupling, coupling guards, drive motor and base plate. Rain hood for drive motor and permanent grating / other suitable approach from stack door at top deck level to fan gearbox.
  - ii. Suitable handling arrangements for fan, gearbox and motor etc.
  - iii. Incoming hot water piping, including vertical run, supported on cooling tower end wall and terminated at a point including piping isolating valves wherever necessary, regulating type distribution valves, splash boxes and orifices in hot water distribution basin.
  - iv. Inlet louvers, tower fill and drift eliminators, including all supporting structures, fastening arrangements & accessories.
  - v. Screens along with guides embedded in concrete, for each cold water outlet sump.
  - vi. One (1) manual chain pulley hoist for each tower, complete with chain and hooks for lifting of the screens.
  - vii. Sluice gates complete with pedestal type manual operator (head stock) and guides embedded in concrete for each cold water outlet sump.
  - viii. Sludge collection pit in cold water basin for removal of sludge from basin to an outside sludge pit. A sludge pit of adequate size & depth for complete dewatering of the cooling tower basin complete with sludge disposal pumps along with motor, non-return valve, isolation valve, pipe supports, discharge piping (IS 1239) with flanged outlet upto Effluent collection tank in ETP RO Plant. Pumps, valves and fittings shall be suitable for Sludge handling duty.



- ix. Supply of all lifting tackles / hoists required for operation & maintenance.
  - x. Supply of companion flanges, bolts, nuts and gaskets as required.
  - xi. Start up and commissioning spares, Mandatory spares and recommended spares.
- Piping, fittings and valves
    - a) CW and ACW piping, fittings and valves shall be installed for the closed cooling system. The broad scope includes but not limited to discharge header from the CW and ACW pumps (separately) and connected to the existing CW and ACW header of the existing plant. The hot water return from the existing CW and ACW system shall also be included in the scope upto the cooling tower. Any modifications/alterations that are required in the piping system shall be included in the scope of the bidder.
    - b) CW blow down pipe with valve
    - c) Other piping, fittings and valves shall be installed as required as per scope of work.
    - d) Supply of companion flanges, bolts, nuts and gaskets as required.

Refer Vol. II, Section 2 for Detailed Technical Specification for Mechanical System.

### 3.2.1.2 Cooling Tower Make-up Water System

The scope shall include design, engineering, supply, installation, testing and commissioning, performance testing and handing over of the system, but not limited to the following:

- 1) Dismantling the Existing river water intake pipe and associated auxiliaries (intake pump house to clarifier-1 area) and install a New river water intake pipe and associated auxiliaries:
  - a. Length of pipe required to be dismantled & new pipe to be installed and its pipe dimensions are as follows:
    - i) MS ERW steel pipe quality as per IS-3589 minimum wall thickness of 6.3mm, 400 NB, river water intake pipe upto Clarifier-I. Quantity: 630 meters
    - ii) MS ERW steel pipe quality as per IS-3589 minimum wall thickness of 6.3mm, 500 NB, (Required to extend from Clarifier U#6 & 7 to CT make-up forebay of U#5), Quantity: 500 meters
  - b. No valve is required to be dismantled. New valves to be installed with companion flanges with gaskets and fasteners are as follows:
    - i) Butterfly valve motorized/actuator type, 400 NB, Quantity: 1 No.
    - ii) Butterfly valve Gear operated, 400 NB, Quantity: 3 Nos.



- iii) Air release valve, 100 NB, Quantity: 2 Nos.
  - iv) MS Shutter for channel, Quantity: 3 Nos.
  - v) CI sluice valve, 300 mm New IS 14846 (Old IS 780) Non rising spindle type, Quantity: 1 No.
  - vi) Butterfly valve, 500 NB, Quantity: 1 No.
  - vii) Circular Penstock, 400 NB, Quantity: 2 Nos.
- c. One number instrument panel is required to be dismantled at clarifier-I area. New instruments to be installed are as follows:
- i) 6 Nos. of Level Indicator for Filter water Channel/sump
  - ii) 1 No. of Conductivity indicator & recorder
  - iii) 2 Nos. of Ultrasonic flow meter mounted on 400 NB pipe
  - iv) 2 Nos. of Ultrasonic flow meter mounted on 500 NB pipe
  - v) 7 Nos. of flow indicator & recorder
  - vi) 1 No. of PH indicator & recorder
- 2) Dismantling the existing pumps & install new CT make-up pumps (3x450 m<sup>3</sup>/h) with associated valves, flow meter, foundations and electrical panels at existing clarifier-1 area. The existing pipe (500 NB) available between Clarifier-1 area and cooling water pump house shall be utilized as Unit#5 CT make-up line.
- 3) Supply of lubricants and consumables till commissioning and handing over of system
- 4) Start up and Commissioning spares, Mandatory spares and recommended spares

Refer Vol. II, Section 2 for Detailed Technical Specification for Mechanical System.

### 3.2.1.3 CW Treatment System

CW Treatment system shall be provided for the Proposed Cooling Tower and the system shall consist of CW chemical treatment system, Chlorine dosing system and side stream filtration system.

The scope shall include design, engineering, supply, installation, testing and commissioning, performance testing and handing over of the system, but not limited to, the following:

- 1) Scale inhibitor dosing system consists of Two (2) Nos. of Dosing tanks of with motorized Agitator and 2 x 100% Dosing pumps with all associated piping, valves, instruments and accessories etc.
- 2) Corrosion inhibitor dosing system consists of Two (2) Nos. of Dosing tanks of with motorized Agitator and 2 x 100% Dosing pumps with all associated piping, valves, instruments and accessories etc.
- 3) Bio-Dispersant dosing system consists of Two (2) Nos. Dosing tanks of with motorized Agitator and 2 x 100% Dosing pumps with all associated piping, valves, instruments and accessories etc.
- 4) Sulphuric Acid Dosing System consists of One (1) no. of Bulk Acid Storage Tank & One (1) no. Acid Measuring Tank with all accessories and two (2) x100% Acid unloading pumps with suction piping, discharge piping and Suction heliflex hose. & Two (2) x100% Acid Dosing pumps with all associated accessories etc.



- 5) Side stream filtration system consists of Four (4) Nos. (3W+1S) Media filters with all accessories and frontal piping etc.
- 6) One (1) no. Backwash waste Collection sump with all accessories and instrumentation.
- 7) Two (2) x 100% SSF Backwash waste transfer Pumps and associated accessories etc.
- 8) Two (2) x 100% chlorine di-oxide onsite generators and associated accessories.
- 9) Sodium chlorite Dosing System consists of One (1) no. of Bulk Storage Tank & two (2) x100% Sodium chlorite Unloading Pumps with Suction piping, discharge piping and Suction heliflex hose & Two (2) x100% Sodium chlorite Dosing pumps with all associated accessories etc.
- 10) Hydrochloric acid dosing System consists of One (1) no. of Bulk Storage Tank & two (2) x100% Acid Unloading Pumps with Suction piping, discharge piping and Suction heliflex hose. & Two (2) x100% Acid Dosing pumps with all associated accessories etc.
- 11) Two (2) x 100% Dilution water Pumps / Booster pumps and associated accessories etc.
- 12) Sodium chlorite area Neutralization system consists of one (1) no. N.Pit, One (1) no. sodium sulphite dosing tank, ejector dosing arrangement and Two (2) x 100% N.Pit waste transfer pumps with all associated accessories etc.
- 13) Hydro chloric acid Neutralization system consists of one (1) no. N.Pit, One (1) no. caustic dosing tank, ejector dosing arrangement and Two (2) x 100% N.Pit waste transfer pumps with all associated accessories etc.
- 14) One set of piping and valves.
- 15) All necessary painting and corrosion protection.
- 16) Three (3) nos. safety showers with eye wash for chemical handling areas.
- 17) Supply of lubricants and consumables till commissioning and handing over of plant.
- 18) Start up and commissioning spares, Mandatory spares and recommended spares.

Verification and modification of existing cooling tower treatment program for Unit-6 & 7 considering the COC of 6 and the required modification / system shall be in Bidder's scope:

- 1) The existing CW treatment of Unit-6 & 7 include solution preparation of namely PBTC, HEDP, Polyacrylate Dispersent, Zinc Sulphate and BTA in each drum of 200 kg capacity and finally transferring them into common tank having two chemical dosing pumps of 196 litres per minute. This CW treatment is based on 5 COC.



- 2) The proposed CW treatment of Unit-5 is based on 6 COC, and review / modification of existing CW treatment of unit 6 & 7 is to be carried out to make it work on 6 COC in future.
- 3) This proposed CW treatment based on 6 COC of all the Units-5, 6 & 7 should also include installation of monitors along with associated pipes and accessories (Scaling monitor, corrosion monitor and chemical dosing pumps. Bio fouling monitor) at CW return line to have close watch on parameters and adjusting the dosing accordingly.

Installation of Auto acid dosing system comprise of pH transmitter and auto stroke system to operate the dosing pumps with respect to the pH transmitter.

- 4) Side stream filtration system consists of Four (4) Nos. (3W+1S) Media Filters with all accessories and frontal piping etc. for each unit (i.e. for Unit-6 & 7).
- 5) One (1) no. Backwash waste Collection sump with all accessories and instrumentation for each unit.
- 6) Two (2) x 100% SSF Backwash waste transfer Pumps and associated accessories etc., for each unit.

Refer Vol. II, Section 2 for Detailed Technical Specification for Mechanical System.

#### **3.2.1.4 Handling facilities**

Refer Vol. II, Section 2 for Detailed Technical Specification for Mechanical System.

#### **3.2.1.5 Ventilation and Air conditioning facilities**

Refer Vol. II, Section 2 for Detailed Technical Specification for Mechanical System.

#### **3.2.1.6 Firefighting and protection facilities**

Refer Vol. II, Section 2 for Detailed Technical Specification for Mechanical System.

### **3.2.2 Civil**

The Scope shall include design, engineering, construction of all related civil, structural, architectural works including necessary testing all satisfactory complete work in all respect. The major buildings / structures envisaged for this contract are as listed below:

- a) Civil works for Cooling water make-up system
- b) Civil works for Induced Draft Cooling tower
- c) The proposed Cooling Tower for Unit#5 shall be located in the existing storage shed area near Unit#6 cooling tower. RRVUNL shall provide the bidder complete emptied storage shed which are to be demolished. The Newly 07 nos. of identical Storage sheds with same dimensions shall be constructed by the bidders at identified location. All usable material such as trusses, roof, gates etc., after the demolishing of existing storage sheds can be re-utilized in construction of new storage shed and balance not usable material shall be deposited in KSTPS O&M



store. After construction of 07 Nos. newly storage shed, the material shall be re-shifted to newly storage shed by RVUNL. Bidder shall also ensure the strict compliance of construction & demolition waste management rules.

Bidder to refer Volume II, Attachments for referring the size for constructing the 07 Nos. new storage shed.

Constructing the new storage sheds is in bidder's scope.

The bidder shall also construct approach roads & cemented platform between newly constructed storage sheds to maintain storage of the spares & material of maintenance activity of Thermal Plant and Approach roads (cement concrete) around cooling tower.

- d) Civil works for cooling water channel from Unit-5 Cooling tower to existing CW forebay of Unit-6.
- e) Necessary Civil works in the existing cooling water pump house for Unit-5 equipment is in bidder's scope
- f) Civil works for CW Treatment system and associated facilities.
- g) Civil works for CW Treatment Chemical House.
- h) Civil works for CT MCC building.
- i) Site leveling & grading as required
- j) Dressing up site upon completion of work
- k) Demolition of any underground with the scope of this contract subjected to owner's approval.

Refer Volume II, Section 5 for Detailed Technical Specification for Civil

Refer Vol. II, Section 2 for Detailed Technical Specification for Mechanical System.

### 3.2.3 Electrical

The Scope shall include design, engineering, supply, installation, testing and commissioning of the following electrical equipment complete with all accessories:

- a) LV service transformers
- b) Modification of existing 6.6 kV Switchgear located in Unit#5 to suit the new CW and ACW pumps ratings.
- c) Modification of existing 6.6 kV Switchgear existing motor feeders located in Unit#5 used for CT MCC to suit as per the transformer or tie feeders ratings.
- d) Modification of existing Clarified Water MCC with suitable rating and to accommodate newly proposed CT Make up pumps in Clarifier-1 area.
- e) 415V Power Control Centers, Motor Control Centers, Distribution Boards, Local starters and Local Push Button Stations.
- f) HT and LT Motors
- g) Electric actuators
- h) LT Power cables and control cables for all the equipment supplied by the Vendor
- i) HT, LT Power cables, control cables and signal cables between existing switchgear/control panel and CT Make-up Water & CW System Switchgear / Control panel / Motors / equipment.



- j) Cabling system complete with cable trays, supports, conduits, glands, lugs etc for all the cables covered in the Bidder's scope.
- k) Illumination system (Indoor & outdoor) complete with lighting distribution boards, lighting panels, lighting fixtures, lighting poles, receptacles, fans, conduits, wires, switch boxes etc.
- l) Fire sealing system for cable penetrations in the walls/floors.
- m) Complete earthing system including, equipment earthing.
- n) Electronic earthing system with earth pits
- o) Lightning protection system for all the buildings, structures and equipment, if applicable.
- p) Safety equipment such as Rubber mats, First aid box, Danger plate, Sand buckets etc.
- q) Engineering of complete Electrical system including preparation of required sizing calculations, layouts, scheme diagrams, cable schedules, Interconnection schedules, relay setting calculation etc.
- r) Mandatory spares
- s) Recommended spares for three (3) years of operation and maintenance
- t) Any other electrical equipment and accessories required to complete the system

### 3.2.4 Control and Instrumentation

The C&I scope of supply & service shall include but not limited to the following.  
Also refer Annexure 1- PLC system configuration diagram attached.

- 3.2.4.1 Control and monitoring of CW Pumps and ACW Pumps shall be from existing DCS in CCR
- 3.2.4.2 Control and monitoring of Cooling Tower and CW Treatment system shall include hot redundant PLC and power supply cabinets, one (1) number operator work station, one (1) number operator cum engineering work station and one no. A3/A4 size colour laser printer etc.
- 3.2.4.3 In addition, One no. operation station (24" LED monitor) for the system along with A4 Color laser printer shall be provided in the Unit 5 Central Control Room
- 3.2.4.4 One No. Lap top with necessary master software loaded for PLC / any other control system shall be supplied along with software in CD/DVD Form.
- 3.2.4.5 All process instruments like Pressure Transmitters / switches / gauges, Level transmitter / switches / gauges, Flow transmitters / totalizer / recorders / gauges, pH analyzers etc.
- 3.2.4.6 All final control elements like on-off valves, control valves, motorized valves, etc necessary for the complete system shall be provided.
- 3.2.4.7 Supply and installation of M/s ABB IO Cards for inclusion of the CW /ACW I/O's in the existing M/s ABB DDCMIS:
  - a. NTA 105 card: 4 No's
  - b. AI0611 card: 4 No's



- 3.2.4.8 All junction boxes, cable trays, cable glands, lugs, cable ties, instrument / junction supports, cubicles, local panels, pneumatic and process hook up hardware, instrumentation cables, control cables, special cables, fiber optic cables and other erection materials and accessories as integral to the system.
- 3.2.4.9 Supply of GPS master clock along with antennas and cables shall be in scope of bidder.
- 3.2.4.10 Cable supply, Laying, termination between field instrument and junction box, junction box to existing DCS, field instrument and junction box, junction box to PLC, time synchronization signals to master clock system from the PLC with all the cables and necessary boosters, MCC/SWGR to PLC (for all drives controlled from PLC), MCC/SWGR to DCS, LCP to PLC, comprehensive pump house instruments junction box to PLC.
- 3.2.4.11 All necessary cables between Local Fire Alarm system to existing plant Main Fire alarm system in Central control room.
- 3.2.4.12 Bidder shall provide complete, control and instrumentation system with all accessories, auxiliaries and associated equipment and cables for the safe, efficient and reliable operation of the system.
- 3.2.4.13 It is bidder's responsibility to provide necessary field instruments, transmitters & analyzers, which are needed for the completeness, safe & reliable operation of the system.
- 3.2.4.14 Bidder has to consider the cable supply and laying of Power cables from MCC feeder to UPS, UPS to Distribution boards and further to PLC system and field instruments etc along with the required accessories.
- 3.2.4.15 Owner shall supply Instrument air tapping point only at one location; necessary local pressure gauges & rest of the distribution shall be in bidder's scope.
- 3.2.4.16 Bidder's Scope of work shall include fabrication, erection (including grouting in the floor/ground) of structural steel plates, angles, pipes etc required for supporting cable trays, junction boxes and field mounted instruments.
- 3.2.4.17 Bidder to provide identification of each tube/cable by engraved aluminum tag plate/ferrules at instrument ends, inside junction boxes and inside instrument panels as per approved tubing and cable schedule etc.
- 3.2.4.18 Laying and connection of the earthing cables from different equipment to the respective earthing pits is in bidder's scope of work.
- 3.2.4.19 Supply of maintenance and calibration equipment, mandatory spares, etc., as required shall be provided.
- 3.2.4.20 Bidder shall refer to Drive control philosophy indicated in Section-4, Annexure – 8. I/O's based on drive control philosophy provided along with the specification are minimum and for bidding purpose only, however the exact IOs based on the drive control philosophy shall be approved during detail engineering and bidder to strictly follow the same without any commercial implication.



- 3.2.4.21 For all document / drawings bidder shall strictly follow the format of Owner only without any commercial implication.
- 3.2.4.22 All necessary protection system & remote annunciation system as per latest technology & state of art shall be provided as a safe guard against failure opening of doors at the landing platforms or any other type of emergency, if any.
- 3.2.4.23 All other I&C items, works and services detailed elsewhere in this specification

### 3.3 CONSUMABLES

- a) Supply of all consumables, chemicals required for erection, commissioning, trial operation and performance test is included in the basic scope and same shall be supplied by successful Bidder. List of such items shall be identified & furnished with bid & finally included in the bill of material document. The complete list shall be furnished by the Bidder in his offer.
- b) Grouting materials for all equipment, structures, etc.

### 3.4 MAINTENANCE TOOLS AND TACKLES

One (1) set of special tools and tackle required for operation, maintenance, dismantling, erection, inspection and repair shall be supplied in neatly packed-in steel boxes complete with operating instructions for the equipment as necessary. These shall not be used for erection/commissioning purposes by the Bidder and shall be in unused and new condition, when they are handed over to the Owner. The complete list shall be furnished by the Bidder in his offer.

### 3.5 COMMON SUPPLIES

All necessary painting and corrosion protection. The painting and corrosion protection for the equipment and structures is included in bidder's scope. The painting scheme and the finish color for all the equipment shall be as specified by the Owner after award of contract. Necessary finish paints including touch up paints, if not applied at shop, should be supplied by the Contractor, in sealed containers for site application.

### 3.6 GENERAL SCOPE OF SUPPLY AND SERVICES

The scope of supply and services covered by this EPC enquiry document shall be complete from site clearing to project take over by the Owner including all supplies and services. The Bidder's scope of supply and services listed below are to be included and shall not be limited to the following:

1. Design, Engineering, Procurement, Testing at Manufacturer's Works, painting, Packing, Forwarding and Supply of all equipment, plants and facilities within the limits of supply and for connection at the boundary limits, as specified in the relevant detailed technical specification for the completion of the Cooling water system on an EPC basis including Special Tools & Tackles, Startup / Commissioning spares, Mandatory Spares etc.,



The scope of supply and services shall also be covered the following:

- All the interfaces with the existing system in the power plants.
  - All coordination required with various agencies of the power plants.
  - As the existing pipes are routed either below ground / pedestal / pipe rack, bidder shall ensure that the proper connections shall be planned without interrupting the existing plant operation. NOC shall be obtained from the respective agencies and time period for carrying out the works shall be clearly brought to the owner's notice.
  - All underground structures shall be studied before carrying out any construction works.
  - The new connections/tap-off from the existing pipelines shall be optimized based on the site conditions subjected to the Owner's approval.
  - The feasibility of the existing equipment like pumps etc., shall be studied and the relevant documentation shall be obtained from the owner. If the same is not available, site survey, measurements etc. shall be carried out to finalise the contract requirements.
  - Bidder shall visit the site to understand that existing layout and the interfaces required within this contract boundary.
2. Intermediate site storage, transport to erection area, Receipt of material at site including unloading from carriers at site, handling, storage & preservation at site and intra site transport with site / owner.
  3. Inspection, testing, cleaning, painting, marking, etc. at the EPC contractors and/or sub-contractors workshops, delivery and transportation to the site, including insurance, unloading, etc.
  4. Overall Project management, project control, quality assurance, site management and coordination for all technical matters, interconnections, connection to off-site facilities, scheduling, contractual matters and obligations, etc. with suppliers, sub-suppliers, subcontractors, vendors, the Owner, authorities as required on a EPC basis for the implementation, construction and putting into commercial operation of the whole project under the overall and sole responsibility of the EPC contractor.
  5. Complete civil engineering including, Geo-technical investigation and design and carrying out all necessary civil and construction works at site as specified. To carry out soil resistivity test for designing of plant earthing system.
  6. Supply of all information, documents, calculations, drawings, reports, etc. which are required for Owner's approval and to obtain all necessary permits, clearances, from the Government authority.
  7. Apply for all permits and get the authorities approval for all actions, which require approval or permit from local government and statutory authorities. The contractor shall obtain and pay for necessary permits as required including license fees for installation and inspection of the equipment, also make such tests as called for by the regulations in the presence of authorized representatives of such authorities as well as in the present of the Owner's representative. The contractor shall be responsible to obtain license, certificate for operating at site.



- 8 Supply of all consumable materials required for civil construction, erection, testing and commissioning, reliability run, performance guarantee test, taking over of the plant. However, water required for these trial / test of the plant will be provided by the Owner at specified terminal point, but shall be under no obligation to do so for any re-run of such tests due to contractor.
9. Provision of all labour, necessary erection equipment, temporary site facilities, temporary connections to power supply, water supply, etc. for erection and commissioning required for the fulfillment of the Contractor's duties in connection with the works and for completion of the entire project in time.
10. Provision of all accommodation, transport, canteen facility etc. for the contractor's personal employees shall be arranged by Bidder.
11. Co-ordination with other agencies including with the Owner at the plant interconnections (interfaces).
12. Cleaning and application of corrosion protection during erection as required by the Owner and apply final & touch up painting in accordance with the specification.
13. Carry out commissioning, testing, trial operation, reliability run and performance guarantee test of the systems / equipment / plant including civil, structural & architectural works specified and handing over of the plant to the Owner requirements and approval and in compliance with the requirements of this specification.
14. Installation and removal of temporary piping and equipment for carrying out flushing or any other operation.
15. Removal of surplus materials, scraps out of fabrication yard, temporary infrastructures, subsequent cleaning up and handing over of plant to the owner.
16. Provision of supply of all documents required and specified including AS BUILT drawings.
17. Training services for the Owner's operation and maintenance personnel.
18. The Contractor shall accept full responsibility for the completeness and for the faultless working of equipment and the plant as a whole. These shall be executed on the basis of proven design principles and in accordance with the state of-the-art in such a manner that the purpose to be served by the plant is fulfilled in every respect and a maximum of operational dependability and efficiency are assured. Standardization of equipment, materials etc. as well as of buildings shall be employed in the design. Care shall be taken to ensure safe operation as well as simplicity of assembling and dismantling of all parts of the plant.
19. Satisfactory conclusion of the Contract:-



By accepting the Contract, the Contractor shall be deemed to accept the obligation of supplying everything necessary for the purpose mentioned above, regardless of any omission in the specification or on the drawings.

More detailed scope of supply and service is described under this section and the relevant chapter of the detailed technical specification.

#### 20. Scope of Engineering Services:-

The engineering services of the Contract refer to the complete basic and detail engineering of all equipment and equipment systems, Providing engineering drawings, data, instruction manuals, as built drawings and other information for the Owner's review, approval and records.

### 3.7 COMMON EQUIPMENT AND SERVICES

The following supplies and services are to be included in the Bidder's scope:

- Plant Hand Book contains the design and performance data of various plant, equipment, systems, covering complete supply package including single line diagram.
- All necessary co-ordination with other contractors on site for erection, testing and commissioning of equipment and accessories.
- Making available of all testing and commissioning equipment.
- All necessary pipelines, warm up system, vents, drains, valves, actuators, required for commissioning, operation and preservation in standstill.
- All temporary installations required for tie-in measures including post weld heat treatment complete, inner cleaning, etc.
- All temporary pipe work as required during connection measures
- All support structures, hangers, supports etc.
- All base frames, mounting plates, grouted in parts, rag bolts, covers, etc.
- All required steel parts embedded in concrete
- All couplings and coupling guards for electric motors and other drives
- All lifting equipment required for maintenance
- Required safety equipment, pressure relief valves, etc.
- All thermal (Hot and Cold) and noise insulation including cladding as well as any other noise attenuation measures
- Stairways, ladders, platforms, galleries and walkways to all plant components, including escape routes as necessary, pipe cross overs
- All necessary steel structures, stairs, ladders and platforms including weather protection
- All required ventilation and / or air conditioning equipment as specified and as required for safe operation of mechanical and electrical equipment, to be supplied
- All necessary corrosion protection measures for plant components and equipment stored or mounted on site up to the time of "Handing Over".
- Complete primer and top coatings conforming to color code, to be agreed with the Owner/Owner's Engineer
- Noise abatements measures to comply with noise pollution control requirement
- Complete labeling of all plant components according to the Owners system in English and also in local language for notices etc.



- All fire protection measures
- Initial lubricant filling and sufficient lubricants for commissioning and reliability test run, minimization of lubricant types by screening and co-ordination with the Owner,
- Flushing of all other pipelines including disposal of the effluents; protection with wood and/or plastic at all instrumentation and appendages to be installed during construction
- Chemical cleaning
- All standard accessories and auxiliary equipment which normally form part of the scope of supplies
- All tests, inspections and works acceptances as well as all certificates and reports of these
- Cleaning of all filters/strainers before “Handing Over” of the relevant Unit
- Valve trims for purging and subsequent exchange
- Removal of any unused material from site
- Detailed Soil investigations of the area
- Earthworks, drainage, excavation and refilling works
- Roads and pavement
- Concrete and reinforced concrete works, masonry and earthing
- Water proofing works for pressing and non-pressing water
- Roofing (non-asbestos)
- Plumbing
- Facade works/glazing works; non asbestos
- Non-load bearing walls/installation partitions/dry construction works
- Metalwork and blacksmith work/raised flooring/doors and gates/sheet metalwork
- Flooring work
- Corrosion protection for underground/ over ground RCC and steel structures
- Crane way works
- Potable water, service water and waste water, sewage water, storm water (permanent and during construction), etc.
- Housekeeping during construction (at least once a week total)
- Transport of all dumping material to dump locations (at least once a week )

### 3.8 SCOPE OF WORKS & SERVICES

- 3.8.1 To protect the security, integrity and reliability of equipment in this package, it is essential to remove vulnerabilities arising out of the possibilities of cyber-attack through malware/Trojans etc. embedded in imported equipment's.
- 3.8.2 This requirement shall apply to any item imported for end use or to be used as a component, or as a part in manufacturing, assembling of any equipment or to be used in this package.
- 3.8.3 Contractor shall comply all the requirements of Order No. 25-11/6/2018-PG, dated 02/07/2020 (Refer Volume II of Attachments), issued by Ministry of Power, Government of India and its subsequent amendments/revisions.
- 3.8.4 Further, Contractor shall furnish back up testing certificates, whenever Owner ask the same.



- 3.8.5 Dismantling of existing chlorination system of Clarifier Stage-I and installation of new Chlorine Di-Oxide Generator System with associated auxiliaries for chlorination of 1000 M3 per hour of raw water.

Bidder also incorporate Storage PAC tank (30 MT capacity) with two nos. unloading pumps and two nos. measuring PAC tanks (2 MT) with associated dosing pipeline, valves and associated electrical works.

- 3.8.6 In HT Switchgear # 5, all six HT feeder are to be modified thoroughly except panel cubical & HT breaker. In these panels, all panel wiring, relay, indications CTs/PTs etc. are to be replaced. Relay should be numerical type. Energy meter should be digital and Class 0.2. LT control panels are to be replaced.

- 3.8.7 In all three LT panel of CT make pump, except breaker, all the wiring, indications and relays and other LT panel equipment are to be replaced with new ones. LT control panels are to be replaced of all three motor feeders.

- 3.8.8 Rating of existing HT motors of Unit#6-

- i). CW Pump Motor: KW-1500, 6.6 KV, FLA-164A, RPM-496, 50 Hz, Frame- VTPC 1700, Make-CGL, Insulation Class-F
- ii). ACW Pump Motor: KW-635, 6.6 KV, FLA-67A, RPM-999, 50 Hz, Frame- VTPC94.0, Make-CGL, Insulation Class-F

- 3.8.9 The bidder shall also refer the available additional existing drawings for Coupler, Incomer, Motors of Unit-7 and details of existing CW & ACW Pumps of Unit-6 for ready reference which are attached in Volume II as Attachments of this tender.

- 3.8.10 Refer Volume-II, Section-1, 2.0, Description of item (ii), page 7 of 100 Auxiliary Cooling Water System in tender documents may be read as “the ACW water system will cool the Generator, Boiler, Turbine and CA etc. auxiliaries and to be connected in existing system in cold BCW inlet system as per feasibility at site and termination of lines approx. 6 to 10 meters level which are coming from 48 meters overhead tank.”

Bidder has to ensure sufficient cooling water flow with sufficient pressure in every auxiliary. If any modification is required to fulfill the system requirement, the same will be in the scope of bidder

- 3.8.11 Details of CW Channel at new CW Channel (From new cooling tower of CT-5 outlet) connection point are as hereunder:-

- Width-3 m
- Depth-4.5 m
- Water Level-3.70 m
- Existing Channel wall thickness-0.50m



## 4.0 TERMINAL POINTS

### 4.1 MECHANICAL WORKS

#### 4.1.1 CW system

As per Flow diagram - CW system. All the modification required at Terminal points shall be included in this contract.

#### 4.1.2 ACW system

As per Flow diagram - CW system. All the modification required at Terminal points shall be included in this contract.

#### 4.1.3 Firefighting and protection system

As per scope of works

#### 4.1.4 CT Make-up & CW Treatment System

Sl. No	Description	Terminal point	Remarks
1.	River water intake	From existing Raw water pump discharge header upto Clarifier-1 inlet.	Bidder shall visit the site to analysis the quantum of works involved.
2.	Cooling tower make-up	From CT make-up pumps suction header upto discharge header in Clarifier-1 area.  From Clarifier of Unit 6&7 to CT make up forebay of Unit 5 Cooling tower.	Bidder shall visit the site to analysis the quantum of works involved.
3.	CT blowdown (Unit-5)	CT blow down pipe (5 m length) with Isolation valve, flow meter & blind flange shall be provided by bidder in CW return line at one point near cooling tower area.  Further routing of CT blowdown pipe upto ETP RO Plant is in Owner's scope.	ETP RO Plant is in Owner's scope.
4.	CT sludge	Terminated upto Effluent collection tank in ETP RO Plant by bidder.	Bidder shall visit the site to analysis the quantum of works involved.  ETP RO Plant is in Owner's scope.
5.	SSF supply	CW water for SSF treatment shall be tapped from the CW supply line of Unit-5, 6 & 7.	Supply of pipes with isolation valves are in bidder scope.
6.	SSF treated	Treated water from SSF shall be	



<b>Sl. No</b>	<b>Description</b>	<b>Terminal point</b>	<b>Remarks</b>
	water	sent to respective CT forebay (Unit-5, 6 & 7).	
7.	SSF reject	Rejects from SSF of Unit-5, 6 & 7 shall be terminated upto Effluent collection tank in ETP RO Plant by bidder.	Bidder shall visit the site to analysis the quantum of works involved.  ETP RO Plant is in Owner's scope.
8.	Service water	From the nearest existing service water header	
9.	Potable water	From the nearest existing potable water header	
10.	Instrument Air	From the nearest existing instrument air header	
11.	Service Air	From the nearest existing service air header	

#### **4.2 CIVIL WORKS**

- a) Access road upto nearest plant road as per plot plan attached. However, Bidder shall visit the site to analysis the quantum of works involved.
- b) Storm water Drain upto nearest existing road side drain.

#### **4.3 ELECTRICAL WORKS**

**HT Power Supply :** HT power supply envisaged at 6.6 kV existing Unit-5 Switchgear

**415 V AC Supply :** Power supply envisaged at 415 V existing MCC panels. Necessary modification in the existing PCC shall be in the bidder scope.

**415 V AC Emergency Supply :** Power supply envisaged at 415 V Emergency Switchgear.

**220 V DC Supply :** 2 nos. 220 V DC supply will be provided at existing DCDB. Necessary feeder installation in the existing DCDB shall be in the Bidder Scope.

**UPS Supply :** 2 nos. UPS supply will be provided in existing DB. Necessary feeder installation in the existing UPS DB shall be in the Bidder Scope.

**Earthing :** 2 nos. earth rod riser will be provided near CW System Panels for above ground earthing.



#### 4.4 CONTROL AND INSTRUMENTATION

Cable, cable tray and accessories including supply, laying and termination	: No Terminal Point. All cables where one end / both end equipment shall be supplied by bidder.
	i) Complete supply, installation and laying by bidder between bidder supplied equipment.
	Complete supply, installation and laying between Field instruments / Valves / local control Panels, PLC and existing DCS.
	ii) Complete supply, installation and laying between Switchgear / MCC & PLC.
	iii) Complete supply, installation and laying between Respective UPS terminal and PLC / Local Control Panel by the bidder
OPC / MODBUS DDCMIS interface	: Terminal Point at respective Plant DCS end (in existing CCR )
GPS master clock Time Synchronization	: Complete supply, installation and laying cable between Respective PLC Panel and Master Clock end
VMAS	: No terminal point. Complete supply and installation by the bidder within his battery limits.
Field Instruments / Final Control elements / Erection hardware	: No terminal point. Complete supply and installation by the bidder within his battery limits.
Earthing	: No terminal points. Complete requirement by bidder within his battery limits
UPS/Auxiliary Supply System	Power : No terminal points. Complete requirement by bidder within his battery limits

#### 5.0 DELETED

#### 6.0 SITE CONDITIONS

##### 6.1 LOCATION AND EXISTING INFRASTRUCTURE

The plant location details are as follows:

Country	: India
State	: Rajasthan
Administrative district	: Kota



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Nearest Railway Station	:	Kota
Nearest Airport	:	Jaipur
Nearest Harbour	:	Mumbai port

The proposed power plant is located at Kota in Rajasthan. The site is accessible by well-developed roads. Railway lines are also located adjacent to the site boundary.

## 6.2 GEOLOGICAL CONDITIONS

Geotechnical information available with the Owner is enclosed as Attachment with this specification as guidance for the Bidder to quote after making his own assessment of the site.

Comprehensive geotechnical site investigation shall be carried out by the Contractor, and upon his full responsibility by considering his proposed general layout of the plant, the pipeline cross over and routing in order to have complete and clear information regarding the type of soil layers, physical and chemical characteristic of soil, allowable bearing pressures, prediction of settlements, geotechnical features etc. for safe and economical design of the buildings, pipeline cross over and supports. Any difference found at a later date in Owner's geotechnical survey detail shall not form the basis of any extra claim or time extension. The details of works proposed to be carried out by the Contractor shall be submitted to the Owner along with the bid.

## 6.3 METEOROLOGICAL CONDITIONS

### Ambient Air Temperature

Maximum recorded temperature : 50°C

Minimum recorded temperature : 3.9°C

### Relative humidity

Mean Maximum humidity : 85%

Mean Minimum humidity : 61%

### Rainfall

Annual rainfall (Maximum) : 800 mm

### Wind

Basic Wind Speed : 39 m/sec

## 6.4 DESIGN REQUIREMENTS RELATED TO SITE CONDITIONS

### 6.4.1 Design Ambient Data

The maximum rainfall in a year to be considered for design is 800 mm in 24 hours and the hourly intensity to be considered is 40 mm/hr. Area drainage study as required is in Bidder's scope of work.



- **Design ambient conditions**

Design Ambient Wet bulb temperature : 27.8°C

- **Design ambient Conditions for Electrical equipment sizing**

For electrical equipment : 50°C

#### 6.4.2 Wind data

Wind loads to be considered for design of structures shall be based on the design wind speeds arrived at based on IS: 875 (Part -3) – Latest Edition. The parameters for calculation of design wind speed as per IS: 875 (Part -3).

#### 6.4.3 Seismic Data

Seismic loads to be considered for design of structures shall be as per as per IS: 1893.

### 7.0 SITE WORK AND ERECTION REQUIREMENTS

#### 7.1 CONSTRUCTION POWER

Construction Power shall be provided free of cost by OWNER at one point inside the plant premises. Any cost related to distribution and taking it to different points/locations shall be borne by CONTRACTOR.

#### 7.2 CONSTRUCTION WATER

Construction Water shall be provided, without any additional cost, to the CONTRACTOR at a single location at SITE. Any cost related to distribution and taking it to different points/locations shall be borne by CONTRACTOR.

#### 7.3 CONSTRUCTION COMMUNICATIONS

Any communication system which the Contractor might need is within the scope of the Contractor's supply.

#### 7.4 ACCESS TO CONSTRUCTION SITE

Most transportation will have to be via rail or road. Heavy equipment if transported by rail have to unloaded at a distance and transported to site by other means. Any road transportation to the site will have to be through the existing plant access road and high ways.

#### 7.5 SITE SAFETY & SECURITY

It's Contractor's duty to organize and constitute a safety system for providing protection to installation work, contracting material storage, warehouse, field office, accommodation etc., within the contractor's scope of supply and services.



Guards shall be provided by contractor for safety and security.

The Contractor is responsible for the storage of material and the upkeep of equipment at the working site. There shall be fencing for temporary storage and material storing yard with special duty personnel on duty day and night.

Temporary safe railings shall have safe lighting equipment to send out indications such as material warehouse, field or site office and accommodation.

The duty of the Contractor includes the site management and safety of the engineers.

#### **7.6 FIELD SAFETY AND HEALTH ORGANIZATION**

According to both, local safety and health regulations, field safety organization shall provide necessary tools, documentation and other measures especially with respect to handling of dangerous goods and fire risks and medical service.

Contractor shall be in charge of examining field safety under the control of a field safety engineers.

#### **7.7 CLEANING ON SITE**

Contractor shall be responsible to keep the construction site clean and remove any waste material or hazardous waste to an appropriated waste disposal site approved by authorities in a safe and orderly way.

#### **7.8 LAYDOWN AND CONSTRUCTION**

Space available within the site shall be utilized for Contractor's laydown and construction.

#### **8.0 SPARE PARTS, WEAR AND TEAR PARTS**

Spares for the total plant of shall be divided into three categories namely:

- (a) Start-up and Commissioning Spares
- (b) Recommended / Operation & Maintenance (O & M) Spares
- (c) Mandatory Spares

##### **8.1 START-UP AND COMMISSIONING SPARES**

Start-up and Commissioning spares are those which would be required during plant or equipment testing, start-up and commissioning. All spares used until the plant is finally handed over by the Contractor to the Owner come under this category. All start-up and commissioning spares as required shall be provided by the Contractor without any additional cost to the Owner. The list and details of start-up and commissioning spares shall be furnished by Contractor prior to award of Contract.

Contractor shall be responsible for the ready and timely availability for all the start-up and commissioning spares as required during various stages of testing, cleaning and commissioning upto handing over of each system of the plant.



## 8.2 RECOMMENDED / O & M SPARES

The spares required for 3 years trouble free operation of the plant shall be identified and listed by the bidder in his offer. Owner will review the list of spares specified and finalize the same including any additional spares that will be necessary for three (3) years trouble free operation to meet the plant O & M requirements. The spares for the plant shall be furnished by the Contractor and delivered during the commissioning of each phase of the total plant.

The spare parts must be able to replace the original part completely and have the same technical specifications in quality, material, inspection and mechanical aspects.

Contractors shall supply all measurement testing data of any spare part supplied, if applicable.

All spare parts supplied shall be packed and stored for a 5 years reservation based on the local climatic conditions. Small spare parts shall be packed and sealed by transparent plastic bags and drying agents will be used if necessary. Every spare parts shall have operation instructions and design marks of the factory when it is supplied.

When multiple spare parts are packed in one packing box or container, the general indication to the spare parts outside the packing boxes or containers shall include a detailed list. All packing boxes, containers, and other such tanks shall be marked properly and numbered clearly. All electrical equipment including switches, fuse connection easy melting and other similar apparatus shall be protected and insulated.

The identification of all spare parts shall be in the English language.

Spare parts shall be supplied 6 months before start of acceptance test of the unit.

Wear & tear parts to be replaced by Bidder/Contractor in warranty period.

Contractor's recommended/required spare part list shall be confirmed during detail design.

Contractor shall identify in the spare parts list, the items having a delivery time of more than 3 months.

## 8.3 MANDATORY SPARES

- a) The list of mandatory spares considered essential by the Owner is indicated in the Annex 1.3 enclosed to this Section. The bidder shall indicate the prices for each and every item (except for items not applicable to the bidders design) in the 'Schedule of Mandatory Spares' whether or not he considers it necessary for the Owner to have such spares. If the bidder fails to comply with the above or fails to quote the price of any spare item, the cost of such spares shall be deemed to be included in the contract price. The bidder shall furnish the population per unit of each item in the Bid Forms & Price Schedules. Whenever the quantity is mentioned in "sets" the bidder has to give the item details and prices of each item.



- b) Whenever the quantity is indicated as a percentage, it shall mean percentage of total population of that item in the station (project), unless specified otherwise, and the fraction will be rounded off to the next higher whole number. Wherever the requirement has been specified as a 'set' it will include the total requirement of the item for a unit, module or the station as specified. Also one set for the particular equipment. e.g. 'set' of bearings for a pump would include the total number of bearings in a pump. Also the 'set' would include all components required to replace the item; for example, a set of bearings shall include all hardware normally required while replacing the bearings.
- c) The assembly / sub assembly which have different orientation (like left hand, right hand, top or bottom), different direction of rotation or mirror image positioning or any other regions which result in maintaining two different sets of spares to be used for subject assembly / sub-assembly shall be considered as different type of assembly/sub-assembly.
- d) The Owner reserves the right to buy any or all the mandatory spare parts.
- e) The prices of mandatory spares indicated by the Bidder in the Bid Proposal sheets shall be used for bid evaluation purposes.
- f) Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until & unless specified otherwise.

## 9.0 TRAINING REQUIREMENTS

### 9.1 GENERAL

The Contractor shall be responsible for the instruction and training of the Owner's operation and maintenance personnel in all aspects of plant design, construction, erection, commissioning, etc. and in such a way that operation, maintenance and if necessary repairs of all the power plant equipment and facilities specified can be handled competently by said personnel.

Such training of the Owner's personnel shall be performed.

- In Contractor's and/or sub-supplier's/manufacturer's home office and/or workshops.
- In similar capacity cooling water system operated power plant and such power plants which are under erection and commissioning as well as at the proposed similar Power Plant by using the training simulator.
- On the job site by the Contractor's and/or his sub-suppliers, supervisors and/or instructors deputed to the site for supervision of erection, commissioning, testing and trial operation and/or by specialized training instructors;
- At the cooling water system by the supervisors deputed to the Plant during the Warranty Period;

In compliance with the provisions of the Contract and the requirements of this specification.



The personnel required for the safe and efficient plant commercial operation and maintenance of the various types of equipment installed shall be provided by the Owner in accordance with the recommendation to be made by the Contractor.

The training will be performed in English. Translators/interpreters shall be provided by the Contractor.

The Contractor's instructors shall use modern training techniques, procedures and aids and make available to the trainees all required notes, manuals, drawings, etc., to supplement the Operation and Maintenance Instruction Manuals.

The Contractor shall provide a detailed description about the recommended training services, including:

- Number, category, seniority, required experience, profile required, etc. of the trainees
- Preliminary training program, showing
  - Training facilities, training aids places of training etc.
  - Training schedule
  - Specialty and details of lectures and training
  - Duration of training courses

for all kind of training activities, abroad, classroom, on the job site, at the cooling water system etc.

The recommended training program should be based on the organizational and staff structures of coal fired power plants already in operation in India and should take into consideration not only the training for operation and maintenance staff, such as operators, skilled workers, foremen and technicians etc, but also for senior staff and key personnel employed for the management and organizational duties of the various power plant decisions, such as for operation, maintenance, instrumentation and control, chemistry, administration, security, spare parts handling, scheduling and engineering, etc.

## 9.2 CONTRACTOR'S OBLIGATIONS AND TASKS

- 9.2.1 The Contractor shall make every effort to train the Owner's personnel so that they can be qualified for the management, operation and maintenance of the Contract Plant.
- 9.2.2 The Contractor shall nominate a person in charge of organization and co-ordination activities for training.
- 9.2.3 The Contractor shall select instructors with proper experience and skillfulness and English speaking capability to train the Owner's personnel.
- 9.2.4 The training program will be carried out according to the requirements of each specialty. It will consist mainly of but not limited to the following:



- a) Systematic explanation in a classroom of specific subjects, such as the equipment performance, construction, main systems, auxiliary systems etc.
  - b) Visit to power plants;
  - c) Practical training in similar power plants which are under erection and commissioning.
  - d) Practical training on simulators and control rooms of cooling water system in similar power plants.
  - e) Supply of all necessary training documentation (such as books, manuals, drawings), equipment, tools and instruments etc. The Contractor will make best effort to achieve above item (c) and (d) with utility authority.
- 9.2.5 The Contractor will make available free of charge to the Owner's personnel working cloths, safety helmets, stationery etc. as needed by the training program.
- 9.2.6 The Contractor shall allow the Owner's personnel to carry back all the technical documents supplied during the training.
- 9.2.7 The Contractor shall make at the end of the training period an evaluation of the results obtained by each trainee. These results will be confidentially notified to the Owner.
- 9.2.8 The Contractor shall assist the Owner's personnel in arranging their entry visas and all the formalities staying in foreign countries for training. The Contractor shall also take all the necessary measures to ensure the safety of the Owner's personnel during their stay in the foreign country.
- 9.2.9 The Contractor shall appoint a person in charge of logistic coordination. This person shall take care for booking of rooms according to the requirements of the Owner and arranging for transportation (free of charge) from their living place to the training site.
- 9.2.10 The Contractor shall provide free medical services to the Owner's personnel, but excluding dentistry, buying glasses and tonic medicines.

### 9.3 OWNER'S RESPONSIBILITIES

- 9.3.1 The Owner shall appoint a person as official representative of the Owner's trainees.
- 9.3.2 The trainees shall understand the English language and shall follow the training courses with due diligence. During their stay abroad the Owner's personnel shall observe the Laws of that country and the rules/regulations of the factories/plants where the training will be conducted. The official holidays or national holidays, Saturdays and Sundays shall be the holidays of the Owner's personnel.
- 9.3.3 For the successful completion of the training program, unless mutually agreed by the parties, the program cannot be interrupted for vacation leave.
- 9.3.4 The Owner shall take care, at his own cost, for:



- a. buying round trip air ticket between India and the place of training
- b. arranging lodging and boarding for the Owner's personnel from their arrival abroad to the date of their departure.

#### **9.4 TRAINING SCHEDULE AND PROGRAM**

- 9.4.1 The Training program for the Owner's personnel will be defined during the liaison meeting.
- 9.4.2 Two (2) months before the arrival of the first group of the Owner's personnel in training site, the Owner shall inform the Contractor of the date when the Owner's personnel are expected to be sent to training site
- 9.4.3 Within 2 (two) weeks after receipt of the Owner's information mentioned above, the Contractor shall confirm its agreement or indicate difficulties, if any, for the staying of the personnel. Thirty (30) days before the arrival of the Owner's personnel in the training site the Owner shall inform the Contractor of the brief career of the personnel including names, date of birth, nationality, specialty, experience, qualification, position and knowledge of foreign languages, passport details etc., so that the Contractor can assist in arranging their entry visas.
- 9.4.4 The Contractor shall not charge the Owner with the costs for the training activities in the respective training sites.
- 9.4.5 In case the Owner fails to send his personnel to attend the above training, the Contractor shall reimburse the relevant amount to the Owner.

#### **10.0 TAGGING**

Components whose identity is important for operation and maintenance of the plant viz., all apparatus, signal tapping points, instruments and control equipment, cubicles, as well as the terminal boards, etc., installed in the latter shall be provided with permanently attached tag bearing the Owner's coding together with relevant text clearly inscribed. The inscription shall be approved by the Owner/Consultant. The tag shall be of engraved plate of sufficient rigidity and figures and letters embossed and painted. Such nameplates or labels shall be of white non-hygroscopic material with engraved black lettering. The language of inscription shall be English. The method of implementation and labeling shall be informed for all components after award of contract. For equipment identification and tagging KKS numbering system shall be adopted.

#### **11.0 PAINTING AND CORROSION PROTECTION**

The painting specification for all the equipment shall be as specified in various sections of this specification Annexure 1.4. The detailed painting specification and colour scheme shall be firmed up by the Purchaser after award of contract. Necessary finish paints including touch up paints, if not applied at shop, should be supplied by the Bidder, in sealed containers for site application.



## 12.0 PROTECTIVE GUARDS

Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy installation and removal for maintenance purposes.

## 13.0 QUALITY ASSURANCE

### 13.1 GENERAL

Contractor shall provide effective quality assurance according to ISO 9001 standard or other equivalent quality standard. The preliminary quality assurance program is part of the contract agreement. The program gives the description to all the management and regulations about the necessary quality assurance activities in relation to the execution of the contract.

Quality achievements shall be ensured by combined factors such as the application of quality system regulations, technical specifications (including acceptance regulation of quality control requirements), the examination of quality achievement, precautionary methods and the control of corresponding data.

All manufacturing, processing, testing and inspection operations affecting the equipment or material shall be subject to surveillance by Owner or Owner's Representative. These will be identified by customer Hold Point.

### 13.2 QUALITY ASSURANCE SYSTEM

The quality assurance system of the Contractor shall illustrate its organization process, duty and obligation, quality supervision and standards and subject to reexamination by the Owner.

The implementation of the system shall be ensured by the following: the guidance and training of all staff by management council in application of the quality assurance program and the ordinary supervision through reexamination and management of the quality assurance program.

If an international joint venture is established, the responsibilities shall be specified so as to let the quality assurance group perform its duty, communicate with the Owner formally, and be responsible for the development of the quality assurance program. An agent should be involved to prepare a report book and introduce it to the quality assurance management staff. The report book illustrates the responsibilities to be fulfilled in management and supervision of the quality assurance program and examine the implementation of the quality assurance guarantee program by the staff of the international joint venture enterprise.

### 13.3 BASIC FILES

The basic working files influencing quality implementation and examination will be developed and kept updated in an orderly manner. The copies of these files should



also be supplied to the construction site to be available for the Owner's representative to take examination.

#### **13.4 PROJECT GUIDANCE AND MANUFACTURE DRAWINGS**

Design shall be based as close as possible on the approved design. Some modifications can also be made in order to make major improvements in the manufacture and building technologies and to meet the special needs of the Owner. Any improvements on the former design shall be checked and examined individually. Those results that have been discussed carefully shall be reflected in project directions and order files of Owner. The plan about the output and input of design, independent design check and evaluation and design changes shall be controlled and quality acceptance standards shall be established.

#### **Quality assurance plan/ overhaul and test plan**

The quality assurance plan to ensure necessary quality shall be included in the quality assurance system of the Contractor. This document shall outline overhaul and test principles and record the procedures and steps of the inspection and the requirements for authorizing the inspection as stipulated in the Contract.

The supply of the main elements of equipment to the Owner shall be included in the quality assurance plan and be submitted to the Owner for reexamination.

The Owner can challenge the inspection point and the required quality assurance records illustrated in the combined plan of inspection and test procedures that have been agreed upon. These and other inspection and test procedures used in the manufacturing period shall be illustrated in detail in a separate document for adjusting and formulating the plan.

The Contractor shall give Owner adequate notice 15 working days prior to each test. The confirmation of the inspection and test data shall be delivered to the Owner in less than 15 days.

Instruction manuals on operation procedures shall be supplied to the Owner.

The content of the instruction manuals ensures that special operation procedures are carried out in a controlled way. All the documents in relationship to the quality assurance plan shall be supplied to working site for the convenience of reexamination.

#### **13.5 WORKING GUIDANCE**

Working guidance shall control quality and production activities mainly and should be supplied to the working site for re-examination.

#### **13.6 NONCONFORMITY POINT**

Nonconformity terms shall be reexamined to make it acceptable or modified or renewed with the final goal of attaining the approved standards. The documents for correct operation shall be provided to manufacturing or construction site for inspection.



### 13.7 QUALITY GUARANTEE RECORD

Contractor shall keep the records for quality guarantee.

These records should prove that the system and equipment has satisfied the requirements of the contract; all staff, operation programs and equipment are qualified in special operation procedure, and that the supervision to the Subcontractor is in accordance with the contract requirements.

The specified quality assurance record that is as approved in the combination plan of inspection and test shall be provided to the Owner.

### 13.8 SUPERVISION

Contractor shall supervise Subcontractor's implementation of combining quality and production.

### 13.9 MATERIAL PURCHASE

Material shall be purchased according to project specification and stated standards. The related control data, such as, chemical analysis, mechanical performance, non-destructive tests shall be illustrated in these standards in detail.

Supervision activities shall be performed in Subcontractor's office in connection with the Contractor's orders and quality plan and standards.

Before the delivery of all goods, the goods shall conform to the random examination and parameter rightness examination and pass the check and acceptance of the records of documents of the Subcontractor to ensure that goods are up to standards.

### 13.10 STANDARD EQUIPMENT AND PARTS

Standard equipment and parts shall be manufactured by a company that has passed quality assurance inspection.

All parts must be manufactured by the standard criteria and quality assurance standards.

### 13.11 PRODUCTION CONTROL

Working guidance shall illustrate in detail about the program procedure, control files and the field procedures.

Inspections and acceptance tests shall be performed and recorded.

The corresponding type of quality management (ISO 9001, 9002 9003 or equivalent standards) shall be illustrated in Contractor's order in such detail that it corresponds to the type and scope of the equipment supply. The standard industrial products that are purchased with no reference to list or manufacturer's directions need not be illustrated.



In the procedure of planning inspection, adjustment, evaluating adjustment and the corresponding quality examination and confirmation, the production control of the Subcontractor should be supervised.

#### **14.0 EQUIPMENT ERECTION, SITE TESTING, COMMISSIONING**

This section generally covers the standards, scope of works, documentation, scope of installation, testing and commissioning of various requirements to be adhered to during the execution of the mechanical, Civil, electrical works and Instrumentation & Control works.

Works shall be performed in accordance with this technical specification and various other drawings and schedules submitted and approved by the Owner during the execution and the instructions from Engineer-in-charge or his authorized representatives during the progress of the work. All consumables required for the job shall be ensured by the contractor. All necessary equipment & instruments required to carry out the works, recalibration of the instruments required during loop checking and commissioning shall be done by the contractor.

Field quality plans shall be submitted and shall detail out for all the equipment, the quality practices and procedure etc. to be followed by the Contractor's site quality control organization during various stages of site activities including receipt of materials/equipment at site, preservation and storage, pre-assembly, erection, pre-commissioning and commissioning. The Contractor shall provide all necessary means for execution of inspection and testing, according to the requirements.

#### **15.0 SPECIAL TOOLS AND TACKLES**

The Bidder shall supply a complete set of unused special tools and tackles, including tool box, as required for erection, maintenance, overhaul or complete replacement of the equipment and components under this Specification. The cost of this shall be included in the base price.

#### **16.0 LANGUAGE TO BE USED**

English shall be used as the general Contract language English translations shall be provided for any code and standards not in English language.

Name plates of equipment and instrument scale, etc. shall be marked in English as required for start-up, testing and training etc.

Documents for training shall be provided in English.

#### **17.0 DOCUMENTATION**

##### **a. Drawings, Data / Documents to be submitted along with BID**

The bid document shall have complete information for the overall plant offered clearly identifying and describing the plant design, implementation and operation concept.



All documentation, diagrams and drawings necessary for presentation of the desired results and for comprehension and clarification of the related technical and commercial matters shall be included in the technical offer and shall contain the following documents as a minimum requirement

- 1 Time schedule for engineering, manufacturing erections/installations, commissioning and Reliability Test Run
- 2 Construction approach, phases of construction, commissioning and operation
- 3 Description of main features of the design concept
- 4 General information and technical documentation of process and auxiliary systems
- 5 Information on conditions of operation
- 6 Descriptive Data sheets, performance curves, catalogues for all pumps and cooling towers
- 7 Documents on the quality assurance system of the bidder
- 8 Training program and schedule for the Corporation's personnel
- 9 Details of operation, maintenance and training
- 10 Standards, codes and regulations: listing of major standards, codes and regulations (local, international, supplier's own country) which will be applied for the design and construction of plant equipment and facilities, for civil works and for testing of equipment
- 11 Completely Filled in Technical Data sheets as per schedule (Vol-II Section-7).
- 12 Sub-vendor list
- 13 Spare lists
- 14 Control System Configuration
- 15 Bill of Quantity for I&C items
- 16 Basic operational and control philosophy of the system offered
- 17 Drive control philosophy

**2 Nos. CD/DVD containing scanned copy of Techno commercial bid shall be submitted along with the hard copies.**

**b. Drawings, Data / Documents to be furnished by the successful Bidder**

The Bidder shall submit the following data / information / documents/ drawings to the OWNER/CONSULTANT, who in turn shall review and furnish comments on only important drawings/ documents. Bidder shall furnish a list of data / drawings / documents which shall be submitted to the Owner/Consultant with due dates of submission immediately after award of Contract. The Bidder on fortnightly basis shall update the list. All drawings shall be generated in AUTO CAD.

- Detailed design and drawings for Cooling tower, CW pump, ACW pump and Side stream filter.
- Final version of all documents drawings submitted along with the offer.
- Bidder to submit and obtain Owner's Engineer's approval of all drawings / documents design, detail engineering and construction before proceeding with construction and execution. A list of such drawings will be finalized at the time of Award and which will get updated as the detail engineering progresses.



Document	Category A – Approval I – Information
<b>General</b>	
• Complete list of documents with proposed submission deadlines	I
• Progress reports	I
• Erection and installation progress reports	I
• Quality assurance procedure and program	A
• List of subcontractors/ manufacturers	A
• Proposed inspection and testing programs	A
• Detailed program for commissioning	A
• Detailed program of Reliability Test Run	A
• Testing documents/Report of results of all tests	A
• As-built-documentation including drawings of all equipment	A
• Spare part lists	I
• Performance guarantee / test procedure	A
• Quality Assurance Plans	A
<b>Mechanical Engineering</b>	
• Layout drawings	A
• GA and Cross sectional drawing of all equipment, tanks, sumps, clarifiers, cooling tower, pumps, blowers, stop log gates, screens etc.	A
• Water balance diagram, P&IDs, HFDs and PFDs	A
• Design basis report, process and sizing calculation and hydraulic calculation.	A
• Pipe sizing calculation	A
• Pump sizing calculation	A
• GA and Cross sectional drawing for buildings, chemical dyke area, tanks, sumps etc.	A
• Piping layout	A
• Equipment layout drawings	A
• Pressure vessel thickness calculation	A
• Piping isometric drawings	I
• GA drawing and data sheet for filters, strainers etc.	A
• Pipe specification	A
• Valve schedule	I
• Valve data sheet and GA drawings	I
• Agitator data sheet and GA drawings	I
• Dosing tanks Data sheet and GA drawings	I



Document	Category A – Approval I – Information
• Data sheet for Electrical hoist/ Cranes	A
• Sectional and detail drawings of all components	A
• Heat load calculations, Data sheet for HVAC	A
• Valve & piping Schedule/ Damper Schedule	I
• Piping Layout of Hydrant system	A
• P&ID indicating Instruments and the interlocks for Hydrant	A
• Hydraulic calculation for Hydrant system	A
• Layout for Fire Detection and Alarm system	A
• Schematic Drawing for fire detection and Alarm system	A
• Data sheet and GA drawings for Hydrants, Detectors, Fire alarm Panel, cabling, Extinguishers etc.	A
• Layout for Make-up water/ Service Water/ Potable water piping with Cross section and details.	A
<b>Electrical engineering</b>	
• Main single line diagram	A
• Design basis report for electrical system	A
• Sizing Calculation for equipment like Transformers, Switchgear, Busduct, Cables, UPS System, Battery, Earthing, lightning protection, Illumination, etc.	A
• Technical data sheet for all the electrical equipment	A
• General arrangement drawing for all the electrical equipment	A
• Schematic diagram / wiring for all the electrical equipment	A
• Characteristic curves for all the motors	A
• Electrical switchgear room layout, Battery room layout etc.	A
• Cable tray layout for all the area	A
• Earthing layout for all the area	A
• Lightning protection layout for all the area	A
• Lighting layout for all the area	A
• Cable schedule	A
• Interconnection diagram	A
• Catalogues	A
• Short circuit, Voltage drop and motor starting study	
• Relay setting calculation for complete system	A
• List of make or vendors	A
• Spares list	A
• List of Special tools	A
• Quality plan	A
• Test reports	I



Document	Category A – Approval I – Information
<b>Control &amp; Instrumentation Engineering</b>	
• Master Drawing List - Instrumentation	A
• System Description and Configuration for the entire system (P&ID wise)	A
• Operation and Control philosophy – Description of closed loop and open loop control schemes along with control schemes/logics	A
• Vendor Data sheets for all the I&C items- Field instruments / analyzers / Detectors / local control panels / Flow elements / Control valves / Final control elements / Cables etc	A
• Control Room layout	A
• GA & IA drawings – Local control panels, Junction Box, LIE / LIR, Field instruments etc	A
• Instrument Hook-up diagrams	A
• Drive Control philosophy	A
• Drive List	A
• Cable tray layouts	A
• Instrument Schedule	A
• Cable Schedule	I
• Cable Interconnection	I
• PLC IO list (hardwire + Soft Link)	A
• DCS IO list (IOs to be interfaced to existing DCS in CCR)	A
• Control valve / Flow element sizing calculations	A
• I&C power distribution and earthing scheme	A
• Quality Assurance Procedure (MQP) / Test certificates	A
• Performance guarantee / test procedure	A
• Drawings / documents of combustion modification system	A
• Bill of Quantity for instrumentation items	I
• Spare list (mandatory, recommended, commissioning, consumables)	I
<b>PLC vendor drawings</b>	
• PLC Hardware and Software design specification	A
• System Architecture	A
• Bill of Quantity for PLC	A
• Data sheets for PLC items	A
• GA & IA of cabinets, consoles	A



Document	Category A – Approval I – Information
• FAT & SAT procedure	A
• IO assignment and Panel layout details	A
• Power Distribution and Earthing scheme	A
• Power Consumption Calculations	A
• UPS sizing calculations	A
• HMI displays and Graphics	A
• Closed loop control schemes	A
• Open loop control schemes - ISA format	A
• List of software and licenses	A
<b>Other Instrumentation drawings / documents</b>	
• O&M manuals	I
• As-built drawings	I
<b>Civil Drawings</b>	
• Detailed civil arrangement drawings of all buildings and RCC/steel structures, with Design Basis Report and foundation system	A
<b>Other documentation</b>	
• Quality assurance manuals	I
• Manual of Codes and Standards	I
<b>Operating manual</b>	
• Operating procedures and instructions of the Plant with description of all systems, processes and functional groups • As built documentation • General and individual control concept description	A
<b>Service and maintenance manual</b>	
• Maintenance procedures and instructions with description of all equipment and facilities	A

Purpose: A: for Approval

I: for Information

**c. General Documents to be furnished by the successful Bidder**

- Contract network schedule
- Flow diagram for all systems indicating equipment, piping valves, specialties and instrumentation including performance test scheme, technical write-ups.
- Final technical data sheets for all equipment
- Installation drawings and manuals for all equipment/systems
- Integrated operation and maintenance manuals for the complete plant as well as for all individual equipment.



- g) Test certificates for type/routine and standard acceptance tests
- h) Detailed interface schedule for all terminal points identifying terminal point no., size, material, type of connection, design flow, pressure and temperature at the terminal points
- i) Detailed schedule of LOA to commissioning shall be furnished in the Bar chart.
- j) Lubricants list (with quantities for initial fill and make-up).
- k) Erection procedure.
- l) As-built drawings for all equipment/systems supplied under this contract and all structures / works executed under this contract incorporating all changes/ modifications up to the time of commissioning / handing over to the Owner/ consultant.
- m) Detailed write-up on all pre-commissioning and commissioning activities.
- n) Storage instructions for all equipment
- o) Drawings/data to be required /submitted to statutory authorities

All documents, data sheets, drawing, schedules, lists, etc., to be submitted by the Bidder against this Contract shall be submitted in soft copies on CD/DVDs in addition to the required number of prints/reproducible. Required number of copies for all revisions shall be arranged by BIDDER.

**d. Engineering Information Submission Schedule**

Prior to the award of Contract, a Detailed Engineering Information Submission Schedule shall be tied up with the Bidder. For this, the bidder shall furnish a detailed list of engineering information along with the proposed submission schedule. The list would be a comprehensive one including all engineering data / drawings / information for all bought out items and manufactured items. The information shall be categorized into the following parts.

- i) Information that shall be submitted for the approval to the Consultant. / Owner before proceeding further and
- ii) Information that would be submitted for Consultant. /Owner's information only.

The Engineering Information Schedule shall be prepared month wise.

The schedule should allow adequate time for proper review and incorporation of changes / modifications, if any, to meet the contract without affecting the equipment delivery schedule. The early submission of drawings and data is as important as the manufacture and delivery of equipment and hardware and this shall be duly considered while determining the overall performance and progress.



## 17.1 TIME SCHEDULING, BASED ON CPM

- Overall time schedule for design, manufacture, supply, assembly and commissioning broken down for the principal plant components and all construction works, stating dates for completion of any preparatory work from others which may be necessary.
- Detailed erection, installation and commissioning schedule.
- The Project is scheduled to be commissioned in 12 months from the date of award of EPC contract.

The Contractor shall ensure that the final draft of all schedules, lists or data sheets / equipment are produced to a uniform format irrespective of whether the source of the above schedules, lists and data sheets is in the main Contractor or a Sub-contractor of the main Contractor. All documents shall carry a uniform numbering system.

All Contractor's drawings which are found to be incorrect during the construction period or which require changes owing to site constraints, shall be corrected by the Contractor to an "as built" condition to reflect any necessary changes.

The stipulations and requirements specified elsewhere in the specification shall also be followed with respect to preparation and submission of drawings.

Apart from those documents named in the various sections of the Specification, the Contractor has to submit as minimum requirement the drawings summarized in the above clause to the Owner or his representatives within the periods specified in months, starting from the "Commencement Date" according to the Definitions of the Contract. The delivery time as far as not specified, shall be proposed by the Bidder in his Tender in accordance with his overall implementation schedule and will be defined finally during Contract negotiations.

## 17.2 LIAISON MEETINGS

The liaison meetings shall be organized by the contractor (once a month during design period and once in 15 days during construction period) in accordance with stipulations specified elsewhere in the specification.

Contractor shall supply all documents required in the appropriated number as requested by the Owner.

## 17.3 DISTRIBUTION OF DOCUMENTS

The source, distribution, no. of copies etc shall be as per the following document distribution schedule.



### Document Distribution Schedule - After Placement of Order

SI. No.	Document	Total Copies	Distribution		
			Owner		Consultant
			HQ	SITE	
1.	PERT Network, work schedules, Bar charts, Layout drawings	12	4	4	4
2.	Data, drawings, documents, write-ups, calculation				
	- Preliminary	12	4	4	4
	- Revised	12	4	4	4
3.	Approved drawings, documents etc.	12	4	4	4
4.	Instruction manuals for erection and O&M	12	4	6	2
5.	As built drawings including O &M manual				
	- Hard Copy	12	5	5	2
	- Soft Copy	5	3	1	1

## 17.4 MANUALS

### 17.4.1 General

The Contractor shall provide the manuals in a timely manner to enable the Owner / Engineer to review and comments and request changes as necessary.

Payments will be withheld for non-compliance or for late delivery of the drawings, procedures and manuals. In particular the Contractor shall be held responsible for consequential damage to the plant where such damage is due to late delivery of the O&M manual resulting in non-familiarity of the operating technique.

The Contractor shall also note that while all documents, procedures and manuals shall be in the English language including that of the sub vendor of the contractor, it is particularly important that the O&M manuals be in clear concise English.

All manuals shall be divided by systems or sections and cross-indexed as necessary.

### 17.4.2 Certification Manual

This manual shall contain the approved works certification documentation for all plant equipment and services as specified in the relevant codes and standards and in this specification and the Contractors Quality Manual. This manual shall also include all material tests certificates. Certificates and test procedures shall be specific to the plant supplied.



#### 17.4.3 Design Manual

This manual shall contain all the design calculations and all equipment and system data sheets and design criteria required under the Contract.

#### 17.4.4 Construction Manual

This shall include a comprehensive record of as built site construction tests and records. Again the manual(s) shall be compiled in separate parts to reflect the plant and services supplied.

#### 17.4.5 Commissioning Manual

This manual shall include all the records, certificates and test results arising from the agreed pre-commissioning and commissioning procedures carried out on site. The performance tests and guarantee test results shall also be included. There is a particular requirement that all commissioned plant/equipment values be recorded in this manual and subsequently incorporated into the O&M manuals.

#### 17.4.6 Operating and Maintenance (O&M) Manuals

The Contractor shall provide the O&M Manual properly bound, within the time specified, to enable the Owner's staff to become fully acquainted with the operation, adjustment and maintenance of the entire plant. The manuals shall contain full and explicit instructions in respect of the operation of the plant under all operating conditions and the maintenance routines and requirements to be established to maintain the plant in optimum performance. These instructions shall be in the English language and be as comprehensive as possible and the form in which they are to be set out shall be agreed with the Owner / Engineer. The instructions may be divided as appropriate into individual sections and sub-sections as necessary. All section and sub-sections shall be clearly indexed and cross-referenced as required for clarity.

The instructions shall be tailored to suit the specific requirements of the Operations and Maintenance functions and personnel, taking into account the staffing philosophy for the thermal power plants.

The instructions for the related parts shall be accurate and easy to understand and shall contain the necessary sequence of individual activities. The diagram and drawings associated with the instruction shall be clear and unambiguous.

It is an essential requirement that all information and plant data contained in the manual must be project specific and derived from the design, manufacturers / suppliers and commissioning data of the as-built plant. Where the Contractor includes standard brochures the installed item of plant or equipment shall be clearly identified. All sections shall contain an introductory description of the particular item/system including its function and operating criteria and any special features. On the basis of the commissioning and running experience of the Plant, the instructions shall be amended to a final form within three months of the end of commissioning and, for this purpose, the Contractor shall supply the required number of printed copies of all approved amendments for insertion in the bound set of instructions.



The entire O&M manuals including that of the sub vendors shall all adopt the same format paper size etc. The Bidder shall prepare manuals integrating all equipment supplied by the sub vendors.

## 18.0 GENERAL REQUIREMENTS

### 18.1 GENERAL

#### 18.1.1 General design requirements

The equipment of the entire supply, the main parts as well as auxiliary parts and accessories, must be designed in such a way as to ensure its proper operation, easy control, regulation, erection and maintenance under every working condition.

In the design, particular importance shall be assigned to simplicity, accessibility and solidity of the machinery and its parts. It is of particular interest to achieve simple assembly, easy access for maintenance and repair and simple and safe operation.

The equipment must operate without vibrations that may affect its operation, that of other machinery or of civil works under every condition.

The works shall be designed to facilitate inspection, cleaning, maintenance and repair. Continuity of supply is of prime concern. The design shall incorporate every reasonable precaution and provision for the safety of all those concerned in the operation and maintenance of the works. The plant shall be designed to operate satisfactorily under all variations of load, pressure, and temperature, as may be met in normal usage under the variation in climatic conditions.

Corresponding parts throughout shall be made to gauge and be interchangeable wherever possible. In case required, the supplier shall provide the necessary references for all kinds of equipment.

All equipment performing similar duties shall be of the same type and manufacture in order to limit the stock of spare parts required and maintain uniformity of plant and equipment to be installed.

In selecting materials and in manufacturing, it is necessary to take into consideration the anticipated operating conditions of components and the environmental state of the plant site. The selection of materials shall also ensure the effective service life of each of the components used in the power plant.

The selection of materials shall conform to the requirement of International Standards Organization. Where there is no sufficient information issued by ISO, it is permissible that the material supplying standards of the manufacturing factory of Contractor are adopted. For all the materials and equipment required by the power plant, only new ones or those which have not been used before shall be supplied. This requirement means that the raw material of the equipment and that part of new materials may not be derived from recycled material.



#### 18.1.2 Standards and Codes of Practice

The work must be performed according to the most recent relevant codes, and standards, accident prevention regulations and legal regulations.

All material and equipment supplied and all work carried out as well as calculation sheets, drawings, quality and class of equipment, methods of inspection, constructional peculiarities of equipment and parts and acceptances of partial plants, as far as these are beyond the special requirements of the specifications, shall comply in every respect with the technical codes of the International Organization for Standardization (ISO). IEC/IS recommendations apply to the electrical equipment.

Equipment and special guarantees not covered in the scope of ISO and IEC/IS, shall conform to internationally approved standards.

The Contractor is not only responsible for each piece of equipment being correct but also the completed plant must meet design operating condition and performance requirements.

Where there are no standards or regulations, or the standard is not sufficient to meet the need of design and supply, for such items relating to the power plant, the Contractor shall carry out the design, manufacture, supply and installation on the basis of good engineering practice with Owner's approval.

During the period of Contract execution, if any standards change, the Contractor shall be responsible to notify the Owner and provide the basis for the prospect that it would not cause the lowering of quality, performance and service life of the power plant due to alteration of the standard. Upon mutual agreement, the amended standard can then be followed.

Further requirements about applicable standards and codes are specified in the detailed technical specifications.

#### 18.1.3 Vibration

Vibration shall be reduced to the minimum as far as possible where there is vibration. Amplitude and frequency limitation in the design and supporting structure shall be considered.

Special care shall be taken to avoid operating equipment making resonance with foundations, packing, duct, platform, piping or other components.

Unless otherwise stated or agreed by the Owner each rotating machine has to comply with the requirements for designation as 'good' stipulated by VDI (Verein Deutscher Ingenieure) Specification 2056 for the respective group of machinery. If the vibration is higher than stipulated as 'satisfactory' the Owner has the right to reject the corresponding equipment, subject to the conditions specified elsewhere.

#### 18.1.4 Noise levels

The plant shall be designed and constructed to reduce the operating noise level as much as possible and when the plant is operating at all loads, the noise pressure levels specified "Environmental Requirements"-must not be exceeded.



#### 18.1.5 Units of Measurement

For all the technical tables and diagrams, calculation results, drawings, test data and scales adopted in the design and provided for the power plant, the standard international unit system (SI) as per International Standardization Organization (ISO) shall be uniformly employed.

SI system shall be employed for all the first-class plant layout and arrangement drawings of equipment made especially for the project. In spite of the employment of British Standard in the layout or drawings and single item standard drawings made with other measuring units, the principal dimensions and demarcation points on these drawings shall also be converted into SI system to be directly marked onto them.

In all correspondence, technical schedules, drawings and instrument scales, the following units shall be used:

Quantity	Name of Unit	Symbol
Length	Metre	m
Mass	Kilogram	kg
Time	Second	s
	Minute	min
	Hour	h
Temperature	Degree Celsius	°C
	Kelvin	K
Electric Current	Ampere	A
Luminous Intensity	Candela	cd
Area	Square metre	m <sup>2</sup>
Volume	Cubic metre	m <sup>3</sup>
	Litre	l
Force	Newton	N
Pressure (gauge or absolute)	Bar	bar
	Kilopascal	kPa
	Millimeter of water column	mmwc
	Kilo gram per square centimeter	Kg/Cm <sup>2</sup>
Stress	Newton per square millimetre	N/mm <sup>2</sup>
Velocity	Metre per second	m/s



Quantity	Name of Unit	Symbol
Rotational speed	Revolutions per minute	rpm
Flow	Cubic metre per hr	m <sup>3</sup> /h
	Tons per hour	t /h
	Kilogram per second	kg /s
	Litre per second	l/s
Density	Kilogram per cubic metre	kg /m <sup>3</sup>
Torque, moment of force	Newton metre	Nm
Moment of inertia (mr <sup>2</sup> )	Kilogram square metre	Kgm <sup>2</sup>
Work, energy or heat	Joule	J
Heat capacity, Entropy	Joule per kelvin	J/K
Calorific value	kilo calorie per kilo gram	kcal/kg
Power, radiatin flux	Watt	W
Heat release rate	Watt per square metre	W/m <sup>2</sup>
Thermal conductivity	Watt per metre kelvin	W/mK
Dynamic viscosity	Newton second per square metre Ns/m <sup>2</sup>	
Kinematic viscosity	Metre squared per second	m <sup>2</sup> / s
Surface tension	Newton per metre	N/m
Concentration	Parts per million	ppm
Electrical conductivity	Microsiemens per metre at 25°C $\mu$ s/m	
Frequency	Hertz	Hz
Electric charge	Coulomb	C
Electric potential	Volt	V
Electric field strength	Volt per metre	V/m
Electric capacitance	Farad	F



Quantity	Name of Unit	Symbol
Electric resistance	Ohm	
Conductance	Siemens	S
Magnetic flux	Weber	Wb
Magnetic flux density	Tesla	T
Magnetic field strength	Ampere per metre	A/m
Inductance	Henry	H
Luminous flux	Lumen	lm
Illuminance	Lux	lx
Thermal resistivity	Kelvin metre per watt	Km / W

#### 18.1.6 Safety

Special importance shall be assigned to all aspects related with the safety of personnel operating, assembling and maintaining the equipment, including other persons who may come in contact with same.

The possibilities of human failure must be foreseen. Provisions shall be taken to avoid damage caused by human error or to ensure that such damage both to persons as well as to the equipment is the least possible.

Rotating or any other moving part of the machinery, hot parts or any part that may cause accident to the staff, must be adequately protected, in accordance with the safest method known.

All components with surface temperatures exceeding 60°C shall be fitted with insulation to protect personnel. The surface temperature shall not exceed 60°C in the condition of the ambient temperature is 40°C.

When it is required to limit the medium temperature drop due to the medium conveying in order to meet the requirements of anti-block, anti-dew and other process, it must be insulated from the point of view to control the medium temperature.

Bright paints will be used to be agreed upon with the Owner to protect personnel, so that anything representing a potential danger will stand out: such as elements in movement, suspended hot, with electric tension, etc.

Likewise, appropriate colors shall be selected for the equipment for the purpose of diminishing weariness of workers.



It should be possible to carry out frequent maintenance operations required by the equipment without interrupting its operation and without danger to the personnel.

The equipment shall be provided with the necessary elements to keep possible failure of the main, auxiliary or control elements from causing serious consequences. For this purpose, protections shall be installed such as: stops in case of failure of shafts auxiliary suspensions that will keep parts from falling or coming loose because of centrifugal forces or others; stops to limit movement in case of failure of normal limiting devices, etc. Protections that will decrease or deviate liquid or gas escapes shall also be provided for the same purpose.

Brakes, gears, clutch and similar devices will be located preferable in the last stage of the transmission, so that they will remain operational even in case of failure in other stages.

Access stairs to the equipment must be safe, with anti-skid rungs and handrail. Normal circulation areas of the equipment shall be protected to keep personnel from falling or shall be surrounded by strong guardrails, platforms should have kicking plates to keep loose objects placed on the floor from dropping off, entrances and large openings in the equipment shall be provided with lids or doors affixed in such a way as to open them also from the inside.

The equipment should be adequately protected against environmental elements, such as humidity, dust etc., and the influences that other equipment may have, such as heat radiation, induced vibrations, etc. The supply shall include protective cabinets for parts exposed to the open air or sensitive parts requiring such protection.

Lubricated parts and parts containing lubricants should be protected against oil leakages, as well as against contamination with extraneous material, with oil seals, packings and similar devices.

Every equipment or parts of equipment that must operate under certain conditions of maximum pressure, temperature, speed, position etc., should have devices to keep such limits from being exceeded and, if necessary, to stop the operation of the machine (Safety valves, limit switches, thermal switches, etc.,)

The operational certainty of these devices should be in relation with the importance and operational need to maintain the established limits. Resetting of these devices, either automatic or manual shall be agreed upon with the buyer in each case. These elements shall be installed in such a way as to make it easy to detect the device that caused the machinery to stop.

For protection against the possible failure of the above devices, additional safety elements shall be provided such as stroke limiting stops, diaphragms, bolts, etc. and/or links or other dimensioned rupture elements so that in case of failure, when exceeding extreme operating conditions, additional safety is provided to the equipment.

Inside air and gas ducts, ladders have to be installed for inspection of dampers, venturries, etc.



In designing an area where combustible gases are likely to accumulate, due consideration shall be given to providing safety measures to allow the gas to continuously diffuse or leak off to prevent explosion. The electric equipment in those areas shall be of the fireproof and explosion proof type. Suitable grounding shall be provided on the casing of electrical apparatus which might be energized.

The design of power plant shall include a complete set of composite fire monitoring, protection, and fighting system to identify, isolate, and distinguish fires as well as minimizing potential fire hazards.

A warning alarm for the power plant and alarm for evacuation shall be provided. The alarm is to be audible in the normal working areas of personnel. The selection of the alarming device shall be such that it is audible about the normal background noise of the plant. Visual alarm shall be provided in addition to audio alarms in high noise areas.

Draining of water and venting of gas shall be performed with respect to the safe mode of discharge, and is not allowed to be carried out at or near the places where people exit and at the exit of the plant.

#### 18.1.7 Fire Protection and Precautions

The Contractor shall adopt necessary methods to minimize fire hazards.

The fire protection system shall in general follow the recommendation of Tariff Advisory Committee of India and the system and equipment shall meet with their approval.

The basic guiding ideology is to adopt two methods: fire prevention and fire control. The following design philosophy will apply:

- Ensure the safety of personnel;
- Ensure the safety of the important and main equipment of the power plant;
- Prevent fire from spreading;
- Limit the damage to equipment.

Fire precaution shall comply with the following principle:

To improve conditions in designing and layout and to reduce potential fire danger, and the spreading of fire by adopting the method of observation.

The following methods shall be adopted to prevent fire from occurring:

- Using as far as possible fire proof or fire resistant materials
- Ensuring that, isolating combustible material is not used or stored in possible fire source area of the power plant.
- Reducing the area where cleaning and examination are difficult in power plant arrangement.

The following methods shall be taken into account to control the spread of fire:

- use of fire proof material
- use of fire detection sensors and/or fire proof construction materials;



- providing a set of effective fire extinguishing system;
- providing a set of effective fire detecting equipment;
- providing the fire detection device in civil construction;

The fire detection system should detect a fire quickly and reliably at the beginning of the fire and activate a special alarm device operation.

The designing of detection system shall prevent against erroneous operation.

The supplied fire detection system will be a combination system involving an automated and manual hydrant, water hose, take up reel and special fire extinguisher.

The end connection type of hydrant shall fit in with local fire brigade requirements to ensure the manual device in power plant to be compatible with the fire control device of local fire brigade.

During the construction phase of power plant, the Contractor adopts advanced and safe working practices and a set of guidelines to keep the site in a clean condition to reduce the possibility of fire.

#### 18.1.8 Markings, Labels

All elements should be properly marked at the workshop, in order to make assembly and maintenance work as easy as possible. Whenever necessary, markings should be indicated in the corresponding drawings and/or special drawings for markings. Marks should be unmistakable and as far as possible follow a logical system that will make it easy to find the marked element. Marks should be indelible and clearly visible. Marks made only with paint will not be accepted. Parts that are the same but are not interchangeable shall be marked so as to differentiate them. Wherever necessary the position of a part within the whole shall be marked.

#### 18.1.9 Signs

##### **General**

Safety colors, safety symbols and safety signs must comply in construction, geometrical form, color and meaning with the ISO Recommendation 507 of the ISO committee TC 80 'Safety Colors'. All signs should give the identification number. All signs shall be in the English language.

The signs should be of a material which is weather-resistant and of sufficient durability of 25 years for the conditions prevailing on site. Indian Regulations and codes are to be considered.

The positions for the signs must be chosen so that they are within the field of vision of the persons to whom they apply. The signs should be permanently attached. Temporarily dangerous areas (e.g. construction sites, assembly areas) may also be marked by movable signs. The safety signs must be mounted or installed in such a manner that there is no possibility of misunderstanding.



### Information signs

Information signs should supply the necessary information to acquaint personnel with the physical arrangement and structure of site, buildings and equipment, e.g. floor numbers, load-carrying capacities including marking of floor areas, working loads of cranes, lifting gear and lifts, room identification etc.

In the choice of information signs in situations not covered by ISO Recommendation 507 the possibility of using pictograms should be considered. Pictograms are particularly suitable for the identification of rooms, areas and buildings in the non-technical areas of the plant, sanitary and amenities buildings, etc.,

### Emergency signs

In the event of accidents, all necessary information should be available immediately to those affected. Thus, a sufficient number of signs of appropriate size should be installed, e.g. escape routes (including marking of floor areas), emergency exits, fire alarms, fire extinguishers, instructions for special fire-extinguishing agents, warnings against fire-extinguishing agents ( $\text{CO}_2$ ), first aid equipment, first aid points, accident reporting points, telephones etc.,

### Mandatory signs

Signs indicating obligatory actions must be provided and installed wherever certain action is necessary e.g. do not obstruct the entrance; keep right etc.

Signs should also indicate when the wearing of protective clothing and equipment is necessary and obligatory, e.g., protective goggles, protective clothing, helmets, head guards, breathing equipment, ear muffs etc.

### Warning signs

Warning signs should refer to the existence or possible existence of danger, e.g. flammable substances, explosive substances, corrosive or noxious substances, suspended loads, general danger, width/height restriction, steps, risk of trapping, slipping, falling, etc. In addition to warning signs, appropriate black-yellow strip markings should also be used where necessary.

### Local indicators

Easily visible indicators have to be arranged for: All dampers, valves, level indicators and flow indicators, dampers, mill classifier, etc.

#### 18.1.10 Package, Storage and Store House

The Contractor should provide all the specifications and instructions for the self purchased and fabricated equipment during the planning period of the Contract. These specifications should include the cleanliness and maintenance requirements of materials during fabrication and the protection measures for the equipment from damage during transportation. Loss of materials during storage should be avoided before installation. The instruction should be worked out especially to suit the particular work site program.



## Packing

All equipment and instruments should be fully packed and protected from damage during transportation and field storage. The equipment instruments should be provided with through protecting measures before packing. All machine surfaces should be protected with planks or similar materials and reinforced with metal strips or plates from the outside.

Under actual conditions, all equipment such as motor, switch, Control device, instrument and component should be sealed at the joint with polyethylene insulation board and a corresponding drying agent should be provided.

For all piping ends as well as pipes and tanks, the openings should be protected from damage and sealed to avoid the invasion of ash, moisture and air. These protection measures should be kept intact before the start of installation or moving for periodic inspection. The cost spent for the moving, modification and replacement of the packing and protection device should be paid by the Contractor.

A waterproof enclosed packing list should be provided in each planks or packing case.

The name of articles in the packing case should be marked clearly on the packing list so as to be identified easily.

The articles in the case should be supported by wooden bars in order to be fixed safely and it should not be wedged individually with wooden pad. The marks outside the case should be printed with climate proof materials or paints so as to be protected from being removed during transportation.

All materials and equipment should be packaged according to the typical environmental conditions during storage. In case of severe conditions, these materials and equipment should be packaged carefully by taking a full and appropriate preventive measure to protect from any damage or wear.

The marks should be painted or printed clearly and durably with characters of 40 mm height at minimum on both ends of the packing case. The labels should be well protected to prevent loss.

A mark indicating the correct lifting position should be shown in arrow on the packing case.

## Field Storage and Cleaning:

The arrangement requirements of storehouse should be developed during the program contracting period to suit the field conditions and possible storage facilities. Equipment components should be packed and maintained to suit the needs of transportation and field storage. The detailed rules should be worked out in the contract to suit the general requirements and any special requirement of storehouse as well as the inspection requirements for special components.



The Contractor and his appointed Subcontractor for installation should guarantee jointly that a good supplementary storage will be carried out within the equipment site controlled by them.

### **Classes for Storehouse:**

Three classes for storehouse are described as follows:

- Storehouse class A: Special measures are taken to protect the stored goods and the temperature, humidity, ash are controlled within a specified range.
- Storehouse class B: Goods are stored with temperature uncontrolled.
- Storehouse class C: It is an outdoor storage with a drainage system on the ground.

No matter what class of storehouse is used, the following basic requirements shall be satisfied.

For storehouses of class A and B they should be fireproof, heat resisting, waterproof and well ventilated. They should not be wet and should be provided with good drainage system and preferably with a brick laying or concrete ground. For storehouses of class C, they should not be wet and should be well drained, preferably with a brick laying or crushed stone ground.

Component surfaces should not be contacted directly with the ground or ground laying material. There should be a layer of oil cloth or wax or other similar materials between the machine surface and ground surface.

After the store house/field are accepted, all components should be inspected as to whether the paint, seal and packing are mechanically damaged. All these damages should be repaired if these components will not be installed immediately.

The components stored in storehouse class C should be protected from rainfall, salt corrosion, ash and other adverse conditions with a temporary cover or tent if possible. A drainage device should be provided for this temporary cover or tent.

### **Inspection during Storage:**

All components shall be inspected for their painting, storing, sealing etc. and any damage or wear should be repaired during acceptance and storage periodically. The inspection interval is determined by the component function, applied protection measure and storehouse class.

Unpacking or inspection for outdoor package (class C) shall not be carried out during rainfall or big wind (salt corrosion is possible).

Many components are provided with a drying agent or sealed in a coverage (polyethylene or insulating cover) containing drying agent. The drying condition shall be inspected during storage after 4 weeks and 8 weeks from acceptance, and then in an interval of every 12 weeks. If it is necessary to replace the drying agent during any inspection, a full inspection every 4 weeks shall be carried out until a successful inspection result is obtained and in the meantime, the conventional inspection shall be carried out continuously.



#### 18.1.11 Painting, Insulation and Anti-dewing

Anti-corrosive coatings and painting should be carried out as a pre-treatment to all equipment and parts. The paint system used should coordinate with the painted objects and surrounding conditions of project.

In multi-layer painting system, different painting layers should be selected to make the painting coordinate. If multi-layer painting system is used, various painting layers should have different colors so that the later layer can be distinguished from the former one.

After the equipment or apparatus finished preliminary or full painting, it can be supplied to field. After the installation is finished, ground coat must be painted.

Entire painting procedure should be supplied in order to repair the injuries of painting coat after the equipment is delivered to field.

##### **Color strip indication system should be used for pipes**

These strips should be painted on the joint of pipes, entrance, valves of pipe. This pipe without outside protection layer should be marked by some color in whole length.

The principle color of field equipment should be determined by Owner and Contractor in contracting stage.

Further requirements with regard to painting, insulation, and anti-dewing are specified in the relevant sections in the detailed technical specifications. The specified requirements shall be applied to the whole equipment and facilities of the Power Plant Contract.

#### 18.1.12 Language to be used

English shall be used as the general Contract language English translations shall be provided for any code and standards not in English language.

Name plates of equipment and instrument scale, etc. shall be marked in English as required for start-up, testing and training etc.,

Documents for training shall be provided in English.

### **18.2 DISCREPANCIES IN THIS TECHNICAL SPECIFICATION**

Any contradiction between Various parts/ sections of this Technical Specification, between text and drawings, the document giving the more extended scope or requirement shall be considered to be within the Contractor's scope of supply.

### **19.0 PLANT PERFORMANCE GUARANTEES**

Performance guarantee parameters shall be as per the individual items of Performance Guarantee as indicated in the Section 7, "Schedules". The applicable values of liquidated damages factors for non-fulfilment of guaranteed performances are indicated under commercial conditions of Contract. The parameters indicated



under 'Correction' shall be guaranteed by the Contractor during the performance tests and if the parameters are not attained during the performance tests, Contractor shall make all efforts to achieve the parameters.

The Performance Guarantee Test procedure along with correction curves Cooling tower, CW Pumps, ACW Pumps etc, shall be submitted by the Contractor for Owner's review and approval. The Performance guarantee test shall be performed by the contractor based on the approved PG test procedure and correction curves.

### **Performance Liquidated Damages**

In respect of items guaranteed under "Liquidated Damages", the Contractor shall guarantee them with the tolerance indicated by them. The performance test results shall be reported as computed from the performance test observations, with corrections for calibrations. No additional allowances for errors in measurement are permissible. The Contractor shall make every effort practicable to correct the deficiencies subject to the LDs stated in commercial conditions of Contract before any settlement is considered by the Owner. Should the performance test results deviate from the guaranteed values the Contractor shall correct his equipment at no extra cost to the Owner and repeat the performance tests within a reasonable period as agreed to with the Owner. If, however, the Contractor fails to meet the guarantee values, LDs will be levied as per commercial conditions of Contract. The Owner retains the option to reject the equipment, and in the case of such option of rejection being exercised, the Contractor shall replace the equipment with one which shall meet the guaranteed values.

### **Items Covered under Rejection and Compulsory Correction**

In respect of items guaranteed under "Rejection and Compulsory Correction", the Contractor shall fulfill the guaranteed values and in the event the guaranteed values are not met vendor shall make every effort practicable to correct the deficiencies within the reasonable time period mutually agreed with the owner. In case the Contractor fails to meet the guarantees, the equipment is liable to be rejected and in case of such an option, the Contractor shall replace the equipment with one that shall meet the guaranteed values without any additional cost to the Owner.

#### **19.1 BASIC CONDITIONS**

Manufacture tolerances are to be included in the guarantees. Only measuring tolerances will be granted.

#### **19.2 POWER CONSUMPTION OF AUXILIARY PLANT EQUIPMENT**

The Contractor has to guarantee the power consumption of complete cooling water system equipment pertaining to this specification, which is required for the operation of Plant at 100 % load.

The Contractor shall list the power consumption and/or losses separately for each equipment item or system and provide correction curves for variation in ambient conditions and cooling water temperature.



### **19.3 PLANT PERFORMANCE GUARANTEE DATA**

Refer Annex-1.2 and respective section.

### **19.4 CONSUMABLES**

Bidder shall specify the major consumables and their consumption. Contractor will be required to guarantee the consumption specified.

### **19.5 VIBRATIONS**

Contractor shall guarantee that the vibration levels as stipulated elsewhere in this specification will not be exceeded under any operating condition.

### **19.6 OTHER GUARANTEES**

Other guarantees as required have been indicated in the respective detailed technical specifications and in the guarantee schedules/ technical data sheets.



**ANNEX - 1.1**

**RAW WATER ANALYSIS**

Date	pH	Cond. Moh/cm	Turbidity, NTU	Total Hard, ppm	Ca. Hard, ppm	Mg. Hard, ppm	Chloride ppm	M Alk, ppm	Silica ppm
1-Nov-16	7.6	287	2.4	96	52	44	31	112	4.4
2-Nov-16	7.7	315	2.7	98	54	44	33	110	4.8
3-Nov-16	7.5	322	2.9	100	56	44	35	110	4.8
4-Nov-16	7.7	321	2.8	96	54	44	30	108	4.6
5-Nov-16	7.7	319	2.9	98	54	44	33	108	4.9
6-Nov-16	7.6	310	2.8	100	56	42	32	108	4.7
7-Nov-16	7.4	318	2.6	100	56	44	35	106	4.6
8-Nov-16	7.9	312	2.9	96	52	44	30	110	4.9
9-Nov-16	7.8	266	2.7	94	52	42	28	108	4.6
10-Nov-16	7.8	302	3.9	98	56	42	31	112	4.9
11-Nov-16	7.7	299	3.5	98	54	44	33	110	4.7
12-Nov-16	7.5	265	3.6	96	52	44	31	108	4.3
13-Nov-16	7.4	280	3.1	94	52	42	30	108	4.3
14-Nov-16	7.7	220	3.3	96	54	42	31	10	4.7
15-Nov-16	7.9	223	3.2	110	64	54	30	116	4.2
17-Nov-16	7.9	210	3.3	100	56	44	32	112	4.4
18-Nov-16	7.8	235	3.5	98	52	46	30	112	4.6
19-Nov-16	7.7	228	3.4	96	52	44	33	110	4.6
20-Nov-16	7.7	231	3.1	98	54	44	30	110	4.1
21-Nov-16	7.7	225	3.7	98	56	42	35	114	4.4
22-Nov-16	7.7	231	3.5	96	54	42	32	112	4.9
23-Nov-16	7.7	230	3.6	98	52	46	35	114	4.7
24-Nov-16	7.8	296	3.2	100	56	44	33	112	4.4
25-Nov-16	7.6	305	3.3	100	54	46	112	29	4.5
26-Nov-16	8	282	3.6	98	54	44	10	31	4.7
27-Nov-16	7.7	296	3.2	96	52	44	29	110	4.2
28-Nov-16	7.5	269	3.3	100	56	44	30	112	3.8
29-Nov-16	7.8	290	3.2	98	54	44	31	108	4.4
30-Nov-16	7.9	281	3.4	96	54	42	30	106	4.8
1-Dec-16	7.9	273	3	98	52	46	34	12	4.7
2-Dec-16	7.6	288	3.6	98	56	42	36	112	4.6



Date	pH	Cond. Moh/cm	Turbidity, NTU	Total Hard, ppm	Ca. Hard, ppm	Mg. Hard, ppm	Chloride ppm	M Alk, ppm	Silica ppm
3-Dec-16	7.6	288	3.5	96	54	42	31	110	4.9
4-Dec-16	7.8	299	3.3	98	56	42	32	108	4.5
5-Dec-16	7.7	287	3.7	100	54	46	29	112	4.9
6-Dec-16	7.4	302	3.5	96	54	42	31	110	4.4
7-Dec-16	8	295	3.3	96	52	44	27	114	4.8
8-Dec-16	7.4	291	3.3	94	54	40	28	110	4.5
9-Dec-16	8	293	4.2	96	52	44	31	112	4.8
10-Dec-16	7.3	284	4	98	54	44	29	110	4.3
11-Dec-16	7.4	300	4.1	98	54	44	30	112	4.5
12-Dec-16	7.5	264	4	98	52	46	32	110	4.4
13-Dec-16	7.5	275	3.2	96	54	42	30	110	4.4
14-Dec-16	7.3	257	3.3	94	50	44	30	108	4.8
15-Dec-16	6.8	240	3	94	52	42	28	106	4.1
16-Dec-16	7.1	226	3.2	96	52	44	29	102	4.5
17-Dec-16	6.8	243	3.9	96	54	42	28	102	4.8
18-Dec-16	7.2	241	3.8	96	54	42	29	104	4.3
19-Dec-16	7.3	280	4	99	54	40	30	102	4.5
20-Dec-16	7	292	3.7	96	54	42	29	104	4.8
21-Dec-16	7.5	275	3.9	96	52	44	30	106	4.5
22-Dec-16	7.3	298	3.5	94	54	40	28	106	4.7
23-Dec-16	7.4	260	6.2	98	54	44	31	106	4.8
24-Dec-16	7.5	275	8.2	98	54	44	30	110	3.8
25-Dec-16	7.5	289	6.9	96	52	44	30	108	4.4
26-Dec-16	7.4	263	6.3	98	54	44	32	106	4.8
27-Dec-16	7.6	248	6.5	94	54	44	29	110	4.9
28-Dec-16	7.6	244	6.6	90	50	40	28	112	5.1
29-Dec-16	7.4	251	6.9	92	52	40	30	108	4.7
30-Dec-16	7.5	252	8.6	94	50	44	28	106	4.9
31-Dec-16	7.6	246	8.3	96	54	42	28	106	5.1
1-Apr-17	8.2	426	8.7	98	54	44	34	110	4.3
2-Apr-17	7.8	414	8.3	100	56	44	31	108	4.1
3-Apr-17	7.6	429	8.7	102	58	44	31	112	4.5
4-Apr-17	7.8	438	8.5	98	52	46	29	110	4.1
5-Apr-17	7.3	435	8.8	96	56	42	32	112	4.1



Date	pH	Cond. Moh/cm	Turbidity, NTU	Total Hard, ppm	Ca. Hard, ppm	Mg. Hard, ppm	Chloride ppm	M Alk, ppm	Silica ppm
6-Apr-17	8.2	434	8.7	98	54	44	35	110	3.8
7-Apr-17	7.7	415	8.7	96	52	44	31	110	4.1
8-Apr-17	7.8	415	8.5	100	54	46	33	108	3.9
9-Apr-17	7.4	405	8.8	100	56	44	29	108	3.8
10-Apr-17	7.6	403	8.5	96	52	44	26	106	4.0
11-Apr-17	7.6	417	8.1	98	54	44	29	112	4.0
12-Apr-17	7.6	383	8.8	100	54	46	35	112	3.5
13-Apr-17	7.6	370	8.5	94	54	40	33	110	4.2
14-Apr-17	7.9	360	8.7	98	56	42	36	112	4.0
15-Apr-17	7.5	390	8.2	102	56	46	35	112	4.3
16-Apr-17	8.3	413	8.5	100	56	44	36	110	4.5
17-Apr-17	7.8	381	8.9	102	56	4	32	112	4.1
28-Apr-17	7.8	371	8.7	102	58	44	33	114	3.7
29-Apr-17	7.2	388	8.2	100	54	46	35	112	3.8
30-Apr-17	8.0	380	8.7	104	58	46	38	114	4.1
1-May-17	7.8	363	8.1	100	54	46	36	110	3.7
2-May-17	7.9	373	8.4	104	58	46	38	112	3.5
3-May-17	7.7	368	8.5	104	60	44	38	114	3.9
4-May-17	7.6	378	8.8	102	62	40	36	112	3.5
5-May-17	7.6	389	8.9	102	56	46	36	114	3.8
6-May-17	7.6	390	8.5	100	54	46	38	112	3.4
7-May-17	7.6	393	8.7	104	58	46	37	110	3.7
8-May-17	7.5	395	8.9	100	56	44	39	114	3.9
9-May-17	7.7	330	8.2	100	60	40	35	108	3.5
10-May-17	7.3	311	8.0	104	62	42	32	106	3.5
11-May-17	7.6	397	8.2	102	60	42	37	112	3.7
12-May-17	7.9	401	8.4	104	60	44	39	110	3.9
13-May-17	7.6	392	8.3	106	62	44	35	114	4.0
14-May-17	7.8	387	8.1	102	88	44	32	112	4.3
15-May-17	7.8	392	8.5	104	60	42	39	116	4.1
16-May-17	8.1	402	8.0	102	58	42	39	114	4.0
17-May-17	8.0	408	8.3	106	62	44	37	114	3.8
18-May-17	8.1	397	8.1	104	60	44	40	112	4.1
19-May-17	8.1	402	8.5	106	60	46	36	114	4.1



Date	pH	Cond. Moh/cm	Turbidity, NTU	Total Hard, ppm	Ca. Hard, ppm	Mg. Hard, ppm	Chloride ppm	M Alk, ppm	Silica ppm
20-May-17	8.1	307	8.0	102	58	44	32	116	3.6
21-May-17	8.4	392	8.0	104	60	44	38	112	3.6
22-May-17	8.6	388	8.2	100	58	42	39	114	3.9
23-May-17	8.6	388	8.3	102	60	42	41	114	3.9
24-May-17	8.1	390	7.9	100	60	40	40	112	3.5
25-May-17	7.8	386	7.9	106	62	44	42	112	3.7
26-May-17	8.0	413	8.0	102	60	42	40	114	3.9
27-May-17	8.1	388	7.5	104	6.2	42	40	110	3.5
28-May-17	8.0	389	7.3	102	62	40	40	108	3.4
29-May-17	8.0	422	8.7	102	60	42	41	114	3.9
30-May-17	8.2	499	8.5	106	62	44	39	112	3.7
31-May-17	8.0	405	8.5	104	62	42	40	114	3.7
1-Jun-17	8.0	398	8.8	100	58	42	38	112	3.9
2-Jun-17	8.0	391	8.9	104	60	44	39	112	3.9
3-Jun-17	8.1	408	8.7	106	64	42	42	116	4.1
4-Jun-17	8.0	411	8.8	102	58	44	37	112	4.2
5-Jun-17	8.0	416	8.4	106	62	44	38	114	4.4
6-Jun-17	8.2	422	8.9	104	62	42	42	116	3.9
8-Jun-17	8.3	381	8.5	108	68	40	42	112	4.1
9-Jun-17	8.3	400	8.1	110	64	46	44	116	4.5
10-Jun-17	8.1	402	8.5	108	60	48	43	114	3.9
11-Jun-17	8.2	412	8.6	110	64	46	41	116	4.1
12-Jun-17	8.1	407	9.3	104	60	44	48	116	3.9
13-Jun-17	8.1	424	8.9	108	64	46	42	112	4.0
14-Jun-17	8.2	409	8.7	106	62	44	46	114	4.5
15-Jun-17	8.3	406	9.1	108	66	42	42	110	4.1
16-Jun-17	8.3	406	8.7	106	60	46	42	112	3.9
17-Jun-17	8.6	417	8.6	108	62	46	45	114	4.2
18-Jun-17	8.7	417	9.2	104	58	46	44	114	4.0
19-Jun-17	8.6	425	9.0	106	60	46	41	116	3.7
20-Jun-17	8.6	422	8.9	104	60	44	45	116	4.1
21-Jun-17	8.4	431	8.6	108	64	44	46	114	4.0
22-Jun-17	3.2	401	9.3	106	64	42	44	114	3.9
23-Jun-17	8.0	423	9.0	106	62	46	45	116	4.0



Date	pH	Cond. Moh/cm	Turbidity, NTU	Total Hard, ppm	Ca. Hard, ppm	Mg. Hard, ppm	Chloride ppm	M Alk, ppm	Silica ppm
24-Jun-17	8.3	411	8.8	108	62	46	43	116	4.1
25-Jun-17	8.2	437	9.2	104	60	44	45	112	4.3
26-Jun-17	8.1	446	9.0	106	64	42	42	114	3.8
27-Jun-17	8.2	432	9.6	104	64	40	45	112	4.0
28-Jun-17	7.7	427	9.1	108	66	42	48	112	4.1
29-Jun-17	8.3	421	12.5	110	66	44	47	116	4.0
30-Jun-17	8.3	417	16.7	110	62	48	49	114	4.3
2-Jul-17	8.4	394	11.1	106	60	46	44	118	3.7
3-Jul-17	8.3	398	12.2	108	66	42	47	114	3.7
4-Jul-17	8.3	397	11.1	110	68	42	48	114	4.3
5-Jul-17	7.9	404	13.1	106	64	42	50	116	4.1
6-Jul-17	8.2	398	10.6	108	66	42	47	116	3.9
7-Jul-17	8.3	399	11.7	110	66	44	49	112	4.1
8-Jul-17	8.4	408	11.0	110	68	42	44	116	4.0
9-Jul-17	8.2	405	11.9	108	64	44	41	114	3.7
10-Jul-17	8.1	420	11.9	108	68	40	47	116	4.4
11-Jul-17	8.5	426	12.3	110	66	44	43	118	4.2
12-Jul-17	8.4	420	12.6	112	66	46	47	116	4.1
13-Jul-17	8.0	382	13.1	110	64	46	45	114	4.2
14-Jul-17	8.0	387	11.6	108	66	42	43	116	4.0
15-Jul-17	8.0	385	11.6	110	68	42	46	114	4.5
16-Jul-17	7.9	390	15.2	112	66	46	48	112	4.1
17-Jul-17	7.8	395	13.3	110	68	42	43	110	3.9
18-Jul-17	8.0	395	12.0	108	62	44	46	114	1.4
19-Jul-17	8.3	417	12.5	108	64	44	42	116	3.8
20-Jul-17	8.2	404	12.8	110	64	46	44	114	4.0
21-Jul-17	7.9	398	13.4	108	66	42	41	110	3.9
22-Jul-17	8.0	396	15.5	110	66	44	42	110	3.7
23-Jul-17	8.0	392	17.6	108	64	44	43	112	3.7
24-Jul-17	8.1	394	15.2	110	66	44	45	116	4.0
25-Jul-17	8.2	396	18.2	110	68	42	45	114	3.9
26-Jul-17	8.0	396	11.6	110	68	42	48	118	4.3
27-Jul-17	7.9	411	10.8	108	66	42	45	116	4.1
28-Jul-17	7.9	398	10.6	108	64	44	47	112	3.5



Date	pH	Cond. Moh/cm	Turbidity, NTU	Total Hard, ppm	Ca. Hard, ppm	Mg. Hard, ppm	Chloride ppm	M Alk, ppm	Silica ppm
29-Jul-17	7.6	407	11.4	110	66	44	50	110	4.5
30-Jul-17	8.0	371	19.6	114	68	46	47	118	4.9
31-Jul-17	8.2	363	14.3	110	68	42	45	118	4.3
1-Aug-17	8.1	371	12.7	112	64	48	47	118	4.1
2-Aug-17	8.0	357	13.4	112	68	44	49	114	4.5
3-Aug-17	8.0	364	11.8	110	68	42	45	116	4.3
4-Aug-17	8.0	372	13.2	112	68	44	47	114	4.3
5-Aug-17	8.2	388	15.8	110	68	42	45	116	4.6
6-Aug-17	8.4	374	13.5	110	66	44	47	118	4.5
7-Aug-17	8.2	372	14.7	112	68	44	43	116	4.1
8-Aug-17	8.3	367	15.3	112	70	40	45	118	4.1
9-Aug-17	7.8	368	15.7	112	66	46	49	114	4.4
10-Aug-17	7.7	316	12.7	110	64	46	47	116	3.7
11-Aug-17	7.7	311	13.1	112	68	44	48	114	4.0
12-Aug-17	7.8	307	15.3	112	66	46	43	114	4.1
13-Aug-17	7.6	310	16.1	110	68	42	45	116	4.0
14-Aug-17	7.8	303	11.2	112	68	44	41	116	4.0
15-Aug-17	7.9	307	11.1	110	64	46	40	110	4.4
16-Aug-17	8.5	301	11.6	112	66	46	39	112	3.9
17-Aug-17	8.4	317	11.2	110	66	44	40	116	4.4
18-Aug-17	7.9	318	12.1	114	68	46	39	114	4.2
19-Aug-17	7.9	324	11.9	108	64	44	38	116	4.6
20-Aug-17	7.8	304	11.8	110	64	46	39	112	4.0
21-Aug-17	7.9	307	11.1	108	66	42	40	116	3.7
22-Aug-17	7.8	301	11.0	110	6.4	46	41	114	3.7
23-Aug-17	7.8	314	10.3	108	66	42	38	112	3.9
24-Aug-17	7.6	305	101	108	64	44	35	114	4.1
25-Aug-17	8.0	312	10.0	108	64	44	32	112	3.9
26-Aug-17	7.8	308	10.2	106	64	42	33	110	3.7
27-Aug-17	7.8	301	10.1	108	64	44	36	108	3.9
28-Aug-17	7.8	304	10.6	106	62	44	35	110	4.0
29-Aug-17	8.0	306	11.2	106	64	42	39	112	4.2
30-Aug-17	8.0	305	9.8	108	62	46	36	108	4.5
1-Sep-17	8.4	301	11.6	108	66	42	36	106	4.0



Date	pH	Cond. Moh/cm	Turbidity, NTU	Total Hard, ppm	Ca. Hard, ppm	Mg. Hard, ppm	Chloride ppm	M Alk, ppm	Silica ppm
2-Sep-17	8.6	307	11.2	108	64	44	38	110	3.6
3-Sep-17	8.6	298	11.4	106	62	44	38	116	4.1
4-Sep-17	8.4	301	11.8	108	64	44	36	116	4.0
5-Sep-17	8.2	322	108	106	64	42	40	118	4.2
6-Sep-17	8.2	322	10.8	106	64	42	40	118	4.2
7-Sep-17	7.9	308	10.8	10.4	62	42	39	114	4.2
8-Sep-17	7.6	328	10.7	106	60	46	40	112	4.0
9-Sep-17	7.9	322	9.8	104	60	44	38	104	4.0
10-Sep-17	7.8	315	9.7	10.2	62	40	37	102	4.2
11-Sep-17	7.8	228	9.6	102	62.0	40	39	106	4.1
12-Sep-17	7.8	229	9.7	104	62	42	37	108	4.0
13-Sep-17	7.8	312	9.8	106	62	44	37	102	4.0
14-Sep-17	8.0	338	9	104	60	44	39	104	4.2
15-Sep-17	7.9	333	9.5	104	62	42	37	106	4.2
16-Sep-17	7.8	334	8.9	108	64	44	39	104	4.1
17-Sep-17	7.8	311	8.5	104	60	44	38	102	4.0
18-Sep-17	7.8	347	8.4	106	64	42	37	100	4.3
19-Sep-17	7.6	325	8.5	104	62	42	38	110	4
21-Sep-17	8.1	348	8.5	106	66	44	35	112	4.0
22-Sep-17	7.9	338	8.4	108	64	44	36	110	4.1
23-Sep-17	7.5	335	8.5	108	64	44	36	104	4.0
24-Sep-17	7.5	340	8.1	110	66	44	35	102	4.0
25-Sep-17	7.8	352	7.9	110	66	44	36	112	4.0
26-Sep-17	7.8	348	7.9	110	64	46	35	112	4.1
27-Sep-17	8.1	350	7.8	110	66	44	36	40	4.0
28-Sep-17	8.0	347	7.7	108	64	44	35	108	4.1
29-Sep-17	8.0	349	7.9	108	66	44	36	108	4.0
30-Sep-17	7.9	350	7.8	110	66	44	35	110	4.0
1-Oct-17	7.9	345	7.9	110	66	44	38	110	3.9
4-Oct-17	7.8	340	7.8	110	66	44	36	110	4.2
6-Oct-17	7.9	345	7.9	106	60	46	36	108	4.1
8-Oct-17	8.1	347	8.1	108	66	42	37	106	4.5
9-Oct-17	8.1	340	8	106	62	44	36	1.8	4.4
10-Oct-17	7.9	343	8.0	108	64	44	38	110	4.2



Date	pH	Cond. Moh/cm	Turbidity, NTU	Total Hard, ppm	Ca. Hard, ppm	Mg. Hard, ppm	Chloride ppm	M Alk, ppm	Silica ppm
11-Oct-17	7.9	347	8.0	108	64.0	44	38	110	4.0
12-Oct-17	7.9	361	8.1	108	64	44	39	110	4.1
13-Oct-17	7.9	350	8.1	110	66	44	39	110	4.1
14-Oct-17	7.9	349	8.2	112	68	44	37	110	4.1
15-Oct-17	7.9	342	8.1	110	66	44	37	110	4.0
16-Oct-17	8	346	8.0	108	64	44	36	110	4.1
17-Oct-17	7.9	398	7.9	112	66	46	39	110	4.1
18-Oct-17	8.1	334	8.1	110	64	44	37	112	4.4
19-Oct-17	8.1	308	7.9	110	64	46	39	110	4.1
20-Oct-17	7.4	338	8.0	108	64	44	39	110	4.1
21-Oct-17	8.0	9.9	8.1	110	66	44	39	112	4.0
22-Oct-17	7.9	330	8.0	110	64	46	40	114	4.2
23-Oct-17	8.1	340	8.1	112	66	46	39	114	4.1
24-Oct-17	8.1	333	8.2	110	66	44	38	116	4.1
25-Oct-17	8.1	333	8.0	110	66	44	38	112	4.4
26-Oct-17	8.0	328	8.1	108	62	46	37	112	4.2
27-Oct-17	8.0	322	8.2	108	64	44	36	114	4.5
28-Oct-17	8.0	330	8.1	110	66	44	38	112	4.1
29-Oct-17	8.1	328	8.3	106	62	44	39	114	4.2
30-Oct-17	7.9	350	7.8	110	66	44	35	110	4.0
31-Oct-17	7.9	345	7.9	110	66	44	38	110	3.9
1-Nov-17	8.1	323	10.3	108	64	44	36	116	4.0
2-Nov-17	8.1	331	10.1	108	64	44	37	114	4.6
3-Nov-17	8.0	321	10.2	108	64	44	35	112	4.1
4-Nov-17	7.8	319	10.3	106	62	44	36	110	4.1
5-Nov-17	8.0	321	10.0	106	64	42	38	112	4.3
6-Nov-17	8.0	319	9.7	106	64	42	38	112	4.7
7-Nov-17	8.0	321	10.1	106	62	44	37	114	4.5
8-Nov-17	8.1	319	10.3	108	64	44	38	114	4.5
9-Nov-17	8.1	320	10.0	106	64	42	38	116	4.5
10-Nov-17	8.0	318	10.4	106	62	44	37	116	4.3
11-Nov-17	8.1	320	10.5	106	64.0	42	35	114	4.1
12-Nov-17	8.1	310	10.1	106	62	44	36	116	4.6
13-Nov-17	8.0	301	1.3	106	64	42	38	114	4.3



Date	pH	Cond. Moh/cm	Turbidity, NTU	Total Hard, ppm	Ca. Hard, ppm	Mg. Hard, ppm	Chloride ppm	M Alk, ppm	Silica ppm
14-Nov-17	8.0	316	10.3	106	64	42	39	114	4.7
15-Nov-17	8.0	312	10.4	108	64	44	36	112	4.5
16-Nov-17	7.9	316	10.3	108	64	44	39	114	4.6
17-Nov-17	7.8	311	9.8	110	64	46	38	114	4.2
18-Nov-17	8.0	310	9.8	110	64	46	38	104	4.2
19-Nov-17	7.9	314	9.7	110	66	44	36	106	4.1
20-Nov-17	7.8	305	9.7	104	64	40	40	108	4.1
21-Nov-17	7.5	302	10.0	106	64	42	39	110	4.2
22-Nov-17	7.8	298	10.5	104	62	42	40	112	4.4
23-Nov-17	8.1	306	10.2	110	66	44	39	110	4.1
24-Nov-17	8.0	305	10.2	108	64	44	41	106	4.2
25-Nov-17	7.6	308	10.1	110	66	44	42	108	4.2
26-Nov-17	7.9	305	10.0	108	62	46	39	108	4.1
27-Nov-17	8.0	308	10.2	110	66	44	39	110	4.0
28-Nov-17	8.0	310	9.8	112	68	44	39	112	4.0
29-Nov-17	8.0	305	9.7	108	66	42	40	110	4.0
30-Nov-17	7.9	308	10.0	110	66	44	38	110	4.0
1-Dec-17	8.0	304	10.2	108	64	44	37	112	4.4
2-Dec-17	8.1	294	10.0	112	66	46	37	110	4.1
3-Dec-17	8.0	299	10.1	110	66	44	39	108	4.0
4-Dec-17	8.1	301	9.8	108	66	42	39	112	4.0
5-Dec-17	8.1	296	10.2	106	62	44	40	110	4.0
6-Dec-17	7.9	298	10.5	106	62	44	39	104	4.1
7-Dec-17	8.0	298	10.3	106	64	42	38	108	4.5
8-Dec-17	7.7	307	10.5	112	66	46	36	110	4.0
9-Dec-17	7.9	313	10.4	110	64	46	39	112	4.1
10-Dec-17	7.8	308	10.2	110	66	44	39	108	4.0
11-Dec-17	8.0	304	10.0	108	64	44	40	112	4.2
12-Dec-17	7.8	313	9.8	110	66	44	36	110	4.0
13-Dec-17	8.1	308	10.2	108	62	46	37	112	4.2
27-Dec-17	8.0	322	8.2	108	64	44	36	114	4.5
28-Dec-17	8.0	330	8.1	110	66	44	38	112	4.1
29-Dec-17	8.1	328	8.3	106	62	44	39	114	4.2
30-Dec-17	8.1	326	8.1	106	64	42	37	112	4.0



Date	pH	Cond. Moh/cm	Turbidity, NTU	Total Hard, ppm	Ca. Hard, ppm	Mg. Hard, ppm	Chloride ppm	M Alk, ppm	Silica ppm
1-Jan-18	7.9	308	9.0	108	64	44	36	112	3.4
2-Jan-18	7.7	310	9.0	112	66	46	37	114	3.7
3-Jan-18	7.9	300	9.2	110	66	44	36	110	3.9
4-Jan-18	7.9	307	8.9	110	64	46	37	108	3.8
5-Jan-18	8.0	307	8.5	108	64	44	37	112	3.7
6-Jan-18	7.3	315	8.4	101	64	46	36	110	3.7
7-Jan-18	7.7	312	8.1	112	66	46	39	112	3.6
8-Jan-18	7.4	314	8.0	110	66	46	40	110	3.7
9-Jan-18	7.7	307	7.9	110	66	44	36	110	3.8
10-Jan-18	8.0	313	7.7	110	66	44	35	114	3.8
11-Jan-18	7.8	324	7.8	108	64	44	36	112	3.7
12-Jan-18	7.5	323	7.7	110	66	44	39	112	3.7
13-Jan-18	8.2	294	7.8	112	66	46	35	104	3.7
14-Jan-18	8.1	324	77.0	110	56	44	37	108	3.6
15-Jan-18	8.1	324	7.5	114	66	48	37	112	3.7
16-Jan-18	8.2	288	7.5	110	66	44	37	110	4.0
17-Jan-18	8.0	293	7.5	114	68	46	39	114	3.8
18-Jan-18	8.0	310	7.4	112	66	46	35	110	3.5
19-Jan-18	7.3	326	7.2	114	68	46	39	110	3.9
20-Jan-18	8.1	296	7.5	112	66	46	3.8	110	3.8
21-Jan-18	8.0	336	7.8	112	66	46	39	112	3.9
22-Jan-18	8.1	314	8.1	110	66	44	39	114	3.8
23-Jan-18	8.0	323	7.9	116	68	48	37	116	3.4
24-Jan-18	7.4	309	7.8	114	66	48	36	114	3.5
25-Jan-18	8.1	287	7.0	114	66	48	37	110	3.6
26-Jan-18	7.9	297	7.1	112	68	44	37	110	4.0

**Note:**

- a. Raw water analysis for various seasons are provided above, Bidder shall arrive the worst quality parameter based on the analysis and the system shall be designed accordingly.
- b. The above water analysis only indicative and bidder shall visit the site and required samples to be analyzed before submitting their proposal.



## ANNEX –1.2

### GUARANTEE PARAMETERS FOR CW TREATMENT PLANT

SL. NO.	PARAMETER	UNIT	VALUE
A	<b>Side Stream Filter Outlet Water</b>		
	Turbidity	NTU	< 2
	TSS	ppm	< 2
B	<b>Corrosion Rate</b>		
	MS	MPY	< 3
	Copper	MPY	< 0.5
	SS	MPY	< 0.5
C	<b>Scaling</b>	mg/dm <sup>2</sup> /day	< 15
D	<b>Micro Bio Fouling Counts</b>		
	Total Viable Count (TVC)	Counts/ml	< 1 x 10 <sup>5</sup>
	Sulphate reducing bacteria (SRB)	Counts /100 ml	< 1 x 10 <sup>5</sup>
E	<b>Circulating water pH</b>		7.7 – 8.0
F	<b>Circulating water LSI</b>		0 – 0.15
G	<b>Circulating water FRC</b>	ppm	0.2 – 0.3

**Note:**

Bidders shall provide guaranteed chemical consumption in their offer.



### ANNEX - 1.3

#### LIST OF MANDATORY SPARES

SI. No.	Description	Unit	Quantity
<b>1.0.0</b>	<b>Vertical Pump (For each type &amp; model)</b>		
a)	Dynamically balanced impeller with impeller nut	No.	1
b)	Shaft with sleeves	No.	1
c)	Pump line shaft bearings, pump sleeve bearings & thrust bearings	Sets	2
d)	Impeller shaft with sleeves	No.	1
e)	Pump line shaft/s with sleeves	Set	1
f)	Thrust bearing complete with housing	Set	1
g)	Thrust and journal pads	Set	1
h)	Line-shaft bearing holders	Set	1
i)	Line shaft keys	Nos.	2
j)	Flexible couplings bushes and locknuts	Sets	2
k)	Shaft couplings	Set	1
l)	Shaft nuts, if any (apart from impeller nut)	Set	1
m)	Lantern rings, wearing rings/suction bell liners, if any	Sets	2
n)	Impeller wearing rings	Set	1
o)	Spare bolts, nuts and washer of various type and sizes provided for CW & ACW pumps	%	10% of the total quantity for each item
p)	Rubber expansion Joint	No.	1
<b>2.0.0</b>	<b>Horizontal Pump (For each type &amp; model)</b>		
a)	Dynamically balanced impeller with impeller wear ring	No.	1



SI. No.	Description	Unit	Quantity
b)	Pump shaft with sleeves	No	1
c)	Glands for stuffing box	Sets	2
d)	Flexible couplings bushes and locknuts	Sets	2
e)	Gasket O-rings used in pump assembly and any other parts requiring replacements on each disassembly (such as lock pins, washers, springs etc)	Sets	6
f)	Shaft couplings	Set	1
g)	Gland packing and mechanical seals	Sets	5
<b>3.0.0</b>	<b>Induced Draught Cooling Tower</b>		
a)	PVC fill packs		15% of the population
b)	Distribution pipes and fittings		10% of the population
<b>4.0.0</b>	<b>Dosing Pump (For each type &amp; Model)</b>		
a)	Small component such as special gaskets, O-ring, spring and adjustment knobs	Set	1
b)	Gasket & Oil seal	Set	1
c)	Diaphragm	Set	1
d)	Gasket & oil seal	Set	1
e)	Bearings	Set	2
<b>5.0.0</b>	<b>Agitators (For Each type/Model)</b>		
a)	Bearings	No	1
b)	Coupling	No	1
c)	Oil seal	No	1
<b>6.0.0</b>	<b>Screw Pump (For each type &amp; Model)</b>		
a)	Rotor - AISI 304 HCP	No.	1



SI. No.	Description	Unit	Quantity
b)	Shaft - AISI 304 UG HCP	No	1
c)	Bearing	Set	1
<b>7.0.0</b>	<b>Air Blower (For each type)</b>		
a)	Rotor	Set	1
b)	Bearing	Set	1
c)	Gasket	Set	1
d)	V-belt	Set	1
e)	Suction filter	Set	1
<b>8.0.0</b>	<b>Piping / Fittings</b>		
a)	Pipes	%	5% of total straight length for each size and material grade of pipe
b)	Gaskets	%	100% total requirement of gaskets
c)	Fasteners (Flanges, Unions, etc.,) and fittings	%	10% of total requirement of fasteners
d)	Hangers and supports	%	5% spare spring box assembly for each type and rating of spring provided
e)	Pipe clamps	%	20% spare pipe clamp / attachment for each size & category.
<b>9.0.0</b>	<b>Valves</b>		
a)	Manual valve (For each type of valve category)	%	5% or min 1 no of each type, rating & size
b)	Auto valve with Actuator (For each type of valve category)	%	5% or min 1 no of each type, rating & size



## ANNEX - 1.4

### CLEANING, PROTECTIVE COATING AND PAINTING

#### 1.0 General

This specification covers the general requirements related to the cleaning protective coating and painting of equipment, components and systems that are covered under main equipment / system specifications. The components and/or equipment shall be mechanically and /or chemically cleaned during the following stages of the Contract.

- Cleaning in workshop
- Cleaning before painting and/or corrosion protection (application of prime coat)
- Cleaning before erection and during installation.

Cleaning of fabricated component items shall be carried out after fabrication and final heat treatment or welding at manufacturer's works or at site, as appropriate. No paint shall be applied surfaces within 75 mm of field welded connections. These surfaces shall be coated with a consumable preservative and marked.

For cleaning in workshop and before painting, mechanical cleaning by power tool and scrapping with steel wire brushes shall be adopted to clear the surfaces. However, in certain locations where power tool cleaning cannot be carried out, hand scrapping may be permitted with steel wire brushes and/or abrasive paper. Cleaning with solvents shall be resorted to only in such areas where other methods specified above have not achieved the desired results. Cleaning with solvents shall be adopted only after written approval of the Owner / Engineer.

Machined surfaces shall be protected during the cleaning operations.

In the event of the surfaces not being cleaned to the Owner's satisfaction, such parts of the cleaning procedures or agreed alternatives as are deemed necessary to overcome the deficiencies shall be carried out at the supplier's sole expense.

For reclining small areas, hand cleaning by wire brushing may be permitted.

#### 1.1 Codes and Standards

Painting of equipment shall be carried out as per the Codes indicated below and shall conform to the relevant IS Code for the material and workmanship.

The following codes and standards shall be followed for the surface preparation, surface protection and painting works.

IS: 5	Colors for ready mixed paints and enamels.
IS: 101	Methods of test for ready mixed paints and enamels.
IS: 104	Ready mixed paint, brushing, Zinc Chrome, priming.
IS: 158	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting.
IS: 161	Heat resistant paints
IS: 1303	Glossary of terms relating to paints.



IS: 1477	Code of practice for painting of ferrous metals in buildings (Parts I & II).
IS: 2074	Specifications for ready mixed paint, Air drying, red oxide zinc chrome priming.
IS: 2338	Code of practice for finishing of wood and wood based materials: Parts 2 schedules.
IS: 2339	Aluminum paint for general purposes, in dual container.
IS: 2395	Code of practice for painting of concrete, masonry and plaster surfaces: Part 2 schedules.
IS: 2524	Code of practice for painting of non-ferrous metals in buildings (Parts I & II).
IS: 2932	Specification for enamel, synthetic, exterior (a) undercoating, (b) Finishing
IS: 3140	Code of practice for painting asbestos cement building products.
IS: 6158	Recommended practice for design safeguarding against Embrittlement of hot dip Galvanized Iron & steel products.
IS: 6159	Recommended practice for design & fabrication of Iron & steel products prior to Galvanizing & metal spraying.
IS: 6278	Code of practice for white washing and Color - Washing.
IS: 10221	Code of practice for coating & wrapping of underground mild steel pipelines.
IS: 33	Inorganic pigments and extenders for paints -Methods of sampling & test.
IS: 13183	Aluminum paint, Heat resistant - specifications.
IS: 144	Specification for ready mixed paint brushing, petrol resisting, Air drying for Interior paints of tanks and containers, Red oxide.
IS: 9954	Pictorial surface preparation standards for painting of steel surfaces.
IS: 11883	Specification for Ready Mixed Paint, Air Drying, Red Oxide Priming for metals.
IS: 9404	Color code for identification of pipelines used in the Thermal Power Plants.
IS: 12744	Specification for Ready Mixed Paint, Air Drying, Red Oxide-Zinc Phosphate Priming.
BS: 2015	Glossary of paint selected terms.
BS: 5252	Final coat color.
BS: 7079A1/S1	Specification for rust grades and preparation grades of uncoated substrates after overall removal of previous coating.
BS: 7079A2	Preparations grades of previously coated steel substrates.
BS: 7079GrC	Surface roughness characteristics of blast cleaned steel substrates.
BS: 7079GrD	Methods for surface preparation.
BS-4232	Surface Finish of Blast cleaned steel for painting.
ASTM	American Standard for Testing Material.



ASTM A 780	Standard practice for repair of damaged galvanized coatings.
AWWA	American Water Works Association.
ASA-A-13.1-1981	Scheme for identification of piping system (American National Standard Institution).
DIN S1S-055900-1967	Deutsehes Institute for Normung Surface preparation standards for painting steel surfaces. ( Swedish standard Institution)
SSPC-SP	Preparation Specifications (Steel structures painting council, U.S.A.).
	National Association of Corrosion Engineers, U.S.A. (NACE).

## 1.2 Scope of Work and General Requirements

This specification covers the surface preparation, method of application and material to be used for all coating of equipment, steel structures and piping. Steel material subjected to surface preparation on shop/site shall have minimum requirements in accordance with Rust Grade B (SSPC/SSPM Volume-2).

Coating materials according to SSPC, EN ISO, ASTM, BIS or DIN standards, shall be used. The paint shall comply with applicable laws, regulations, ordinances etc., of the local authority, state or the nation pertains to the work. The materials shall be matched with each other so that they are compatible. Coatings deviating this specification shall be subject to approval.

**Standards of surface preparation and painting shall give a time to first maintenance of minimum 10 years.**

The paint to be applied shall be approved by Owner.

All paints & paint material used shall be procured from approved manufacturers. Paint shall be supplied in manufacturers original containers with the description of content, specification No., colour, ref no, date of manufacture, shelf life expiry date & pot life.

The paint manufacturers shall provide coating system data sheet for each coating system to be used containing the following information

- a. Surface preparations
- b. Film thickness (min and max)
- c. Min and max recoating intervals at relevant temperatures
- d. Mixing ratio, thinner details and coating repair systems

The sample for testing the paint being used may be taken by the Owner at any time.

In general Shop fabricated equipment will be delivered to the site coated with a shop applied system or the manufacturer's standard finish in accordance with the requirements of this specification.



For equipment that has received shop prime coat, all touch-up prime coat and additional coats shall be applied in accordance with the coating schedule. It is responsibility of the vendor to ensure compatibility between shop and field applied paint systems.

Necessary precautions shall be provided to all equipment, structures to protect other surfaces from abrasive blasting, coating over spray and spatter. Damage to other surfaces or equipment shall be repaired by the vendor.

The Contractor shall submit the following for review and approval by the Owner:

- a. Manufacturer's recommended paint scheme for the project
- b. Latest published product & instructions for application data,
- c. Procedures for surface preparation and application.
- d. Pre-qualification for equipment and blasting materials, product, procedure and personnel qualifications for the paint and painting systems.
- e. Painting repair procedures

Painting records shall contain:

- Equipment/components/location painted
- Date of painting
- Paint details such as specification No, colour, date of manufacture, shelf life, expiry date
- Application equipment
- Ambient conditions at the time of painting
- Surface temperature
- Drying time between coating, DFT and number of coatings
- Appropriate work plan for painting.

The supply of all necessary equipment, weather protection, and scaffolding for painting to ensure work is carried out in accordance with the specification and agreed programme.

Maintenance of the paint work until completion of the contract, this shall include repair of any damaged areas caused by third party.

Disposal of painting waste resulting from painting, shall comply with applicable laws, regulations, ordinances etc., of the local authority, state or the nation pertains to the work and coating materials.

It is a mandatory requirement that all operatives working to this procedure take full cognizance and implement necessary safety precautions.

## 2.0 Cleaning at manufacturer's works

Mechanical cleaning shall preferably be carried out by abrasive blasting. The Owner is prepared to consider alternative methods such as chemical cleaning provided they achieve the necessary surface condition.

In case of chemical cleaning, the detailed procedure for chemical cleaning as well as the system for which chemical cleaning is required shall be submitted by the



contractor for Owner's approval. The procedure shall comprise of pre-treatment and acid treatment to achieve cleanliness equivalent to that specified for mechanical cleaning.

**Surface condition:**

The Metal surfaces shall be clean and free of mil scale, rust, dirt, grease and any other deleterious matter.

Where metal surfaces are to be painted the surface profiles shall conform to the painting specification requirements.

Where this does not apply, surfaces shall have a surface texture not coarser than Grade 80 abrasive paper.

**Abrasives:**

Abrasives containing silica, silicates or slag residues shall not be used for water/steam side surfaces of plant except for cleaning sand castings, where hydro blasting may be employed.

For austenitic materials only, abrasives containing 98% or more of alumina,  $\text{Al}_2\text{O}_3$ , shall be used.

**Removal of abrasive and debris:**

After cleaning, abrasive and debris shall be thoroughly removed for components.

### **3.0 Protection at manufacturer's works**

As soon as all items have been cleaned and within four hours of the subsequent drying, they shall be given suitable anti-corrosion protection.

All water, air and steam side surfaces shall be protected by the application of approved water soluble corrosion inhibitors, or vapor phase inhibitors that can be subsequently removed by site water washing or steam blowing.

The gas side of steam generating plant items shall be protected by the application of temporary protective that do not require to be removed before commissioning, but which are removed during initial firing.

The rate of application of volatile corrosion inhibitors shall be at least 10 grams per square meter or 35 grams per cubic metre, whichever is the greater, except for pipes up to 300 mm diameter for which the minimum application rates shall be 5 grams per square metre.

Immediately after the protective treatment has been applied all vessels and pipes shall be suitably sealed off by discs or caps or approved alternatives to prevent ingress from the surroundings. Cylindrical plugs shall not be driven into the ends of pipes. These protective covers shall not be removed until immediately before final connection is made to the associated equipment.



#### 4.0 Weather conditions

Painting shall be done only when the surface temperature is above 5°C. Surface temperature must be at least 3°C above dew point to ensure that condensation does not occur on the surface.

Reasonable protection against precipitation and seawater spray shall be exercised for the painting of outdoor parts.

Precautions shall also be taken against solar radiation to ensure that the specified dry film thickness of priming or finish coats is obtained.

Any prime coat exposed to excess humidity, rain, dust etc., before drying, shall be permitted to dry and the damaged area of primer shall be removed and the surface prepared and primed again.

Sheltered or unventilated horizontal surfaces on which dew may collect require more protection, and to achieve this additional top coat of paint shall be applied.

The temperature quoted as "normal" in the "Paint System Tables" refers to the average local climatic conditions.

#### 5.0 Surface preparation

In preparing any surface to be coated, all loose paint, dirt, grease, rust, scale, weld slag or spatter or any other extraneous material shall be removed and defects repaired, so as to obtain a clean, dry, even surface to receive the priming or finishing coat (s) as called for in the painting schedules. Sharp edges should be rounded, especially when tank linings have to be applied.

All machined surfaces, including flange faces, shall be suitably covered to prevent damage during surface preparation.

All surfaces should be blast cleaned whenever possible.

##### Surface preparation methods:

Bare steel surfaces should be prepared by one of the methods described below in order of preference and in accordance with Swedish Standard SIS 05 59 00 or Steel Structures Painting Council, SSPC, Vis 1, or DIN 55928, section 4.

The relative humidity level should not be more than 60% & the steel surface temperature at least 3°C above the dew point during dry blast cleaning operations.

###### a. White metal blast cleaning

###### Sa 3 or SSPC - SP 5

Sa 3 Blast cleaning to bare metal. Mill scale, rust and foreign matter must be removed completely. Subsequently, the surface is cleaned with vacuum cleaner, clean dry compressed air or a clean brush. It must then have a uniform metallic color and correspond in appearance to the prints designated Sa 3.



**b. Near white metal blast cleaning      Sa 2 1/2 or SSPC - SP 10**

Sa 2 1/2. very thorough blast cleaning. Mill scale, rust and foreign matter shall be removed to the extent that the only traces remaining are slight imperfections in the form of spots or stripes. Subsequently, the surface is cleaned with a vacuum cleaner, clean dry compressed air or a clean brush. It must then correspond in appearance to the prints designated Sa 2 1/2.

Mechanical cleaning should only be used when procedures (a) and (b) are not practicable.

**c. Near white metal blast cleaning      P Sa 2 1/2 DIN 55928**

Very thorough blast cleaning. Very adhesive coatings remain. From all other surface mill scale and rust are to be removed to such an extent that the only traces remaining are slight imperfections in the form of spots or stripes. Further treatments see Sub b).

The adhesivity of residual coatings in the transition zone has to be tested even after the application of the primer.

**d. Very thorough mechanical scraping and wire brushing St 3**

St 3 very thorough scraping and wire-brushing - machine brushing - grinding - etc. are to be preferred. Surface preparation as for St 2. But much more thoroughly. After the removal of dust, the surface must have a pronounced metallic sheen and correspond to the prints designated St. 3.

**e. Thorough scraping and wire brushing St 2**

St 2 Thorough scraping and wire-brushing - machine brushing - grinding - etc. The treatment shall remove loose mill scale, rust and foreign matter. Subsequently, the surface is cleaned with a vacuum cleaner, clean dry compressed air or a clean brush. It should then have a faint metallic sheen. The appearance must correspond to the prints designated St 2.

**f. Air Blasting with Non-Metallic Abrasives Powder**

Whenever the "Duplex"-process is to be applied (hot dip galvanising followed by painting), prepare the hot dip galvanised surface by water washing to remove flux residues and careful air blasting with non-metallic abrasive powder. Use an abrasive with grain size from 0.1 to 0.5 mm, at a greatly reduced air pressure, max. 2 bar (g) (28 psig).

This procedure also applies to stainless steel and aluminium surfaces to be coated.



<b>Surface preparation methods</b>	<b>SIS 055900</b>	<b>DIN 55928 Part-4</b>	<b>BS 4232 only for blasting</b>	<b>SSPC-Vis</b>
Blasting acc to item (a),(b),(c),	Sa 3		First quality	White metal SP 5
Blasting acc to item (b)	Sa 2 1/2		Second quality	near White SP 10
Blasting acc to item (c)	Sa 2		Third quality	Commercial blast SP 6
Hand/or power tool derusting acc to item (e)	St 2		--	Hand tool cleaning SP 2
acc to items (d) and (e)	St 3		--	Power tool cleaning SP 3
Flame jet cleaning		F1	--	Flame cleaning SP 4
Pickling		Be	--	Pickling

Steel structures to be blast cleaned have to be free of pitting and other severely corroded places in accordance with B.S. 4232 and SIS 055900.

The abrasives used for blast-cleaning shall be graded flint, grit, shot or silica sand and shall be such that they will produce an average keying profile on the blast-cleaned surface of not more than 40 microns.

An air pressure of 7 bar g at the nozzle shall be used.

After blast-cleaning, all accumulated grit, dust, etc., must be removed leaving the surface clean, dry and free of mill scale, rust grease and other foreign matter.

In the event of rusting after completion of the surface preparation, the surface must be cleaned again in the manner specified.

Oil, grease, soil, cement, salts, acids or other corrosive chemicals shall be cleaned from steel surfaces, by the use of solvents, emulsions or cleaning compounds. The final wiping shall be with clean solvent and clean rags or brushes. There shall be no detrimental residue left on the surface.

Primed areas which suffer damage must be spot blasted on site to a degree of cleanliness Sa 2 1/2 before, touching up.

Protective coating must be applied as quickly as possible after the completion of surface preparation no matter what cleaning method has been used.

No blast-cleaned surface shall be allowed to remain uncoated overnight.

Steel work protected by shop primer after arrival on site must be cleaned of salt, sand, oil etc. Before the first coat of paint is applied on site. Shop primer damaged



during transport must be rectified by blast-cleaning and coating before application of the site coats.

Wood surfaces shall be sanded clean. All nail holes shall be puttied and sanded before priming.

Concrete: If a protective coating is required, concrete shall be allowed to cure before painting.

## 6.0 Preparation of coating materials

All containers shall remain un-opened until required for use.

Primers and paints which have livered, gelled or otherwise deteriorated shall not be used.

The oldest primer or paint of each kind shall be used first.

All ingredients in any container shall be thoroughly mixed before use, and shall be agitated frequently during application to keep the primer in suspension.

Primer or paint mixed in the original container shall not be transferred until all settled pigment is incorporated into the body of liquid.

Mixing in open containers shall be done in a well ventilated area.

Primer or paint shall be mixed in a manner ensuring the breakdown of all lumps, complete dispersion of pigment and uniform composition.

Two-component primers shall be mixed in accordance with the manufacturer's instructions.

Thinner shall not be added to primers or paints unless necessary for proper application according to the manufacturer's instructions.

When use of thinner is permitted, it must be added to the primer or paint during mixing.

### 6.1 Primer Paint

After the surface is prepared, one coat of suitable primer shall be applied. After this first coat is dried up completely, second coat of primer shall be applied.

Primer shall be applied by brushing to ensure a continuous film without 'holidays'. The dry film thickness of each coat shall be as specified in Paint System of this specification.

The primer should be worked by brush application to cover the crevices, corners, sharp edges etc. in the presence of inspector.

The shades of successive coats should be slightly different in color in order to ensure application of individual coats, the thickness of each coat and complete



coverage should be checked as per specification approved by Engineer before application of successive coats.

The contractor shall provide standard thickness measurement instrument with appropriate range(s) for measuring.

Elko meter for measuring the Dry film thickness of each coat, surface profile gauge for checking of surface profile in case of sand blasting. Holiday detectors and pinhole detectors for checking the painted surface discontinuities should be provided by the contractor.

The contractor shall make arrangements for paint manufacturer to provide expert technical service at site as and when required free of cost and without any obligation to the Owner, as it would be in the interest of the manufacturer to ensure that both surface preparation and application are carried out as per their recommendations.

Final inspection shall include measurement of paint dry film thickness, check of finish and workmanship.

## 6.2 Rub down and Touch Up of Primer

The shop coated surfaces shall be rubbed down thoroughly with emery paper to remove all dust, rust and other foreign matters, washed, degreased, then cleaned with warm fresh water and air dried.

The portions, from where the shop coat has peeled off, shall be touched up and allowed to dry before applying a coat of primer.

The compatibility between shop coat and field primer shall be ascertained from the paint manufacturer. In case degreasing with white spirit is not effective, the surface shall be finally wiped clean with aromatic solvent like xylol or light naphtha.

## 6.3 Non Compatible Shop Coat Primer

- a) The compatibility of finishing coat shall be confirmed from the paint manufacturer. In the event of use of primer such as zinc rich epoxy, inorganic zinc silicate etc., the paint system shall depend on condition of shop coat. If the shop coat is in satisfactory condition showing no major defect, the shop coat shall not be removed. The touch up primer and finishing coat(s) shall be identified for application by Engineer. Shop coated (coated with primer & finishing coat) equipment shall not be repainted unless paint is damaged.
- b) Shop primed equipment and surfaces shall only be 'spot cleaned' in damaged areas by means of power tool brush cleaning or hand tool cleaning and then spot primed before applying one coat of field primer unless otherwise specified. If shop primer is not compatible with field primer then shop coated primer shall be completely removed before application of selected paint system for particular environment. For package units/equipment, shop primer shall be as per the paint system given for particular environment.
- c) In case of existing paint, compatibility between finishing coat and new selected finish coat shall be ascertained before application of finish coat. In case, the coat



is selected for upgrading existing alkyd coating to high performance coating then, surface preparation shall be by manual/mechanical means to remove loose rust, peeled off/damaged paint, but sound old coating need not be removed. It shall be touched with suitable primer wherever it has peeled off before application of tie coat. The tie coat shall be applied after 7 days of curing of the primer. If, new paint system is not suitable to upgrade existing coating then complete paint shall be removed by mechanical or blast cleaning before application of new coating system.

#### 6.4 Finish Paint

Suitable Finish paints as per the schedule shall be applied for the jobs. The color/shade shall be as approved by the Owner. After cleaning the dust on the dried up primer, first coat of finished paint shall be applied. After this first coat dries up hard, the surface is wet scrubbed cutting down to a smooth finish and ensuring that at no place the first coat is completely removed. After applying second coat, allowing the water to get evaporated completely, third finish coat of finish paint may be applied (if applicable).

### 7.0 Steel Structures Painting

Generally, all steel structures shall receive two primer coats and two finish coats of painting. First coat of primer shall be given in shop after fabrication before dispatch to erection site after surface preparation as described below. The second coat of primer shall be applied (if required) after erection and final alignment of the erected structures. Two finish coats shall also be applied after erection.

Steel surface which is to be painted shall be cleaned off dust and grease and the heavier layers of rust shall be removed by chipping to grade ST-2 as per SIS05-5900 or as per IS: 1477 (part -I) prior to actual surface preparation. Suitable primer of required DFT shall be applied as specified in the Paint system of this document- Annex.

Suitable finish paint of required DFT shall be applied as specified in the Paint system of this document- Annex. The undercoat and finish coat shall be of different tint to distinguish the same from finish paint. All paints shall be of approved brand and shade as per the Owner's requirement.

Joints to be site welded shall have no paint applied within 100 mm of welding zone. Similarly where Friction grip fasteners are to be used no painting shall be provided. On completion of the joint the surfaces shall receive the paint as specified.

Surfaces inaccessible after assembly shall receive two coats of primer prior to assembly. Surfaces inaccessible after erection including top surfaces of floor beams supporting gratings or chequered plate shall receive one additional coat of finish paint over and above number of coats specified before erection. Portion of steel member embedded / to be encased in concrete shall not be painted.

### 8.0 Paint Materials

The paints shall conform to the specifications given in this Annex and class-1 quality in the products range of any of the following manufacturers:



- a. Asian Paints (India) Ltd.
- b. Berger Paints India Ltd.,
- c. Good lass Nerolac Paints Ltd.,
- d. Garware Paints
- e. Jenson & Nicholson
- f. Shalimar Paints
- g. Equivalent other country manufacturer after prior approval of Owner.

## 9.0 Storage

All paints and painting material shall be stored only in rooms to Engineer's approval. All necessary precautions shall be taken to prevent fire. The storage building shall preferably be separated from adjacent buildings. A signboard bearing the words "PAINT STORAGE - NO NAKED LIGHT - HIGHLY INFLAMMABLE - DANGER - NO SMOKING" shall be clearly displayed outside. All paints shall be stored in the safest manner so that no container rolls down and causes accidents. The shelf life of the paints shall be ensured so that the paint materials are not in storage and use after the date of expiry.

## 10.0 Application

### Health and safety of work

The supplier has to check all painting work to be carried out according to the specification of the paint supplier further to all relevant prescriptions and regulations concerning the health and safety of work.

The paint supplier has to present a written specification including at least the flash point of the paints, ventilation requirements, handling precautions such as inhalation, eye and skin protection, and first aid procedure, storage requirements, spill or leak procedure, fire precaution, waste disposal.

### Methods

Quality of the surface to be painted or coated has to be tested acc. to DIN 55928 and DIN 8202.

Temporary corrosion protections are to be completely removed prior to applying the definite one, in acc. with DIN 55928.

All prime coatings shall be applied by brush or airless spray or a combination of these methods, as approved by the coating manufacturer.

All doors, windows, stairways, handrails (if painted), bolts, flanges and equipment supports shall be finish painted by brush.

Spray guns should not be used outside in windy weather or near surfaces of a contrasting colour unless the latter is properly protected.

All cold-spray painting shall be done using standard equipment in accordance with accepted standards and methods.



Care has to be taken not to connect spraying devices for nitro and backelite paints simultaneously to oil based paints.

Paint applied to items that are not being painted shall be removed at the supplier's expense, leaving the surface clean, unstained and undamaged.

### Dry film thickness (DFT)

To the maximum extent practicable the coats shall be applied as a continuous film of uniform thickness and free of pores. Overspray, skips, runs, sags and drips should be avoided. The different coats shall not be of the same colour.

For a composite paint or coating system consisting of several coats, the total DFT must be at least equal to the sum of the minimal DFT's for the individual coats. If, the paint system does not have the required minimum DFT those areas should be marked & repainted. If the occurrence of those areas is high, the complete surface must be repainted. It is also critically important to check the DFT of primers and intermediate coats and to correct them where necessary.

For paintings based on Zinc silicate the DFT is limited as well on minimum DFT as on maximum (150 $\mu\text{m}$ ) because of the risk of mud cracking.

### Consumption of paints

Has to be evaluated according to DIN 53220. The paints shall be tested as per IS - 101.

Each coat of paint shall be allowed to harden before the next is applied. For epoxy paint the hardening time normally is 12-14 hours. Suppliers' recommendations regarding hardening time of epoxy paints must be followed.

Particular attention must be paid to full film thickness at edges.

The minimum total dry film thickness of the paint systems shall be as recommended in the following tables below. The DFT is given in microns (millionths of a metre).

## 11.0 Protective coatings and paint systems

The colour coding for identification of pipelines should comply with IS-2379 & IS - 9404.

The type and number of protective coats for any item requiring painting are to be in accordance with DIN 55928 and are to be at least of a quality as shown in the attached Annex- Paint System.

Alternative to the Annex- Paint System specified, are to be presented on the schedule Departure from Specification, as indicated elsewhere.

Generally, all parts shall receive the specified prime coat (s) at the supplier's works to ensure that no corrosion occurs during transport to the site and storage at the site.



Parts which cannot be damaged during transport shall receive the full number of coats.

Types of Substrate, Base metal:

- Ferrous (Surface Temperature during operation < 120° C, EN ISO 12944:1998)

To this group belongs carbon steel, low alloyed steel & high alloyed steel. All paint systems are inevitable for corrosion protection.

- Hot dip galvanized surfaces.

Hot dip galvanized surfaces do require painting in a wet, industrial, chemicals and/or marine environment

- SS (EN ISO 12944:1998 conditionally applicable)

In general, SS surfaces do not require painting unless in a chemical and/or marine environment. In case of chemical and/or marine environments determination of whether or not the surface requires painting depends on the chemical content of the base metal.

The following formula applies

$$W = Cr + 3.3 \times Mo + 22.45 N_2$$

If  $W < 23$ , then the surface has to be painted.

If  $W < 28$  &  $W > 23$ , then the surface to be painted if splash contact with the media ( i.e. sea) is possible. This may also occur if there is a strong wind carrying drops to the surface.

If  $W > 28$ , then the surface need not be painted.

- Aluminium

By default such surfaces/components will not be painted. Exceptions are architectural/aesthetic reasons and high corrosive conditions, which shall be evaluated separately depending on aluminum alloys.

## 12.0 Galvanizing

Galvanizing works shall conform in all respect to B.S. 729, B.S. 3083 and B.S.C.P. 2008 and to DIN 50976 whatever requires the higher quality and shall be performed by the hot dip process, unless otherwise specified.

It is essential that details of steel members and assemblies which are to be hot-dip galvanized should be designed in accordance with B.S 4479.

Vent-holes and drain-holes should be provided to avoid high internal pressures and air-locks during immersion, which may cause explosions, and to ensure that molten zinc is not retained in pockets during withdrawal.



Careful cleaning of welds is necessary before welded assemblies are dipped. The welds and the surrounding metal should be cleaned separately, preferably by blast-cleaning, because the usual preliminary pickling cannot be relied on to remove the welding slag.

All defects of the steel surface including cracks, surface laminations, laps and folds shall be removed in accordance with B.S. 4360. All drilling, cutting, welding, forming and final fabrication of unit members and assemblies shall be completed, where feasible, before the structures are galvanized. The surface of the steelwork to be galvanized shall be free from paint, oil, grease and similar contaminants in accordance with DIN 55928, part 4 and DIN 50976. The weight of zinc coating per unit area has to be noted in the manufacturing documents in accordance with DIN 50976.

The minimum average coating weight shall be as specified in Table 1 of B.S. 729 or Table 2, DIN 50976, whatever requires higher quality.

Structural steel items shall be initially grit-blasted to B.S. 4232, second quality, (Sa 2 1/2) or by pickling in a bath and the minimum average coating weight on steel sections 5 mm thick and over shall be 900 g/m<sup>2</sup>.

On removal from the galvanizing bath, the resultant coating shall be smooth, continuous, free from gross surface imperfections such as bare spots, lumps, blisters and inclusions of flux, ash or dross.

Galvanized contact surfaces to be joined by high-tensile friction-grip bolts shall be roughened before assembly so that the required slip factor (defined in B.S. 3294, part 1 and B.S. 4604, part 1) is achieved. Care shall be taken to ensure that the roughening is confined to the area of the mating faces.

Bolts, nuts and washers, including general grade high-tensile friction grip bolts (referred to in B.S. 3139, and B.S.4395 part 1) shall be hot dip galvanized and subsequently centrifuged (according to B.S. 729). Nuts shall be tapped up to 0.4 mm oversize after galvanizing and the threads oiled to permit the nuts to be finger-turned on the bolt for the full depth of the nut. No lubricant, applied to the projecting threads of galvanized high-tensile friction-grip bolt after the bolt has been inserted through the steelwork, must be allowed to come into contact with the mating faces of the steelwork,. A local remelting of the galvanized parts to achieve the nuts to be finger turned on the bolt is possible in accordance with DIN 50976.

Protected slings must be used for offloading and erection. Galvanized work which is to be stored at the works or on site shall be stacked so as to provide adequate ventilation to all surfaces to avoid wet storage staining (white rust).

Small areas of the galvanized coating damaged in any way shall be restored in accordance with DIN 55928, part A and DIN 50976 by:

- Cleaning the area of any weld slag rust and other impurities and by thorough wire brushing to give a metallic clean surface.
- Application of suitable number of coats of zinc-rich paint containing more than 90 % w/w of zinc in dried film. The dry film thickness shall exceed at least 50 % the



thickness of the desired galvanization. In case of application of a low melting point zinc alloy repair rod, the rods shall be in accordance with DIN1707, the thickness of the alloy shall be at least as of the desired galvanization.

The restored area is not to exceed 1 % of the galvanized surface.

Surface restoration of parts in contact with drinking water is not allowed and the quality of the galvanization is to be in accordance with DIN 2444.

After fixing, bolt heads, washers and nuts shall receive two coats of zinc-rich paint. Connections between galvanized surfaces and copper, copper alloy or aluminum surfaces shall be protected by suitable preferably hydrophobe tape wrappings to the owner's approval.

### 13.0 Sprayed Metal Coatings

Corrosion protection may be also achieved by spraying of suitable metals as zinc and/or aluminum on the surfaces of structures. For special cases tin, copper, lead can be used as well. Methods of surface preparation have to conform to B.S. 2569 or to DIN 8567. A proper treatment of the surface followed by an immediate spraying is to apply to ensure adhesion of the sprayed metal. The surface has to be clean, free of impurities, rust, mill scale and rough enough to have binding properties to ensure good enticulation with the sprayed layer. Suitable roughness can be achieved by blast cleaning acc. to BS 4232 or DIN 8567. Welds are to be cleaned and prepared with special care. All surfaces to be treated have to be dry and accessible.

Application of coatings, requirements for thickness, adhesion, composition of coating metals, and subsequent treatment have to conform to BS 2569, DIN 8565 and 8567.

Testing of the spray coated layers are to be carried out in accordance with DIN 8565.

The contractor has to specify the type, composition and thickness of the sprayed metal and of the sealing coating according to DIN 8565 including the corresponding warranties and tests if, sprayed metal coating will be applied.

#### Safety of work:

All precautions connected with this type of application of corrosion protection have to be in accordance with German regulation DVS 2307, page 1. 2.

Sprayed, unfused coating of metals and metallic compounds applied by combustion gas flame, plasma arc, detonation and similar processes, and the preparation of components, spraying techniques, sealing, finishing and inspection shall be according to B.S. 4761.

The hot galvanized surface has to be cleaned before the application of the coats to remove corrosion products, dirt, dust, grease.

The cleaning can be achieved by

- brush off
- washing with 1 - 1.5 % ammonia water with up to 0.1 % detergent added and followed by wet grinding to turn the foam to grey color,
- steam blasting.



## 14.0 Warning Notes / Signals

This Instruction serves the identification of the coated surfaces that are received from shop in assembled condition / module wise.

The warning note shall prevent any possible damage to the coated surfaces during transportation / assembly at site.

Eg.: Welding work OR Heat treatment work on the outside of coated or lined surfaces is prohibited.

## 15.0 Colour Code for Piping

- a. The colour code scheme is intended for identification of the individual group of the pipeline. The system of colour coding consists of a ground colour and colour bands superimposed on it. The colour coding for the identification of pipelines shall comply with **Annex** of this specification.

Ground Colour shall be applied throughout the entire length for un insulated pipes. For insulated pipes, on the metal cladding or on the pipes of material such as non-ferrous metals, austenitic stainless steel etc., ground colour coating of minimum 2m length or of adequate length not to be mistaken as colour band shall be applied at places requiring colour bands. Colour band(s) shall be applied at the following location.

- i. At battery limit points
  - ii. Intersection points & change of direction points in piping ways.
  - iii. Other points, such as midway of each piping way, near valves, junction joints of service appliances, walls, on either side of pipe culverts.
  - iv. For long stretch/yard piping at 50 M interval.
  - v. At start and terminating points.
- b. Flow direction shall be indicated by an arrow in the location stated above and as directed by Engineer. Colors of arrows shall be black or white and in contrast to the color on which they are superimposed. The size of the arrows shall conform to IS:2379. Product names shall be marked at pump inlet, outlet and battery limit in a suitable size as approved by Engineer. As a rule minimum width of color band shall conform to 75 mm up to 300 NB and to 100 mm over 350 NB. Whenever it is required by the Engineer to indicate that a pipeline carries a hazardous material, a hazard marking of diagonal stripes of red and golden yellow as per IS:2379 shall be painted on the ground color.
  - c. All uninsulated piping systems, hangers and supports shall have two coats of suitable primer coats and with suitable finish paints as per Annexure- Painting system. Shades shall be as per IS 5 or as indicated by Owner /Engineer. Service of the pipe/line designations shall be painted on all pipes at visible locations.

## 16.0 Identification of Vessels, Piping etc.

Equipment number shall be stenciled in black or white on each vessel, column, equipment and machinery after painting.



Line number in black or white shall be stenciled on all the pipelines of more than one location as directed by Engineer; size of letters printed shall be 150 mm (high) for column & vessels. 50 mm (high) for pump compressor and other machinery and shall be as per IS: 9404 for piping. The storage tanks shall be marked as detailed in the respective drawing.

## 17.0 Inspection and Testing

- a) All painting materials including primers and thinners brought to site for application shall be procured directly from manufacturer as per specifications and shall be accompanied by manufacturer's test certificates. Paint formulations without certificates are not acceptable. Engineer at his discretion, may call for tests for paint formulations. Contractor shall arrange to have such tests performed including batch wise test of wet paints for physical & chemical analysis. All costs thereof shall be borne by the contractor. The paints shall be tested as per IS: 101 / equivalent international standard and approved by the Owner.
- b) The painting work shall be subject to inspection by Engineer at all times. In particular, following stage wise inspection shall be performed and contractor shall offer the work for inspection and approval of every stage before proceeding with the next stage. The record of inspection shall be maintained in the registers. Stages of inspection shall be surface preparation, primer application and each coat of paint. In addition to above, record shall include type of shop primer already applied on equipment e.g. red oxide zinc chromate or zinc phosphate or Silicate primer etc.
- c) Any defect noticed during the various stages of inspection shall be rectified by the contractor to the entire satisfaction of Engineer before proceeding further. Irrespective of the inspection, repair and approval at intermediate stages of work, contractor shall be responsible for making good of any defects found during final inspection/guarantee period/defect liability period as defined in general condition of contract. Dry film thickness (DFT) shall be checked and recorded after application of each coat and extra coat of paint shall be applied to make-up the DFT specified without any extra coat to the Owner.

## 18.0 Guarantee

The contractor shall guarantee that the chemical and physical properties of paint materials used are in accordance with the specifications contained herein/to be provided during execution of work. The contractor shall produce test reports from the manufacturer regarding the quality of the particular batch of paint supplied. The Engineer shall have the right to test wet samples of paint at random for quality of the same. Batch test reports of the manufacturer's for each batch of paints supplied shall be made available by the contractor.



## 19.0 Standard Final Colour of Equipment and Piping

### 19.1 Standard Colour Code for Mechanical Equipment

Sl. No.	Description	Ground Colour
A	<b>Closed Cooling Water System</b>	Sea Green
B	<b>Crane &amp; Hoist</b>	
1	Power house EOT crane	Canary Yellow
2	CW pump house EOT crane	Canary Yellow
C	<b>Compressed Air Plant</b>	
1	Air compressor	Sky Blue
2	Compressed air dryer	Sky Blue
3	Air receiver	Sky Blue
D	<b>Chemical Dosing</b>	Dark Admiralty Grey
E	<b>Fire Protection System</b>	
1	Diesel engine driven pump	Fire Red
2	Fuel tank for diesel engine driven pump	Fire Red
3	Main hydrant pump (Electrical)	Fire Red
4	Jockey pump	Fire Red
5	Fire Water Storage tank	Fire Red
6	CO2 cylinder	Fire Red
F	<b>Air Conditioning and Ventilation System</b>	
1	Refrigerant compressor	Sky Blue
2	Chilled / condenser pumps	Sea Green
3	Condenser water pipe	Sea Green
4	Fans	Grey

#### Notes:

This color code basically refers to IS:2379 for piping with necessary modifications

For any item left out, color coding will be decided after Owner's approval.

## 19.2 Standard Colour Code for Electrical Equipment

1	Transformers	Olive grey for power transformers and pebble grey for service transformer	RAL 7002 for power transformers and RAL 7032 for service transformers
2	Bus ducts	pastel turquoise for indoor and olive grey for outdoor	indoor 6034 and outdoor 7002
3	Junction boxes.	Pebble grey	RAL 7032
4	HT/LT Switchboards, Distribution boards, Control & Relay panels		
	a) Indoor	Pebble grey	RAL 7032
	b) Outdoor	Pebble grey	RAL 7032



5	UPS Panel, charger panels	Light grey	Exterior RAL 7032 Interior Brilliant white
7	LT Motor	Olive grey	RAL 7002
8	HT Motor	Grass green	RAL 6010
9	Lighting fittings	As per manufacturer's standard	As per manufacturer's standard
10	Cable trays	Galvanized	

1. For interior coating, manufacturer's standard can be adopted subject to Owner's approval.
2. All panels that are to be erected at control room shall be painted using RAL 7032 (exterior colour). All Electrical, C&I, Fire alarm or any other panel shall have this colour.

### 19.3 Colour Coding for Identification of Pipelines used in Thermal Power Plants

Sl.No	Medium	Ground Shade		Band Shade		Remarks
		Color	Color No. as per IS:5	Color	Color No. as per IS:5	
1	Water system	Sea green	217	White Light orange French blue French blue	- 557 166 166	White is not included in IS - 5-2007
	a) Untreated or raw / service					
	b) Treated/dematerialized					
	c) Potable water					
2	Service & clarified water	Sea green	217	French blue	166	with aluminum
	Steam system					
3	Auxiliary steam	Aluminum	-	Signal red	537	with aluminum
	Air system					
a)	Instrument	Sky Blue	101	White	-	



Sl.No	Medium	Ground Shade		Band Shade		Remarks
		Color	Color No. as per IS:5	Color	Color No. as per IS:5	
b)	Service/Plant	Sky Blue	101	White	-	White not included in IS-5 - 2007
c)	Vacuum pipes	Sky Blue	101	Black	-	Black not included in
4	Transformer oil	Light brown	410	Light orange	557	
5	Fire services	Fire red	536	-	-	-
6	Effluent pipes	Black	-	-	-	-

#### 19.4 Colour Code for Structural Steel

SL. NO	ITEM/SERVICE	COLOR	COLOR No. as per IS:5
1	Gantry girder & monorail	Brilliant green	221
2	Gantry girder & monorail stopper	Signal red	537
3	Building structural steel columns brackets, beams bracings, roof truss, purloin, side grit, louvers, stringers	Dark admiralty grey	632
4	Pipe rack structure & trestle	Dark admiralty grey	632
5	Chequered plate (Plain Face)	Black	-
6	Grating	Black	-
7	Ladder	Dark admiralty grey	632
8	Hand railing Hand rail	Signal red	537
9	Middle rail	Signal red	537
10	Toe Plate	Signal red	537
11	Vertical post	Black	-



## Notes

1. Covering capacity and DFT depends on method of application. Covering capacity specified above is theoretical. Allowing the losses during application, min specified DFT shall be maintained.
2. All primers and finish coats shall be cold cured and air dried unless otherwise specified.
3. All paints shall conform to relevant Indian Standard and shall be applied in accordance with manufacturer's instructions for surface preparation, intervals, curing and application. The surface preparation, quality and workmanship shall be ensured.
4. Technical data sheets for all paints shall be supplied at the time of submission of quotations.
5. In case of use of epoxy tie coat, manufacturer shall demonstrate satisfactory test for inter coat adhesion. In case of limited availability of epoxy tie coat, alternate system may be used taking into consideration the service requirement of the system.
6. Contractor will submit the final colour shade for all equipment & piping under his scope for final approval by client / consultant.

### Data Sheet for Painting System - Dry Arid Climate. ( C1 - C3 Environment )

Surface/ Location	Temp	Coat	No of coats	Generic Description	Dft / coat
Indoor & Outdoor. Structural Steel work like technological structures, pipe rack, junction towers, piping ( Oil + Water), tanks outside surface, cranes, steel floors, galleries, stairways.	< 130 Deg	Primer	1	Two component polyamide cured epoxy anti corrosive primer pigmented with zinc phosphate.	75
		Mid coat	1	Two component high build epoxy intermediate pigmented with Lamellar Micaceous Iron oxide.	100
		Finish	1	2 pack Acrylic Aliphatic Polyurethane top coat - with Gloss retention of atleast 90% on QUVB exposure of minimum 1000 hrs.	75
					250
<b>Alternatively.</b>					
The Epoxy Primer to be replaced by Inorganic Zinc Silicate Primer.		Primer	1	Two component Moisture curing Inorganic Zinc Silicate meeting compositional and performance parameters as per SSPC Paint 20 Level 2.	75



<b>Surface/ Location</b>	<b>Temp</b>	<b>Coat</b>	<b>No of coats</b>	<b>Generic Description</b>	<b>Dft / coat</b>
Structural Steelwork, piping, indoor and outdoor	130 to 200 Deg	Primer	1	Two component Moisture curing Inorganic Zinc Silicate meeting compositional and performance parameters as per SSPC Paint 20 Level 2.	75
		Finish	3	Heat Resistant Silicon Acryl Paint Suitable upto 250 Deg C. Min VS 20-25%, Dual container Paste & medium, 20 microns/ coat dft, 10-12 sqm/ ltr.	20
Structural Steel work Piping, Uninsulated Carbon Steel Indoor and Outdoor	200 to 400	Primer	1	Two component Moisture curing Inorganic Zinc Silicate meeting compositional and performance parameters as per SSPC Paint 20 Level 2.	75
		Finish	3	Single pack Heat Resistant silicon Aluminium paint suitable upto 400 Deg C. Min VS 20-25%, Dft 20 mic/ coat, 10-12 sqm/ ltr coverage	60
Structural Steel work in the battery rooms, chlorination plant and water treatment plant, ( extremely aggressive atmosphere )	ambient	Primer	1	Two component Moisture curing Inorganic Zinc Silicate meeting compositional and performance parameters as per SSPC Paint 20 Level 2.	75
		Mid coat		Two component High Build high Solid Aliphatic Amine Cured Epoxy coating. - Min VS 85%	140
		Finish		Two component High Build high Solid Aliphatic Amine Cured Epoxy coating.	140
Uninsulated - equipment, tanks and piping etc.	Upto 80 Deg c	Primer	1	Two component polyamide cured epoxy anti corrosive primer pigmented with zinc phosphate.	75
		Mid coat	1	Two component high build epoxy intermediate pigmented with Lamellar Micaceous Iron oxide.	100
		Finish	1	2 pack Acrylic Aliphatic Polyurethane top coat - with Gloss retention of atleast 90% on QUVB exposure of minimum 1000 hrs.	75
					250



<b>Surface/ Location</b>	<b>Temp</b>	<b>Coat</b>	<b>No of coats</b>	<b>Generic Description</b>	<b>Dft / coat</b>
Steel Tanks inside Surface ( Total ) for Oil Storage	Normal	Primer	1	Two component high build amine cured epoxy Primer with zinc phosphate pigment.	75
		Finish	2	Two component Self priming High Build Polyamine adduct cured epoxy coating @ 125 microns/coat	250
					<b>325</b>
Steel Tanks inside Surface ( Total ) for DM water.	Normal	Primer	1	Two component high build polyamide cured zinc phosphate Primer	75
		Finish	2	Two component Self priming High Build Polyamine adduct cured epoxy coating - certified by CFTRI for Potable water usage. 125 microns / coat	250
					<b>325</b>
Surfaces permanently or predominantly in contact with water except buried water pipelines.	< 60 Degc	Finish	4	Two pack high build Polyamine cured Coal tar epoxy with epoxy resin blended with coal tar . Min VS 65% min, DFT 100-125 mic/coat., Coverage 6.0-6.5sqm/ltr	500
					<b>500</b>
Water Pipelines - Outside Surface, Indoor	< 60 Deg	Primer	1	Two component polyamide cured epoxy anti corrosive primer pigmented with zinc phosphate.	75
		Finish	1	Two component high build Rust encapsulating aluminium pigmented modified epoxy coating.	125
					<b>200</b>
Oil pipelines - Outside surface, above ground	< 100 Degc	Primer	1	Two component polyamide cured epoxy anti corrosive primer pigmented with zinc phosphate.	75
		Finish	2	Two component high build Rust encapsulating aluminium pigmented modified epoxy coating. ( 125 microns / coat)	250
					<b>325</b>



# **RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD**

**Cooling Water System Package  
for  
Kota Super Thermal Power Station  
Unit # 5 (1 x 210 MW)  
Kota, Rajasthan, India**

[ DOC. No. FCE-1117155-ME-DOC-SPC-3000-033 ]

**VOLUME II  
SECTION - 2  
DETAILED TECHNICAL SPECIFICATION –  
MECHANICAL**

**FICHTNER Consulting Engineers (India) Private Limited**  
Chennai-Bengaluru, India



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**VOLUME II**

**SECTION – 2**

**DETAILED TECHNICAL SPECIFICATION - MECHANICAL**

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## VOLUME – II

### SUB-SECTION 2.1

#### COOLING WATER SYSTEM

#### 1.0.0 INTRODUCTION

This section covers general description and design criteria for cooling water system for 1 x 210 MW Unit-5. At present the Once-Through Condenser cooling and Auxiliary Cooling water system is in operation for Unit-5, which needs to be converted to Circulating Cooling water system.

#### 2.0.0 CODES AND STANDARDS

The Cooling Tower system along with all its associated fittings would be designed and manufactured as per well-established international engineering standards and codes.

The following codes / standards and regulations shall be generally followed:

CTI	:	Cooling Tower Institute
CTI Code, ATC - 105	:	Acceptance test code for water cooling towers
HIS	:	Hydraulic institute standards
ATC -128	:	Code of measurement of sound from water cooling towers
CTI Std.-111	:	Gear speed reducer for application in industrial Water cooling towers
CTI STD 136	:	Polyvinyl chloride and chlorinated polyvinyl chloride materials used for Film fill, splash fill, Louvers and drift eliminators
AGMA	:	American Gear Manufacturer's Association
BS: 4485	:	Specification for Water Cooling Towers
OSHAS	:	Health and safety at work - Principles and practices
AWWA C200-86	:	Steel water pipe 6 inch and larger
AWWA C504	:	Rubber seated Butterfly valves
ANSI 16.10	:	Face to face and end to end dimensions of valves
ANSI B16.34	:	Valves - Flanged, Threaded and welding end
ANSI B16.5	:	Steel pipe flanges and flanged fittings
NFPA 251	:	Standard Methods of Tests of Fire Endurance of Building Construction and Materials



ASME Section II A	: Ferrous material specifications.
ASME Sec IX	: Welding and brazing qualification
IS: 1710	: Specification for pumps - Vertical turbine Mixed flow and Axial flow, for clear cold water
IS: 5120	: Technical requirements for Rotodynamic special purpose pumps
IS: 9137	: Code for Hydraulic performance acceptance test for Centrifugal, Mixed and Axial flow pumps - Class C
BS EN ISO 9906	: Rotodynamic pumps – Hydraulic performance acceptance tests. Grade-1,2&3

All material selection, equipment, system design, field application, installation, testing and commissioning will be ratified by Design Head to comply with, but not be limited to, all relevant and applicable Indian and International Standards.

### 3.0.0 SCOPE OF SUPPLY

The scope described here is by no means exhaustive and the items though not specifically mentioned but needed for safe, efficient, trouble-free and coordinated operation of the system shall be included in the scope. The system shall include, but not be limited to the following:

#### Cooling Tower

Induced draft cooling tower with all equipment & accessories necessary for safe, suitable and efficient operation.

Cooling tower shall be located in the space identified in storage shed area near Unit-6 Cooling tower. The existing plant ancillary buildings like special store shed shall be relocated to accommodate the cooling tower and the outlet channel. All the materials in the existing storage sheds shall be shifted to newly constructed Storage shed. After shifting the entire materials, the existing storage shed shall be demolished. Bidder to visit the site to identify the size of existing storage sheds for constructing the new storage shed. Constructing the new storage shed is in bidder's scope.

#### Cold Water Basin, CW Channel and Forebay

- RCC basin portioned into compartments with supporting structures and foundations
- Stop log gates at water outlets channels
- Overflow and sludge removal
- Removable screens at water outlet channels with provision for proper cleaning.
- Handling arrangement for the gates and screens
- Cooling water channel from Unit-5 Cooling tower to existing CW pump house forebay. Bidder shall visit the site to analysis the quantum of works involved.



- Coarse screen for each CW and ACW pump sump bay. Bidder shall visit the site to analysis the quantum of works involved.
- Stop log gate for isolation of CW and ACW pump sump bay. Bidder shall visit the site to analysis the quantum of works involved.
- Design shall be as per HIS.

### CW Pump house

CW and ACW pumps for Unit-5 shall be located in the space available in existing CW Pump house of Unit-6. Necessary civil and structural works in cooling water pump house for Unit-5 equipment is in bidder's scope. Bidder shall visit the site to analysis the quantum of works involved. Existing crane shall be utilized for handling the CW pumps and motors and other equipment in the CW pump house. Refer to Attachment for the details of existing CW pump house & crane. Accordingly, Maximum height & weight of equipment to be handled shall be considered.

### Submersible Pump

Two nos. of submersible pump for CT Basin shall be provided.

### Piping

All necessary interconnecting piping, pipe fittings, valves, air release valve, rubber expansion joints etc., as per requirement for system along with pipe supports.

All valves located at elevations shall be provided with operating platform with access ladder / chain sprocket arrangement.

## 4.0.0 SYSTEM DESCRIPTION

This specification gives the function, general description, design basis, operation and control of Cooling water system for the existing 1 x 210 MW Unit-5, as a replacement of existing Once-Through Condenser cooling and Auxiliary Cooling water system to meet the December'2015 MOEF Norms.

The Induced Draft Cooling Tower shall be of low-drift, Counter Flow type, sized for the cooling duty of the Condenser and Auxiliary cooling water of the existing Unit-5. The cooling tower shall be designed for the heat rejected from condenser, boiler and turbine auxiliary coolers at the ambient wet bulb temperature with specified recirculation allowance.

System interface points are given as the following:

Bidder shall strive for the use of cooling water lines (supply and return) and other facilities in the existing CW system. Bidder shall also indicate in their bid the items to be replaced / added, with sufficient reasoning and back-up calculations.



## 5.0.0 DESIGN AND CONSTRUCTION

### 5.1.0 Vertical Turbine Pumps

#### 5.1.1 Pump Type

Pumps shall be of vertical shaft, submerged suction, self-lubrication type (water) design, complete with bowl, column, discharge head and drive assembly, etc. If the water quality (as given in the Annex) is found to be unsuitable for self-lubrication, the Bidder shall provide an arrangement for filtering and use the same water as external water for lubrication. Water for lubrication shall be taken from the discharge pipe. It shall then be filtered and its pressure reduced to be used for lubrication of shaft bearings & cooling of stuffing box.

#### 5.1.2 Discharge Head

The pump discharge head arrangement shall be as indicated in the pump data specification sheet. The pump installations contain an expansion joint located immediately at the pump discharge, and hence are subjected to an additional thrust. The foundation bolts and base plate shall be capable of absorbing all the thrust which shall be based as a pressure equal to shut-off head.

#### 5.1.3 Column Pipes

Column Pipes shall be flanged and bolted and shall be complete with bolts, nuts & gaskets. The standard lengths of the column pipe pieces shall be dictated from considerations of ease of handling and as per IS: 1710 column pipes shall be designed for full internal vacuum.

#### 5.1.4 Bowl Assembly Suction Bell, Suction Strainer

The bowl assembly shall consist of rotating impellers which are housed in stationary bowls having guide vanes. The bowl shall also include the bearing housing of the bottom pump shaft to bearing. The bowls shall provide smooth water passages and shall be hydraulically designed to minimize radial thrust. Pumps shall be provided with an adequate dimensioned suction bell to stream line the intake of water into the bowl assembly.

#### 5.1.5 Impeller

The impeller shall be of closed type and shall be of non-overloading characteristic.

The pump shaft shall have provision for adjusting the impeller position in a vertical direction from an accessible location preferably from the housing of thrust bearing. The impeller adjustment mechanism must take into consideration the extension of the line shaft caused by hydraulic down thrust, the weight of shaft and impeller.

#### 5.1.6 Impeller shaft, line shaft & head shaft

Shaft size selected shall take into consideration the critical speed which should be considerably away from the operating speed and the runaway speed.



The impeller shaft shall be guided by bearings provided in each bowl or above and below the impeller shaft assembly. The butting faces of the shaft shall be machined square to the assembly and the shaft ends shall be chamfered on the edges.

The line shaft couplings shall preferably be of muff type.

Replaceable shaft sleeves shall be furnished, at applicable locations, particularly under stuffing boxes and other locations where it is subject to wear.

Pump shaft shall be connected to the motor shaft by a heavy flexible coupling.

#### 5.1.7 Bearings

Impeller shaft, line shaft and head shaft bearings:

Adequate number of properly designed bearings shall be furnished. The bearings located above the minimum water level shall be self-lubricating type, "Thordon make".

#### 5.1.8 Thrust Bearings

Thrust bearings (tilting pad, anti-friction type) shall be furnished separately for pump and motor for taking the entire pump thrust arising from all probable conditions of continuous operation and also at the shut off condition. It shall be centrally pivoted suitable for reverse rotation. The thrust bearing shall be designed on the basis of 40,000 working hours minimum, for the load corresponding to the shut off condition. The bearing shall also be sized for a 25% margin over the thrust occurring at shut off condition. It shall be conveniently located for access and easy maintenance. The bearings shall be lubricated by grease or oil. The design shall be such that the bearing lubricating oil/grease does not contaminate the liquid being pumped. Provisions shall also be made in the pump assembly such that dust or the pumped liquid may not enter the thrust bearing housing. Cooling of thrust bearing, if necessary, shall be done by liquid tapped from the discharge of the pump itself. The bearing enclosure shall be provided with temperature indication and alarm.

Lubrication system shall be designed in such a way that there will not be any damage to the bearing while coasting down to stop in the event of a total power failure.

#### 5.1.9 Pump-motor supports, Base plates, etc.

The pump and motor shall have a common support. The necessary supporting frame, base plates, mounting plates, foundation and anchor bolts, nuts, etc. as required shall be supplied under this specification. The base frame of the pump shall be leveled and grouted during the erection stage in order to avoid fresh leveling each time the pump is dismantled.

### 6.0.0 INSPECTION AND TESTING

#### 6.1.0 At Manufacturer's Works

1. The Bidder shall conduct all tests required to ensure that the equipment furnished shall conform to the requirements of the specification in compliance with the requirements of the applicable codes.



- 2 The particulars of the proposed tests and the procedures for the test shall be submitted to the Owner/Consultant for approval before conducting the tests.
- 3 All materials, castings and forging shall be of tested quality and certificates made available. If mill certificates are not available, the Bidder shall arrange for physical and chemical testing at his own.
- 4 The general performance testing of the pumps shall be carried out as per the requirement of HIS / IS: 9137 in presence of Owner's representative.
- 5 In addition to the above, all major components shall be subjected to various material, in-process, dimensional, hydrostatic and NDT tests. Necessary test certificates to this effect shall be furnished to the Owner.
- 6 All pressure parts shall be subjected to hydrostatic testing at a pressure of 1.5 times the design pressure for a period not less than 1 hour.
- 7 Inspection shall also include dimensional check of pump and motor duly mounted on the base plate, in accordance with the General assembly drawing. Unless otherwise specified, the following minimum tests have to be performed and shall be witnessed by the Owner or by their authorized representative or by both together.
  1. Hydrostatic test
  2. Performance test
  3. Reliability test
  4. Shop inspection test
  5. Dynamic balancing of rotating assembly.
  6. Strip off test after the performance test
  7. Other tests (if any) as described in the inquiry and order.
- 8 The pump shall be tested at minimum five points:
  1. Zero flow
  2. Minimum continuous stable flow
  3. Midway between minimum continuous flow and rated flow
  4. Rated flow
  5. Maximum continuous stable flow.
- 9 Minimum submergence test at maximum flow for vertical turbine pumps.
- 10 Pressure gauges / pressure transmitter shall be calibrated prior to start of test.
- 11 Job motor shall be used for testing and the rating of the motor shall not exceed 150% of power that may be consumed while running at duty point with water or power at VFO condition, whichever is higher.
- 12 Vibration measurement shall be conducted for two points; minimum continues stable flow and rated flow.



- 13 As far as possible weld repairs on all castings shall be avoided. However, if the same is unavoidable, radiography must be carried out after such repair and the test report shall be submitted to the inspecting authority for approval. But Cast Iron components are not allowed for repair.
- 14 Testing shall be conducted using the job motor.
- 15 All rotating components of the pumps shall be subjected to dynamic balancing test.
16. Performance test shall be conducted to power the entire range of operation of the pumps to check their satisfactory performance, free from vibration, balance and proper ceiling of the stuffing box.
17. Pumps shall be capable of operating from shut off point to a max. flow of 10% over the point of intersection between system resistance curve and pump H-Q curve for single pump operation.
- 18 All NDT shall be performed in accordance with ASME Sec. V.
- 19 Filler material that will deposit weld metals with a composition and structure as near as that of the material being welded shall be used. All welding electrodes shall be got approved by the Owner. The electrodes shall be dried before use.
- 20 Any procedure for the repair of the defects in the weldments and all other materials shall be submitted to the Owners/Consultant for his approval prior to any repairing being done.
- 21 Pipe butt welds shall be examined by liquid penetrate for the root and final passes. 10% of Butt joint welded by each welder shall be checked by RT. 10% of Fillet welds shall also be similarly examined by PT. The tests shall be carried out as per ASME sec V. Acceptance criteria shall be ANSI B31.1.
- 22 Reports of all shop tests shall be submitted to the Owner/Consultant prior to dispatch for review and approval.

## 7.0.0 INSPECTION AND TESTING AT SITE

### 7.1.0 Test at Site

After completion of erection and/or installations and before start-up, each equipment and all its appurtenances shall be thoroughly cleaned, and then inspected in the presence of Owner's representative. It is responsibility of the successful Bidder to check the correctness, soundness and completeness of installation and acceptability for start.

After pre-commissioning operation the vertical turbine pumps and its associated system will be put in trail run for a period of 15 days. During the trail run the vertical turbine pumps and its associated system will be subject to a "reliability run" for 72 hours uninterrupted.



During the trial run logbook will be maintained to note the various performance data, the malfunction, output deficiency and the short comings etc. The malfunctioning, short comings and deficiencies shall be rectified by the successful Bidder to the satisfaction of the Owner at no extra cost.

The objective of test run shall be to ascertain that the following are within the permissible limits and the operation is satisfactory.

1. Performance of the Vertical turbine pumps
2. Vibration, noise level
3. Bearing temperature
4. Performance of lube oil system
5. Motor winding temperature
6. Any other parameters considered necessary

Tests shall be conducted as per HIS / IS: 9137. Instruments required for measuring the above parameters shall be furnished by the manufacturer.

Any other pre-commissioning and field test not included in the above list and which are specified in the relevant standards, Electricity Rules, Code of practice shall be carried out at no extra cost to Owner. Also, if the Owner wishes any particular test is to be repeated or freshly carried out, the same shall be done by the successful Bidder without any extra cost.

The reports on the site tests shall be submitted to Owner by the Bidder.

## 8.0.0 COOLING TOWER SYSTEM EQUIPMENT

A brief description of sub-components of Cooling Tower is given below:

### 8.1.0 Tower Structure

The tower structure shall be of Reinforced Cement Concrete (RCC). The cooling tower structure shall be of adequate strength to withstand the wind load and the effect of earthquake on the structure. The size and design of all structural members, bracing and connections shall be such that the stresses will not exceed allowable safe values and end wall shall have a fire resistance rating of 20 minutes or more when tested in accordance with NFPA 251 shall be provided.

### 8.2.0 Water Distribution System

Hot Water from the CW system pipe line enters in the internal distribution system. The distribution system consists of distribution pipelines & fittings, valves etc., of suitable material for handling hot water coming from condenser. C-PVC/ RCC conduit is considered for Distribution system material. Also, Distribution header ends will have suitable end covers to permit opening for inspection and cleaning.



### 8.3.0 Fills

The fill will be of splash type and easily installable. The tower will be leveled so that water will uniformly be distributed and will not cause channeling. Fill shall be constructed and arranged to permit ease of handling and removal.

The spacing between the water distribution and the top of the fill shall be sufficient to allow for the addition of a standard layer of fill in the event of a performance shortfall or other need to enhance thermal performance.

The fill shall be of proven quality and the performance of the fill should have been established for the specified / higher duty conditions. The properties of fill material shall be as per CTI STD – 136. The fill material should be resistant to deterioration and shall be fire resistant.

Fills shall be supported at frequent intervals to minimize any sagging. Any dislodgment and damage due to induced vibration shall be eliminated.

### 8.3.1 Fill Supports

The fill support structure consists of beams, columns and bracing placed in a grid arrangement. The beams are at two levels for supporting hot water distribution system & fills. Fill supporting structure/grillage shall be SS316LN/GRP.

### 8.3.2 Drift Eliminators

PVC drift eliminator with minimum two passes shall be provided so as to limit the drift loss value. The air pressure drop across the eliminators shall be kept to a minimum by providing proper number of airflow direction changes across the eliminators. The water collected in the eliminators shall be returned to the tower basin and shall not mix with the discharge air system.

The eliminator frame shall be of rugged construction and shall be firmly secured to the structural frame to arrest vibration. The packs shall be bottom supported on beams and shall cover the entire plan area of the cell. Supporting grids, spacers and hangers for drift eliminators shall be provided as required.

### 8.3.3 Tower Basin

The cold water basin shall be provided underneath the tower for collection of cold water and shall be of reinforced concrete construction. The basin shall be designed for free board of at least 0.30m above maximum water level. Cold water from the basin shall flow by gravity to the CW pump intake, directly from the basin.

### 8.3.4 Drainage of Basin

Each half of the tower basin will be sloped from center towards periphery, which in turn will be sloped towards a collecting sump to be provided on the opposite side of outlet channel. From the collecting sump, the water will be drained using GRP/HDPE pipe which is embedded below the basin floor to the sludge sump outside the tower basin. Suitable sluice valves (rising type) will be provided in the sludge sump. Sludge



sump will be of adequate size and depth to enable lowering/placement of submersible pumps etc. for complete dewatering of Sludge Pit.

### 8.3.5 Fans and Fan Drives

Each fan assembly shall be provided with all necessary gear drives, drive shafts, non-lubricated flexible shaft couplings with coupling guards, drive mountings, fan stacks, drive motors and all other required equipment and materials. Fans shall be of the single speed multi-blade propeller type designed for low noise level and vibration free operation. All fan components including hubs, blades, shafts, bolts and mounting hardware shall be sized to transmit the maximum torque and power produced by the motor under all conditions including minimum and maximum voltage. Blades, shanks and hubs shall be suitably protected against electrolytic corrosion.

Coronal based type lightning arrester shall be mounted on each fan cylinder for protection.

Anti-vibration / vacuum low oil level switch for protection of each fan gear box shall be provided.

### 8.3.6 Inspection and Testing

#### i. Shop Inspection and Testing

The equipment covered under these specifications shall be subject to inspection and test by Owner / Engineer or its authorized representative during manufacture, erection and on completion. If the material/work is rejected then the contractor shall rectify or replace the defective material at no additional cost. The approval by Owner/Engineer of providing acceptance of such inspection or test will not, however prejudice the right of the Purchaser to reject the equipment if it does not comply to the specification, when erected or give complete satisfaction in service. The cost of all testing shall be borne by the Supplier.

The material used for various components/parts of the equipment shall be tested for mechanical and chemical properties including hardness as per the requirements of relevant codes/standards. These shall include hot water distribution nozzles, hot water piping, fill material, drift eliminators, GRP components, fan hub, fan blades, gear reducer, fan drive shaft, motors, valves, grids, and piping, pumps, chain pulley blocks, instrumentation, galvanised items, bolts, nuts etc. The material test certificates for the above shall be furnished. The minimum testing requirements are provided here below:

#### a) Gear Reducer

1. The materials for various components/parts of the gear reducer like gear blanks, gear sets, shaft, gear casing etc. shall be tested for mechanical and chemical properties including hardness. Heat treatment records shall be verified for the same and the procedure is subjected to Purchaser/ Engineer's approval.
2. Gear reducer, shafts and gear blanks shall be subjected to ultrasonic test. Shafts and gears after finish machining shall be subjected to DP/MPI test.



3. Each gear reducer shall be tested / checked for overall assembly, dimensions and backlash of gears during assembly. The relevant test certificates for gear reducer bearings shall be checked.
4. No load run test for all gear reducers shall be carried out for 8 hours in shop. The temperature rise shall be established and any abnormal noise, excessive vibration and oil leakage should not be there. Temp. rise after 8 hours no load run and tooth bearing pattern shall be checked. The power consumption at no load and at full load is checked. Full load torque shall also be checked.

**b) Fan**

1. Material test certificates for raw materials like resin, glass roving, fiberglass mats and foam compounds shall be submitted to Purchaser for each batch of raw material.
2. Gel time of the resin shall be checked as per relevant codes.
3. The fan blades shall be checked visually for surface defects, colour, contour and dimensions. The blades shall also be checked for proof strength and moment weight.
4. The GRP hub cover segments shall be checked visually for surface defects, colour and dimensions.
5. The mechanical and chemical properties including hardness for various components like fan hub centre, spoke tube, blade clamp, hardware etc. shall be checked and heat treatment records wherever applicable shall be verified.
6. Welds shall be 100% DP tested and 10% Radiography on butt welds of hubs shall be carried out.
7. Galvanising checks for appearance, uniformity of coating, coating thickness, adhesion to base metal, mass of zinc coating shall be carried out.
8. Fan assembly shall be checked in shop for overall assembly, dimensions, static balancing, blade track variations and blade tip clearances.

**c) Drive shaft**

1. Drive shaft components like shaft tube, flange, yoke etc. shall be checked for mechanical and chemical properties including hardness.
2. The relevant test certificates for rubber bushing including hardness mechanical and chemical test certificates for hardware used shall also be checked.
3. Welding shall be done by qualified welders and procedures and the same shall be approved by Engineer/Purchaser. The welding procedures and qualification shall be as per ASME Sec IX. Drive shaft tubes shall be checked for internal defects by U.T /eddy current test and all other tests at manufacturer's works as per relevant codes.



4. All fillet welds shall be subjected to 100% Dye Penetration test. No butt weld is allowed.
5. The complete drive shaft assembly and various components shall be checked dimensionally.
6. Assembled drive shaft shall be subject to Dynamic Balancing as per ISO-1940 Grade 6.3/ IS 11723.

**d) PVC Fill and Drift Eliminators**

The following tests shall be carried out on PVC fill and drift eliminator material as per procedure and acceptance norms stipulated in CTI bulletin STD-136

- Tensile strength, yield ,elastic modulus
- Impact Resistance
- Heat distortion
- Flexural modules -Flexural strength

Fills and Drift eliminators shall be tested for resistance to Ultra Violet Light (UV) by exposing the sample to laboratory light source as per ISO 4892 under simulated conditions of exposure i.e. at exposure temperature of 40-50°C and humidity level of 60-70 RH for minimum duration of 500 hrs. After exposure, there shall not be any change in colour and there shall not be deterioration in impact properties beyond the acceptable limit specified by CTI standard.

Fills and Drift Eliminators shall be tested for colour, density, Vicat Softening Temperature as per IS 6307/DIN 53460.and Dimensional conformity, thickness etc.

The fills and drift eliminator shall be also checked for dimensions including minimum thickness, length, corrugation height and load test after gluing. Fills shall be free from any surface defects like pin hole and wrinkles etc.

All the above tests shall be carried out in an Engineer approved third party laboratory on representative test samples duly identified by Purchaser and detailed procedure and acceptance norms to be discussed and finalized with an Engineer to approval of Purchaser.

**e) Fill support grids, supports and hangers**

1. The material test certificates for material shall be verified.
2. Visual and dimensional check shall be carried out.

**f) Galvanised Items**

Galvanising shall be checked for thickness of coating, weight of zinc coating, adhesion test, visual Examination and pierce test for uniformity of coating as per the requirement of relevant IS Codes.



### g) Butterfly Valve

All inspection and test as required by applicable codes and standards shall be performed for the butterfly valves during their manufacture and after completion for manufacture test at shop shall include but not be limited to the following.

- 1) Both tensile and transverse tests shall be carried out on fully representative cast test pieces for each heat of casting for body and disc. All materials used shall be of tested quality.
- 2) Chemical analysis shall be carried out on representative samples for body and disc for sulphur, phosphorus and nickel content.
- 3) Stubs and driving shafts shall be tested for internal defects by ultrasonic method.
- 4) Valve disc shall be checked for surface and sub-surface defects by magnetic particle examination.
- 5) Each valve castings shall be clean and free from injurious defects. Manufacturer's Standardization Society Standard SP-55 shall be employed as basis for visual inspection. No repair welding will be allowed in C.I. castings.
- 6) Valve body shall be subjected to hydraulic pressure test before painting at twice the design pressure. Duration of test shall be minimum 10 minutes. During the test there shall be no leakage through the body of its bonnet joints and no part shall be deformed.
- 7) Each valve shall be subjected to air seat leakage test with the disc in closed position and air pressure applied to lower face of the disc. During the test upper surface of the valve disc shall be visible and shall be covered with pool of water at zero gauge pressure. During the test, there shall be no indication of leakage past the valve disc (visible in the form of bubbles in the water pool on the top of the disc). Duration of test shall be minimum five minutes.
- 8) With one end of the valve open to atmosphere and the disc in the closed position, valve shall be subjected to hydraulic test pressure at twice the design pressure applied on the other end of the valve for a minimum period of 10 minutes. This test shall be conducted on both sides of the disc on all valves, During or after the test, no part of the valve or disc shall be permanently deformed or damaged.
- 9) One number actuator gear box (if any) of model and torque rating similar to the one being offered shall be subjected to a shop torque equal to or greater than twice the rated torque to check the torque is transmitted without damage to the faces of the gear teeth of the contact faces of screws or nut. Each actuator assembly shall be tested by manufacturer for specified torque.
- 10) The establish adequacy of the valve being offered to perform under specified design requirement one valve of design, size and rating similar to the one being offered shall be tested for life cycle test as per AWWA-C-504. The test shall be carried out with the type of actuator being supplied. The valve shall be checked for drop tightness under the design pressure differential upon completion of the



test in case, above test has already been carried out as per AWWA-C-504 on previous supplies in presence of the Purchaser / Engineer, the bidder may submit the test report of the same for Purchaser/ Engineer's review and approval.

- 11) After assembly each valve with respective actuator shall be shop operated over the full range of movement in both the directions with the valve body subjected to the full hydrostatic pressure conditions to demonstrate that the unit is in working order without any leakage through the joints and that torque switches, limit switches, torque clutches and position indicators are operating satisfactorily. During the test, hand wheel operation and valve opening and closing time shall also be checked. The test shall be conducted for three successive cycles with the valves shaft both in the vertical and horizontal planes.
  - 12) After complete assembly each valve with actuator shall be subjected to performance test by opening and closing the valve from fully closed to fully open position and the reverse under no flow for at least 25 cycles to check.
    - 1) Smooth uninterrupted movement of valve.
    - 2) Closing and opening time
    - 3) Operation of position indicator
  - 13) DPT shall be carried out on shafts and seat rings etc.
  - 14) Hydraulic test of pressure parts.
  - 15) Test pieces of rubber seal material shall be subjected to:
    - i) Aging test
    - ii) Hydraulic stability test as per ASTM D-471. Increase in Volume shall not be more than two percent.
  - 16) Ozone resistance test in accordance with ASTM-D-1149. Test shall be conducted on unstressed sample for 24 hours at 42°C without visible cracking in a surface of test sample after test.
- h) CW Pipes**
- a) Testing for pipes shall be as per IS 3589
  - b) Material test certificates for the pipes shall be checked.
  - c) All pipes and fittings shall be checked dimensionally for inside and outside diameters, thickness, length, squareness of pipe ends, workmanship etc.
  - d) The pipes shall be checked hydro-statically at twice the design pressure and shall be limited to 5 MPa as applicable.



## ii. Testing at Site

### Testing for Performance Guarantees

The Guarantee condition and the guaranteed parameters are as follows:

1. Cooling tower capacity: Design flow m<sup>3</sup>/h (-) 0.0%
2. Design ambient wet bulb temperature: 27.8°C
3. Cooling range: 10°C +0.0°C
4. Approach to wet bulb temperature: 5°C +1°C
5. Total power consumption
6. Guaranteed fan power / Cell

## 9.0.0 STOP-LOG GATES

### 9.1.0 Design and Operating Requirements

The stop-log units shall be designed in accordance with the provisions of IS:5620 (latest revision), in general and in accordance with the specification indicated below. The gates will be designed corresponding to the maximum water level as indicated elsewhere in the specification and wave effect with full hydrostatic pressure with the downstream completely empty.

Earthquake effect shall also be considered and allowed in the design in accordance with IS: 1893. An increase of 33 percent over the normal allowable stresses may be allowed for the structural members and 25 percent for bolts and nuts etc. for earthquake condition.

The permissible stresses in various components shall not exceed those specified under Appendix B of IS: 5620 for wet conditions, (accessible) column and those mentioned in these specifications.

The stop log assembly units shall normally be kept in maintenance area. These shall be required to be lowered and raised in the balance condition for attending to any maintenance or repair jobs of the water bays or the pump assemblies or the associated civil structure. All the stop-log assembly units shall be identical and interchangeable for each size except the bottom unit. Clear marking to be done for identifying bottom unit easily.

All the units shall have music note type side seals and bottom seal. Suitable arrangement shall be made at the top of the units for sealing the bottom seal of the unit to be placed above it. The skin plate and bottom seal clamp plate shall be suitably chamfered to prevent damage to bottom seal.

Suitable drain holes shall be provided on all the horizontal girder webs and horizontal stiffeners. Each stop-log unit shall be provided with three (3) guide shoes, one (1) near the top and one in middle and the other near the bottom at each end. Lifting points should be suitable for the automatic engaging and disengaging hooks provided on the lifting beam. Two (2) suitable guide rods equidistant from centre shall also be provided on the units at the webs of the top horizontal girders to match the guide bush (pipe) provided at the bottom of the lifting beam to facilitate lowering of lifting beam correctly to engage the stop-log.



The stop-log assembly units are required to be lifted/ lowered under balance conditions of load. The lifting operation shall be done only after the water level on both ends has equalized, suitable filling valve shall be provided in the stop-log units under each lifting lug so that before lifting beam, lifts the stop-log gate the dewatered portion is filled with water through the filling valves and balances the water pressure on both the sides.

The stop-log unit shall be required to be raised / lowered at a speed of 1 to 2 meters per minute.

In closed position, the stop-log assembly units shall be completely water tight with design water head.

The stop-log assembly and its accessories shall be so designed that the stresses in the different members due to dynamic loads during closing and opening operations and static loads in the closed position do not exceed the permissible stresses. The frames and anchors shall be designed as per Clause 6.0 of IS: 5620. The bearing plates shall be of mild steel and surface shall be machined. This shall slide on the machined structural steel plates provided on embedded parts.

#### 9.2.0 Arrangement of Stop-Logs

The stop-log gate assembly shall consist of a skin plate provided on downstream side and shall be supported on horizontal girder and vertical stiffeners. Each stop-log gate assembly unit shall have two (2) bearing pads, one (1) on each end supported by end vertical girders. The bearing pad shall transfer the thrust to concrete through the embedded angle. Suitable lifting attachments, guiding stems shall be provided.

The side seals shall be music note rubber seals with solid bulbs and bottom seal shall be wedge type.

Six (6) guide shoes, three (3) on each side of the unit, shall be provided to check side and lateral movement of the units and to restrain the same within specified limits.

The side and bottom seals should have perfect leak proof jointing, and the side seal bulbs should be in a true vertical plane.

The end vertical girders shall have suitable inclined cut at bottom, so that only skin plate and bottom seal rest on bottom seal seat.

#### 9.3.0 Design and Construction

The stop-log assembly units and guiding parts shall consist of the following component parts and shall involve the design of these components:

- a. Stop-log unit leaf consisting of skin plate horizontal and vertical girders/plates, end vertical girders; lifting points; guide steam; guide steam; guide shoes; bearing pads.
- b. Seals and accessories e.g. clamp plates, nuts and bolts etc.



### c. Guides

The gate leaf and its components shall be designed in accordance with clause 6.1 of IS: 5620 (Latest revision). The maximum deflection of stop-log unit shall be limited to 1/800 of span (centre to centre of bearing pads). The unit leaf shall also be checked for additional forces due to earthquake.

Structural steel construction suitable bearing pads shall be provided and the bearing surface shall be machined.

### 9.4.0 Seals

- a) Music note type solid bulb seals for side seals and wedge type bottom seals shall be furnished complying with clause 6.3 of IS:5620 (Latest revision), stainless steel AISI-316 bolts shall be used for clamping. The minimum seal comp. shall be 3 mm. Seals shall be so fixed as to ensure a positive water pressure between the seal and the gate and shall bear tightly on the seal seat to prevent leakage. The side seals should be in single piece of suitable length. However, use of moulded corner seal pieces shall be preferred. Friction forces shall be computed as per IS:5620.
- b) The bottom rubber seal shall be so provided as not to have any leakage past the gate when the gate is in deflected position due to full water pressure. The side and bottom seals on the gate should also be joined in such a manner that there is no leakage at the seal joints when the gate is in closed position.
- c) Track cum-side seal seat assembly shall consist of rolled structural steel/plate sections, which shall form the base over which stainless steel plate shall be welded / screwed to present a smooth surface to bearing pads and seals. The bearing stress in concrete should not exceed 40 kg/cm<sup>2</sup>.
- d) Guides shall consist of structural steel plate anchored to embedded steel by bolting/welding. The guide shall be tapered at top for easy entry of unit.

### 9.5.0 Erection Tolerances

The erection tolerances in various components of stop-log assemblies, lifting beam etc. shall be in accordance with IS:5620 and other relevant Indian Standard Codes and shall conform to the best engineering practice. It is the responsibility of the tenderer to ensure that his embedment are correctly aligned when civil work is carried out at site.

## 10.0.0 COARSE SCREENS

### 10.1.0 Design and Operating Requirements

- 10.1.1 The coarse screen shall be designed in accordance with the design criteria furnished under specified data sheet. The coarse screen shall be designed for 50% choking condition.



- 10.1.2 Earthquake effect shall also be considered and allowed in the design in accordance with IS:1893. The design shall be checked for additional force due to horizontal and vertical seismic co-efficient. An increase of 33 percent over the normal allowable stresses may be allowed for the structural members and 25 percent for bolts and nuts etc. for earthquake condition.
- 10.1.3 The screens shall always remain in position, under water, to stop objectionable large debris and floating matter.
- 10.1.4 Screen shall be lowered and lifted only under balanced conditions of head. The lifting operation shall be only for maintenance / painting requirements or for cleaning of screen in case of excessive choking.
- 10.1.5 The screens and its components shall be so designed that the stresses in different members due to dynamic loading during closing and opening operations and static loading in the closed position do not exceed the permissible stresses.

#### 10.2.0 Arrangement of Screen Parts

Each unit of screen shall consist of vertical and horizontal frame. The screen shall be of minimum 12 gauge Carbon steel to IS-2062, Gr.B wire bolted on rolled structural steel frame with flat all round. Pitch of opening shall as per specified data sheet.

As the screen units shall always remain submerged under water a lifting beam/frame with automatic engaging and disengaging hooks shall be used for lifting and lowering purposes. The lifting frame shall also be guided in the embedded track-cum-guide.

The screen shall mainly comprise of following components:

- i. Load bearing horizontal members
- ii. End frame members
- iii. Screen
- iv. Lifting points
- v. Pilot rods/pipe
- vi. Rest pads

#### 10.3.0 Design Criteria for Screens

The coarse screens shall be designed to cater the following requirements:

- i) The frame shall transmit the load uniformly to the concrete structure through bearing plate duly stiffened and welded to the horizontal members. The inclined ties shall also be provided to prevent any distortion of unit during handling. The bearing stress to concrete shall not be more than 40 kg/cm<sup>2</sup>.
- ii) Minimum 12 gauge wire mesh shall be fixed on units with bolts duly laced with flats all-round the frame. Screen shall be designed for 50% choking condition.
- iii) The depressed lifting lug shall be provided at the top of each unit for its lowering and raising in or out of guide with the help of the lifting beam/ frame. If necessary the points shall be suitably stiffened without obstructing the opening area.



- iv) The pilot pins and pilot rods shall be provided at suitable location to ensure correct centering of the coarse screen unit one above other in the guide. The pilot pin and pilot rod shall be so located and designed that minimum area is encroached in the opening. The location if required shall be suitably stiffened.
- v) Since the welds in case of screens are susceptible to corrosion, frame shall be painted as per paint specification after welding.

#### 10.4.0 Erection Tolerances

The tolerances and allowances for establishing the limit in sizes of mating parts shall be in accordance with the best engineering practice for the equipment of the type covered by these specifications and drawings, due consideration being given to the special nature of the parts and corresponding accuracy required to secure proper operations.



## ANNEX 2.1.1

### SPECIFIED DESIGN DATA

#### 1.0 Specified Design Data for Vertical Turbine Pumps

S No	Description	Unit	Data	Data
1.0.0	<b>General</b>			
1.1.0	Equipment name		CW pumps	ACW pumps
1.2.0	Duty		Continuous	Continuous
1.3.0	Location		Indoor	Indoor
1.4.0	Design Temperature	°C	50	50
1.5.0	No. of pumps to be installed	Nos.	2	2
1.6.0	No. of pumps working	Nos.	2	1
1.7.0	Parallel operation		Yes	Yes
1.8.0	Stand by	Nos	Existing standby pump shall be utilized	1
1.9.0	Type of Internal element		Non pull out	Non pull out
1.10.0	Suction Specific Speed	rpm	8500 / As per HIS	8500 / As per HIS
1.11.0	Seal		Self-water	Self-water
1.12.0	Acceptable noise level		Not greater than 85 dBA at a distance of 1.0 m from the equipment	Not greater than 85 dBA at a distance of 1.0 m from the equipment
2.0.0	<b>Parameter</b>			
2.1.0	Capacity	m <sup>3</sup> /hr	16000	3000
2.2.0	Head	mWC	Bidder to calculate based on the layout and the system requirement with 10% margin on the frictional loss. <b>(Minimum 25 mWC)</b>	Bidder to calculate based on the layout and the system requirement with 10% margin on the frictional loss. <b>(Minimum 55 mWC)</b>
2.3.0	Shutoff head	mWC	Bidder to provide	Bidder to provide
2.4.0	Range of operation	%	Pumps shall be capable of operating from 40% to 120% of rated flow	Pumps shall be capable of operating from 40% to 120% of rated flow



S No	Description	Unit	Data	Data
2.5.0	Motor rating	kW	Bidder to indicate considering the duty & ranges specified	Bidder to indicate considering the duty & ranges specified
2.6.0	Critical Speed	rpm	Speed shall be at least 125% or greater of the max. operating speed.	Speed shall be at least 125% or greater of the max. operating speed.
3.0.0	<b>Liquid Data</b>			
3.1.0	Liquid handled		Clarified river water	Clarified river water
3.2.0	Specific gravity		1.0	1.0
4.0.0	<b>Design and Construction Features</b>			
4.1.0	Pump type		Vertical type	Vertical type
4.2.0	Impeller type		Mixed flow	Mixed flow
4.3.0	Type of lubrication		Oil/Grease/Self lubrication	Oil/Grease/Self lubrication
4.4.0	Shaft enclosing tube		No	No
4.5.0	Column pipe connection		Flanged	Flanged
4.6.0	Discharge head arrangement		Above pump floor slab	Above pump floor slab
4.7.0	Type of thrust bearing		Tilting pad	Tilting pad
4.8.0	Thrust bearing make		SKF or Equivalent	SKF or Equivalent
4.9.0	Type of coupling (between pump & motor)		Flexible	Flexible
5.0.0	<b>Material of Construction</b>			
5.1.0	Suction bell		2% Ni Cl to IS 210, Gr. FG 260	2% Ni Cl to IS 210, Gr. FG 260
5.2.0	Bowl		2% Ni Cl to IS 210, Gr. FG 260	2% Ni Cl to IS 210, Gr. FG 260
5.3.0	Bowl liner		2% Ni Cl to IS 210, Gr. FG 260	2% Ni Cl to IS 210, Gr. FG 260
5.4.0	Impeller		SS 316	SS 316
5.5.0	Shaft		SS 410	SS 410
5.6.0	Shaft sleeve		SS 316	SS 316



S No	Description	Unit	Data	Data
5.7.0	Impeller & casing rings		A351/CF8M	A351/CF8M
5.8.0	Column pipe		IS 2062 Gr.B with epoxy painting	IS 2062 Gr.B with epoxy painting
5.9.0	Line shaft Bearing		Thordon	Thordon
5.10.0	Bolts		A 193 B 8M type 316	A 193 B 8M type 316
5.11.0	Nuts		A194B7M type316	A194B7M type316
5.12.0	Base plate /sole plate		Fabricated steel to IS:2062	Fabricated steel to IS:2062

- Note :**
1. Material of construction for other components not specified above shall be similarly selected inline with the above for the duty intended and subject to approval.
  2. Rotor assembly shall be both statically and dynamically balanced meeting requirement/recommendation of VDI – 2060

## 2.0 Specified Design Data for Cooling Tower

S No	Description	Unit	Data
1.0	Type		Induced Draught Cooling Tower
2.0	Number of tower		One (1)
3.0	Tower Capacity	m <sup>3</sup> /hr	35000
4.0	No. of cells		Multi cell
5.0	Cells operating		One standby
6.0	Type of tower		Counter flow
7.0	Design wet bulb temperature	°C	27.8
8.0	Cold Water Outlet temperature	°C	32
9.0	Hot Water Inlet Temperature	°C	42
10.0	Wind Velocity : (a) For performance (b) For design of structures	kmph m/sec.	10 50
11.0	Tower operation		Continuous
12.0	Liquid handled		Clarified river water
13.0	Drift eliminators		Yes Drift not to exceed 0.005% of circulating water flow



S No	Description	Unit	Data
14.0	Screens / stop logs at CW outlet channel		Required
15.0	Cycle of concentration (COC)		6
16.0	Construction		
16.1	Type of fill		Trickle splash anti-choking fills
17.0	<b>Material of Construction</b>		
17.1	Fill		PVC / PP
17.2	Fill Support		RCC / Stainless steel
17.3	Drift Eliminator		PVC
17.4	Water distribution nozzles		Polypropylene
17.5	Water distribution system		Carbon steel / PVC
17.6	Tower casing / Tower basin		RCC
17.7	Fan deck		RCC
17.8	Fan blades		Hollow FRP / GRP and fan shaft should be carbon fibre shaft.
17.9	Fan cylinders / Recovery stack		RCC
17.10	Screen		
	a) Frame		Mild steel, epoxy coated
	b) Mesh		Stainless steel, 10 mm sq. mesh
17.11	Basin curb level		0.3 m + FGL
17.12	Maximum water level in CT basin		FGL
17.13	Minimum water level in CT basin		The level will be fixed to store minimum 10 minutes of water in circulation between normal and minimum water level
17.14	Invert level of basin		0.3 m below minimum water level.
18.0	Performance Tests Method		As per BS 4485 / CTI Code
19.0	<b>Instrumentation</b>		
a)	Temperature gauge on each hot water inlet header		Yes
b)	Low oil level switch and sight glass to be provided for each gear box and its lubrication line		Yes



S No	Description	Unit	Data
c)	Vibration limit transmitters to stop fan on excessive vibrations		Yes
d)	Temperature Switch for alarm and trip for each speed Reduction gear unit		Yes
e)	Water level in cold water basin		Yes
<b>20.0</b>	<b>Submersible Pumps</b>		
a)	Type of pump		Submersible type
b)	Service		Intermittent
c)	Drive		Electric motor
d)	Numbers provided		2 Nos. (1W+1S)
e)	Application		Disposal of sludge / water from cooling tower cells at cold water basin
f)	Design flow		100 m <sup>3</sup> /h
g)	Head		Bidder to calculate based on the layout and the system requirement with 10% margin on the frictional loss
h)	Type of impeller		Open / Semi open
i)	Type of lubrication of bearings		Grease
j)	Accessories		Pump discharge piping with discharge valve, NRV, pipe supports, connecting counter flanges & hardware and local push button station

### 3.0 Specified Data Sheet – Stop-Log Gate and Screens

Sl. No.	Description	Unit	Data
<b>1.0</b>	<b>Data Sheet for Stop-log gate</b>		
a)	Type		Stop-log
b)	Design code		IS:5620
c)	Flow	m <sup>3</sup> /h	As per scope
d)	Fluid to be handled		Clarified river water
e)	Velocity of fluid (design)	m/s	0.5



Sl. No.	Description	Unit	Data
f)	Quantity		As per scope
g)	Sump details		
	<ul style="list-style-type: none"><li>- No. of compartments</li><li>- Wall to wall inside dimension of compartment</li><li>- Sump bottom level</li><li>- Pump floor level</li><li>- Minimum water level</li><li>- Maximum water level</li></ul>		As per pump house / CT forebay requirement
h)	Maximum height of single unit of gate assembly	m	1.5
i)	Material of construction for Stop log gate Lifting arrangement with chain Seal arrangement Guide frame Valve Assembly		Carbon Steel to IS 2062, Gr.B Chain - Galvanised Pin -SS304 Rubber SS304 CI
<b>2.0</b>	<b>Data Sheet for Coarse Screen</b>		
a)	Type		Static type
b)	Fluid to be handled		Clarified river water
c)	Flow of fluid through screen		As per scope
d)	Velocity of fluid through screen (design)	m/s	0.5
e)	Pressure drop across coarse screen	mmWC	50 max
f)	Screen mesh opening size	mm	12 x12
g)	Wire diameter	mm	2.5
h)	Sump details		
	<ul style="list-style-type: none"><li>- No. of compartments</li><li>- Wall to wall inside dimension of compartment</li><li>- Sump bottom level</li><li>- Pump floor level</li><li>- Minimum water level</li></ul>		As per existing pump house / CT forebay requirement



Sl. No.	Description	Unit	Data
	- Maximum water level		
i)	Maximum height of single unit of screen assembly	m	1.5
j)	Material of construction for Screen  Lifting arrangement with chain  Seal arrangement  Guides frame		SS304  Chain-Galvanized Pin -SS304 Rubber SS 304
k)	Embedment parts		Carbon Steel to IS 2062 / Cl, IS 210, Gr. FG260
<b>3.0</b>	<b>Embedment</b>		All embedded parts such as channels / plate supports, fittings, hardware required are to be provided by Bidder for all grooves / compartment envisaged for stop-log gate, coarse screen.

#### 4.0 Specified Data Sheet for Rubber Expansion Joints

Sl. No.	Description	Unit	Data
1.	Designation		CW/ACW system
2.	Expansion joint ID/Pipe ID	mm	As per scheme
3.	Fluid handled		Clarified river water
4.	Operating temperature	Deg.C	50
5.	Movements		Max Min.
	(i) Axial Compression	mm	25 15
	(ii) Axial elongation	mm	13 10
	(iii) Lateral movement	mm	13 10
6.	No. of arches		One (1)
7.	Controls unit to be provided		Yes
8.	Companion flanges		One piece or in segments. If segmentally welded, 100% radiography shall be carried out.  Companion flanges shall be supplied with bolts, nuts, washers and gaskets.



Sl. No.	Description	Unit	Data
9.	Material of construction		
	(i) Main body		High grade abrasion resistant natural or synthetic rubber compound
	(ii) Reinforcement		Steel rings
	(iii) Retaining ring		Galvanized steel retaining rings
	(iv) Outer cover		Exposed surface shall be given 3 mm thick coating of neoprene
	(v) Bolts & nuts		IS 1367 Gr. 4.6
	(vi) Stretcher bolt plates		IS 2062

## 5.0 Specified Data Sheet for Butterfly Valves

S. No.	Description	Unit	Data
1.	Service		As per scope
2.	Valve opening / closing time	Secs.	30 seconds (maximum)
3.	Frequency of valve operation		Intermittent
4.	Location		Indoor / Outdoor
5.	Type of operation		Electric/manual (refer enclosed flow diagram)
6.	Preferred face to face dimension	mm	As per AWWA C 504
7.	Material of construction		
	(i) Body		2 % Ni Cl to IS 210 Gr FG 260
	(ii) Disc		2 % Ni Cl to IS 210 Gr FG 260
	(iii) Shaft		SS - 410
	(iv) Body seat rings		SS
	(v) Disc seal rings		Nitrile rubber
	(vi) Seal retaining rings		SS
	(vii) Companion flange		Carbon Steel to IS 2062 Gr. B
	(viii) Internal hardware		SS 316
	(ix) External hardware		High tensile steel
8.	Butterfly valves shall be provided with end limit switches, torque limit switches and adjustable limit switches as per the logics and interlock controls for electric valves actuated.		



**VOLUME - II**  
**SUB-SECTION 2.2**  
**CT MAKE-UP WATER & CW TREATMENT SYSTEM**

#### **1.0.0 GENERAL**

- 1.1.0 This section is intended to specify the detailed requirements of the various mechanical equipment of the CT makeup water system and CW treatment system (Unit#5) as covered in this specification. Verification and modification of cooling tower treatment program for 2 x 195 MW (6<sup>th</sup> and 7<sup>th</sup> unit) considering increasing the COC to six (6).
- 1.2.0 The complete system with associated accessories shall be designed, manufactured, inspected, tested, including supervision of erection, testing and commissioning to well established engineering practices, safety codes and other relevant codes and standards.
- 1.3.0 Compliance with this specification shall not relieve the Bidder of the responsibility of furnishing material and workmanship to meet the specified conditions.

#### **2.0.0 CODES AND STANDARDS**

Design, manufacture, inspection and testing of the equipment covered by the specification shall, unless otherwise specified, conform to the latest edition of the codes and standards including all addenda mentioned below:

- |                        |   |
|------------------------|---|
| ASME Sec. VIII, Div. I | - Boiler and pressure vessel code   |
| IS: 9222(Part I): 1990 | - Recommendations for handling and dosing devices for chemicals for water treatment Part I Coagulants |
| ASME / ANSI B31.1      | - Codes for power piping  |
| IS: 2825               | - Codes for unfired pressure vessels  |
| ISA S 5.1              | - Instrumentation Symbols and Identification  |
| IS: 10500 - 2012       | - Drinking water  |
| IS: 3025               | - Methods of sampling and test (Physical and Chemical) for water and waste water                      |
| IS: 1239               | - Steel Tubes, Tubulars and Other Wrought Steel Fittings  |
| IS: 3589               | - Steel Pipes for Water and Sewage (168.3 to 2 540 mm Outside Diameter)                               |



IS: 4682, Part I	- Code of practice for lining of vessels and equipment for chemical processes Part 1 Rubber lining
MSS-SP-58	- Pipe hangers & supports - Material & Design
MSS-SP-69	- Pipe hangers & supports – Selection & Application
BS EN 13397:2002	- Industrial valves. Diaphragm valves made of metallic materials
BS EN ISO 15761:2002	- Steel gate, globe and check valves for sizes DN 100 and smaller, for the petroleum and natural gas industries
BS EN 13121-3:2016	- GRP tanks and vessels for use above ground. Design and workmanship
IS 803	- Code of Practice for Design Fabrication and Erection of Vertical Mild Steel Cylindrical Welded Oil Storage Tanks.
ANSI B 16.5	- Code of steel flanges and pipe fittings
ASTM	- Standards for all tests and materials
ASME Sec V	- Nondestructive examination
ASME Sec II	- Material specification.
API-2000	- Venting of storage tanks.
IS: 875	- Code of Practice For Design Loads (Other Than Earthquake) For Buildings And Structures
IS10553	- Requirements for Chlorination Equipment

### 3.0.0 CT MAKE UP WATER SYSTEM

#### 3.1.0 General

This section is intended to specify a detailed specification of CT make-up water system for Unit#5.

The make-up water for Unit#5 Cooling tower shall be taken from the existing clarified water storage tank of Clarifier-I.



The scope shall include dismantling the existing pumps & install new CT make-up pumps (3x450 m<sup>3</sup>/h) with associated valves, flow meter, foundations and electrical panels at existing clarifier-1 area. The existing pipe (500 NB) available between Clarifier-1 area and cooling water pump house shall be utilized as Unit#5 CT make-up line.

Bidder scope shall also include dismantling the existing river water intake pipe between Raw water intake pump house & Clarifier-1 inlet and install a new pipes with associated auxiliaries (valves, instruments etc.). Installing new pipe from Clarifier U#6 & 7 to CT make-up forebay of U#5) is in bidder's scope, Bidder shall visit the site to assess the quantum of works involved.

Compliance with this specification shall not relieve the Tenderer of the responsibility of furnishing material and workmanship to meet the specified conditions.

#### 4.0.0 COOLING WATER TREATMENT SYSTEM

##### 4.1.0 General

This section is intended to specify detailed specification of cooling water make-up system.

Cooling water treatment system for Unit-5 shall comprise of chemical treatment, chlorine di-oxide dosing system and side stream filtration and for unit # 6 and 7 shall comprise of the adequacy checking of existing CW treatment system and carryout necessary modification in the system and installation Side stream filtration system are in bidder's scope.

The cooling water treatment system shall be designed based on make-up water and COC. The inlet to the side stream filtration shall be taken from CW pump discharge header and the outlet of filter shall be fed to CW forebay. The filter backwash waste shall be collected in filter backwash waste collection pit and further pumped to Effluent collection tank in ETP RO Plant.

The dilution water required for chlorine di-oxide system shall be taken from CW pump discharge header. The generated chlorine di-oxide shall be fed to CW forebay with suitable diffusers. The N.Pit waste collected from the chlorine di-oxide area shall be fed to CW forebay with suitable treatment with neutralizing chemicals.

Verification and modification of existing cooling tower treatment program for Unit-6 & 7 considering the COC of 6 and the required modification / system shall be in Bidder's scope:

- The existing CW treatment of Unit-6 & 7 include solution preparation of namely PBTC, HEDP, Polyacrylate dispersent, Zinc Sulphate and BTA in each drum of 200 kg capacity and finally transferring them into common tank having two chemical dosing pumps of 196 liters per minute. This CW treatment is based on 5 COC.



- The proposed CW treatment of Unit-5 is based on 6 COC, and review / modification of existing CW treatment of unit 6 & 7 is to be carried out to make it work on 6 COC in future.
- This proposed CW treatment based on 6 COC of all the Units-5, 6 & 7 should also include installation of monitors along with associated pipes and accessories (Scaling monitor, corrosion monitor and chemical dosing pumps, Bio fouling monitor) at CW return line to have close watch on parameters and adjusting the dosing accordingly.

Compliance with this specification shall not relieve the Tenderer of the responsibility of furnishing material and workmanship to meet the specified conditions.

#### 4.2.0 Design and Construction

##### 4.2.1 Sizing Criteria

- The design chemical dosage shall be as per the below,

Scale Inhibitor dosage : 30 ppm on Blow down rate

Corrosion Inhibitor dosage : 30 ppm on Blow down rate

Bio Dispersant dosage : 5 ppm on Blow down rate

(Dosing rates indicated are tentative requirements however it shall be confirmed by successful bidder during detail engineering to meet the specifications & functional requirement)

- The basis for sulphuric acid dosage rate,

Desired Alkalinity in CW water : 120 ppm as CaCO<sub>3</sub>

- The design COC of cooling tower shall be 6.

- The sulphuric acid dosage shall be calculated based on the makeup water rate to the cooling tower.

- All dosing pumps are sized to achieve rated capacity at 70% stroke length.

- Bulk sulphuric acid tanks are sized considering 30 days storage requirement or min. one tanker capacity.

- Side stream filters shall be designed for 2% of recirculation rate of cooling tower.

- Chlorine di-oxide dosing system shall be sized considering 1 ppm dosing rate on recirculation rate of cooling tower for 6 hrs dosing period.

- The concentration of chlorine dosing at the outlet of reactor shall be limited to maximum 1000 ppm.

- The bulk tanks of Hydrochloric acid and Sodium chlorite shall be sized considering 30 days requirement or min. one tanker capacity.

##### 4.2.2 Design and Construction

###### a) Chemical dosing system

The chemical dosing system shall be skid mounted and each skid shall accommodate the tanks, dosing pumps and associated accessories.



The Tanks shall be of Vertical construction with a motorized Agitator of suitable material, drain and vent. Necessary instruments and mountings and pipe connections shall be provided as per the Flow diagram as minimum.

The MOC of dosing skid frame shall be MS with epoxy coated. The dosing tanks shall be provided with following features and accessories,

- Overflow, drain and vent nozzles
- Level Instruments
- Level Gauge
- Agitator as applicable
- Dissolving basket
- Inlet nozzle for water filling
- Inlet nozzle with Funnel arrangement for chemical filling
- Man hole as applicable
- Removable door at top

The piping MOC shall be CPVC, industrial grade, PN 10 rating, DIN standard or ASTM standard schedule 80 class. All the ball valves shall be of union type.

#### **b) Sulphuric Acid Storage Tank**

Bulk Sulphuric acid shall be horizontal consisting of mechanical level indicators, pressure indicators, level switch, drain valve and vent valve that shall be adequately guarded and connected with fume absorber arrangement as per the Flow diagram (minimum).

All flange dimensions and drilling details shall confirm to ANSI B16.5. Providing ribs and compensations as per code requirements shall suitably reinforce all branches / nozzles. The tank shall be of Shell Carbon Steel to IS 2062 Gr.B, Dish-IS 2002.

#### **c) Side stream filtration**

The Side Stream filters shall be of Horizontal cylindrical type. It shall have shells and dished ends constructed of IS: 2062 Gr.B and shall be designed as per IS: 2825. The filters shall be designed to contain filter media, distribution system and under drain system. All fasteners for internals shall be SS 316.

The Filter media shall be of Anthracite and Sand. The filter shall be provided with one sight glass located in such a way to enable clear view of bed rise during backwash. Sampling facilities shall be provided at all requisite points, upstream and downstream of the vessels.

The vessels shall be designed for a working pressure of at least the shut off pressure of upstream Pumping station plus 10% margin and shall have two (2) manholes as per DN 500 each.



The filters shall be supplied with frontal pipe work with valves and fittings. Instrument and accessories shall be supplied as per Flow diagram as minimum.

## 5.0.0 PRESSURE VESSELS AND TANKS

### 5.1.0 FRP vessel and tanks

Design of all FRP pressure vessels shall conform to ASME Section X standard.

Resins used for the tanks shall be a commercial- grade corrosion- resistant thermoset, fully tested and accepted for the service conditions. Resins shall not contain fillers, pigments, dyes or colorants. A thixotropic agent that does not interfere with either visual inspection of laminate quality or with corrosion resistance of laminate may be used

Clear UV absorbers shall be used in final resin coat.

Tanks shall be flat bottom and covered top with suitable reinforcing and bracing.

Filament wound reinforce polyester tanks shall be manufactured in accordance with the proposed product standard of the corrosion resistant structures subcommittee of the reinforced plastic / composite division of the society of the plastic industry.

Regardless of the theoretical design requirements, the minimum total laminate thickness of the filament wound tank shall not be less than 12 mm, without exception.

All surfacing shall be finished as so to obtain complete cure of the resin without air inhibition. For the surfaces which are not mould surfaces, this can be achieved by coating the exposed surface after cure with a paraffin containing resin or by covering the wet surface with a film prior to cure. Acetone sensitivity on any surface shall be considered evidence of unsatisfactory cure.

Unless otherwise specified, the inner surface shall consist of a resin-saturated layer of 0.25 to 0.50 mm thick Type C glass surfacing mat. No resin gel coat shall be used.

A minimum of 0.9 kg of chopped glass per sq. meter shall be used on the interior layer. The longitudinal strength of the cylindrical shell shall be at least 25% of the hoop strength. No paints or pigmented, colored, or dyed resins shall be used on the outside surface of the tank.

The knuckle radius of the top and bottom heads shall be a minimum of 38 mm. Top and bottom heads shall have a minimum thickness of 8 mm. Top head shall have a non- slip finish

The area on the back of all flanges around each bolt hole and the diameter of the standard washer shall be flat and parallel to the flange face. This area shall be spot faced if necessary to meet this requirement.



Unless otherwise specified, nozzles on top and bottom heads shall have a flanged face perpendicular to the vertical centerline of the tank and nozzles on sidewalls shall have flanges facing perpendicular to radial centerlines. Tolerance on angle of flange face with respect to tank centerline is  $\frac{1}{2}$  degree.

Man ways on sidewalls of the tanks shall be made the same as for the flanged nozzle of the same diameter. Boss flange type flush man ways shall not be used. Blind flanges and manhole covers shall be the same thickness as the flanges to which they are attached. Tolerance on flatness shall be the same as for the flanges.

There shall be no vertical joints (in axial direction) in the cylindrical shell. The entire thickness of the cylindrical shell shall be built up prior to removal of the shell from the mandrel.

Heads may be fabricated integrally with the shell or may be fabricated separately; heads fabricated separately shall be moulded with an integral skirt. The minimum skirt length shall be 100 mm. The entire head including knuckle radius and skirt shall be fabricated in one piece. The tanks shall have bolted and gasketed covers.

Tanks shall be designed so that no external bracing, ribs, hoops or support wires are required.

Saddle supports or legs as specified and bolts for anchoring tank to concrete pedestal shall be provided.

Tanks shall have internal support members. The bulk storage tanks shall be fabricated such that all edges having a minimum corner radius of 3.2 mm.

Tanks shall have Teflon gaskets. All linings and coatings for MS tanks shall extend through all tank openings and nozzles and around to flange faces.

Each tank shall have two support saddles.

All surfaces exposed to chemical shall be resin rich and the thickness of this inner layer shall be a minimum of 1 mm.

Each tank shall be equipped with a level gauge. The gauge shall include 50 mm x 20 mm PVC reducing flange, two 20 mm PVC isolation ball valves, 20 mm clear PVC sight tube and indicator board calibrated in 200 liter increments.

Each tank shall be equipped with an interior stilling well and interior overflow down pipe supported from the tank wall. Each fill down pipe shall be provided with a small diameter hole where it enters the tank to prevent back siphoning.

## 5.2.0 Atmospheric steel tanks and pressure vessels

Design of all pressure vessels shall conform to ASME Section VIII, Div. I or IS 2825. Design pressure shall be the maximum expected pressure to which the vessels may be subjected to plus 5% additional margin.



Design of all vertical cylindrical atmospheric storage tanks shall conform to IS: 803 / AWWA D100.

Design temperature of all pressure vessels and storage tanks shall be 10°C higher than the maximum temperature that any part of the vessel / tank likely to attain in course of operation.

In case, tank is subjected to vacuum, the same shall be taken care in designing the tank.

All vessels / tanks without inside rubber lining shall have a corrosion allowance of minimum

3 mm and mill allowance (minimum 0.3 mm) shall be considered for shell and dished ends.

All the atmospheric tanks shall have sufficient free board above the "Level High" / "Normal Level" as the case may be. The overflow level shall be kept least 100 mm above the "Level High" / "Normal Level" for' all the tanks. Further, a minimum 100 mm free board shall be provided above the top of overflow level to the top of the tank.

All atmospheric tanks shall be fabricated of steel conforming to IS: 2062 Gr.B.

The material of construction for various connections for all the lined or unlined vessels / tanks shall be same as that of interconnecting piping material. Suitable lining shall be provided wherever required. The nozzle flanges, manhole / manhole covers, reinforcement pads etc. shall be fabricated out of the same material as that of the vessel / tank. However, screwed fittings for instrumentation, sample connection, drain connection of size 25 NB and less shall be of stainless steel construction (ASME SA 479 Gr. 316).

The vessel ends for storage tanks of vertical type shall have flat bottom. However, the ends of horizontal storage tanks, and all the pressure vessels shall be dished design of Torispherical type design. The dished ends shall have a minimum straight flange length of 40 mm. Conical or flat (with or without reinforcement) ends shall not be accepted.

Interior surfaces of tanks shall be clear of stiffeners and other structural supports. Tanks shall be reinforced and stiffened externally as required.

All the joints (circumferential / longitudinal) shall be double butt welded with full penetration or single butt welded without backing strip. DP test shall be conducted after final welding.

Vessel / tank seams shall be so positioned that they do not pass through vessel connections as far as possible. In case openings are to be made in or adjacent to the welds, same shall be as per clause QW 14 of ASME- Section VIII Div. 1. Vessel



connections shall be flushed with inner surface and welded continuously on both sides of the shell. Sharp inside edges shall be rounded to a minimum 3 mm radius.

All welds or inner tank surface shall be free of voids, gaps craters, pits, high spots, sharp edges, abrupt ridges and valleys or undercut edges. High spots, irregularities and sharp edges shall be removed by grinding. Inside weld seams shall be ground and smooth applicable for corrosion resistant coating or lining.

All internal baffles, wear plates, pipes etc. shall be continuously welded on both sides at all contact points with full fillet welds which shall be free of voids, gaps, craters, high spots, sharp edges and undercutting. Sharp edges shall be ground to a 3 mm minimum radius.

All welding shall be as per ASME or equal and the qualification of procedure and welders should be as specified in ASME Section IX and welding electrodes shall be as per ASME Standards.

Welding sequence shall be adopted in such a way so as to minimize the distortion due to welding shrinkage. Welding shall not be carried out when the surface of the parts to be welded are wet from any cause and during periods of rain and high winds unless the welder and work are properly shielded.

The plates for cylindrical tanks shall be accurately formed in bending rolls to the diameters called for, and the completed shells are concentric and plates shall be cold-rolled by plate bending machine in a number of passes to true curvature and joined by welding. Pre pinching before rolling, if required shall be carried out.

All pressure vessels shall be fabricated complete and tested at manufacturer's works to ensure better workmanship.

All the pressure vessels and horizontal type storage tanks shall be provided with at least one manhole of 500 mm diameter minimum size at the top head, complete with cover plate, lifting handle, davit, cope, nuts, bolts, gaskets etc. to ensure leak tightness at the test pressure. The manholes for the vessels having diameter equal to or more than 1800 mm shall be provided with davit type covers. The manholes for the vessels having diameter less than 1800 mm shall be provided with hinged type covers. The vessels having dia between 1200 mm and 2000 mm shall be provided with one manhole and the vessels having dia above 2000 mm shall be provided with total two (2) nos. manholes. Pressure vessel shall be provided with minimum two (2) nos. sight windows. Side manholes shall be provided with hinged connection.

The vertical type storage tanks shall be provided with a manhole of 500 mm dia minimum on the top cover and one man hole of 500 mm in shell, if the diameter of the tank is 2000 mm or more.

All the vessels and tanks shall be normally provided with a hand hole of 150 mm gasketted located near the bottom of the straight side.



The required lining / coating for the inside surface of the manhole / hand hole, nozzle and cover plate of the manhole / hand hole shall be same as that of the respective vessel / tank.

All spare (unused) flanged connections should be supplied complete with matching counter flanges, nuts, bolts and gasket materials. The flange design (thickness and drilling) shall match with the interconnected piping flanges.

Bolts and nuts to be used externally to the vessels shall be of hexagonal head conforming to IS: 1367. Internal fasteners if any shall conform to IS: 1367 or shall be as per manufacturer standards to suit the duty application.

Gaskets shall be of full face type.

Sight glasses shall be provided for the tanks / vessels. The material for sight glass shall be of high quality transparent Acrylic material of sufficient thickness to withstand the test pressure. The sight glass shall be provided with suitable gaskets and bolts to ensure leak tightness at the test pressure.

Adequate supporting arrangements like straps, saddles, skirt boards, pipe leg supports, pillars etc. shall be provided to transfer all loads to civil foundation. All foundation bolts, inserts etc. shall also be provided.

All vessels of internal diameter of 1200 mm or greater shall be provided with minimum four (4) lifting lugs for safe and effective handling during erection. Smaller vessels shall be provided with at least two (2) lifting lugs.

Material of construction for these vessel supports, saddles, lugs shall be of tested quality conforming to IS: 2062 Gr.B. In case leg supports are fabricated from ERW pipe, the pipe shall conform to IS: 1239 (Heavy Grade).

Vessel internals wherever required shall be provided as detailed out elsewhere in the specification.

All the pressure vessels and tanks shall be provided with drain connections along with drain valves of suitable size. Further all the atmospheric storage tanks shall be provided with over flow connection designed for the filling rate of the respective tank.

All the pressure vessels and tanks shall be provided with the vent connections. The design shall be as to offer adequate area for venting. Venting area shall be such that over pressure / vacuum is not created in the tank during maximum filling / drain-off rate. The maximum draw off rate for the storage tanks design shall be considered.

Various instrumentation and the fittings required for the same shall be supplied as elaborated in data sheets.

Inside surfaces of all tanks / vessels shall be protected by anti-corrosive paints or rubber lining as required / specified. External surfaces of all tanks / vessels shall be protected by anti-corrosive painting.



### 6.0.0 CLEANING AND PAINTING

Any painting work (including surface preparation) on piping or equipment shall be commenced only after the system tests have been completed and clearance for taking up painting work is given by the consultant / Owner, who may, however at his discretion authorize in writing the taking up of surface preparation or painting work in any specific location, even prior to completion of system test.

Irrespective of the method of surface preparation, the first coat of primer must be applied by brush on dry surface. This shall be done immediately and in any case within 4 hours of cleaning of surface. However, at times of unfavorable weather condition, the consultant / Owner shall have the liberty to control the time period, at his sole discretion and / or to insist on recleaning, as may be required, before primer application is taken-up. In general, during unfavorable weather conditions, blasting and painting shall not be carried out.

All steel tank surfaces before painting shall be thoroughly abrasive blasted to remove rust, mill scale, grease, dirt and dust by the Bidder.

The surfaces shall be blast cleaned. On completion of cleaning operation, the blasted surface shall be clean and free from any scale or rust and must show a grey white metallic lusture. Blast cleaning shall not be done in bad weather without adequate protection or when there is dew on the metal which is to be cleaned or humidity exceeding 85 %. Surface profile shall be uniform to provide good key to the paint (i.e. 25 to 35 microns). The Bidder shall make his own arrangement for all equipment, labour, compressed air etc. required for cleaning.

Suitable ventilation shall be provided within the tanks to comply with the relevant standards and safety regulations. Any fittings likely to be damaged during blasting shall be adequately protected.

After abrasive blasting the surface shall be brushed or vacuum cleaned to remove all traces of dust, and the surface profile shall be those compatible to the standard.

### 7.0.0 PIPE MATERIALS

S. No	Service	Material
1.	Clarified Water, Cooling tower blow down water, Service Water, Noncorrosive waste water, SSF inlet and outlet pipelines and Service air	ERW Carbon Steel Pipe to IS-1239, Part-I heavy grade for pipe size up to 150 mm NB and IS-3589 for 200 mm NB and above.
2	Hypo chlorite solution and Chlorine di-oxide solution	Sch 80 CPVC as per IS: 4985
3	Hydrochloric acid (at all concentration)	Rubber lined ERW carbon steel pipe to IS-1239, Part-I, Heavy grade or Sch 80 CPVC



S. No	Service	Material
4	Sodium hydroxide (at all concentration)	Rubber lined ERW carbon steel pipe to IS-1239, Part-I, Heavy grade or Sch 80 CPVC
5	Neutralized effluent	Rubber lined ERW carbon steel pipe to IS-1239, Part-I, Heavy grade up to discharge isolation valve
6	Sulphuric Acid (98%)	ERW Carbon Steel pipe to IS: 1239 Part- I, Heavy grade.
7	Scale Inhibitor, Corrosion Inhibitor, Biocide (at all concentration)	SS 304 / CPVC(Schedule 40)
	<b>Notes</b>	
1	For small diameter pipe, where rubber lining is not possible, stainless steel pipe instead of rubber lined steel pipe shall be used.	
2	For Corrosive service, pipeline of size 32 mm NB and below where SS-304/316 cannot be used, CPVC of schedule 40 pipeline shall be provided.	
3	For small diameter pipe, where rubber lining is difficult, CPVC, Schedule 40 shall be used for hydrochloric acid and stainless steel pipe instead of rubber lined steel pipe shall be used for other services.	
4	Instrument piping shall be of stainless steel 316 for all pressures. Pipe connections after the isolating valves may be by means of compression type couplings to the approval of the Owner.	

#### 7.1.0 In general Pipes and Fittings shall conform the following:

##### 1. Pipes

- a. Service : Corrosive
- Material : IS : 1239 / IS:3589 ERW lined with natural rubber 3 mm thick & hardness  $65 \pm 5$  shore D as per IS : 4682 Part 1
- Ends : Flanged with lining upto face.
- b. Service : Non-corrosive
- Material : IS: 1239 / IS: 3589 ERW
- Ends : Plain end upto and including 40 NB, Bevelled end as per ANSI B 16.25 for sizes above 40 NB.

**2. Fittings**

a. Service : Corrosive  
Material : IS: 1239 / IS: 3589 ERW lined with natural rubber 3mm thick.

Ends : Flanged with lining upto face

Dimensions : ANSI B 16.9 / IS: 1239

b. Service : Non-Corrosive

Material : IS: 1239 / A 105 / A 234 WPB  
Ends : SW for sizes upto and including 40 NB and Bevelled ends as per ANSI B 16.25 for sizes above 40 NB.

**3. Flanges**

a. Service : Corrosive

Material : IS 2062 Gr.B Plate type with Natural rubber 3mm thk, covering the face of the flange.

Dimension : ANSI B 16.5

Type : SOFF

b. Service : Non-Corrosive

Material : IS 2062 Gr.B Plate type

Dimension : ANSI B 16.5

Type : SORF or SOFF

**4. Bolting (Bolts & Nuts)**

a. Material : IS 1367

**7.2.0 Bends and Fittings**

Pipe fittings such as bends and tees, shall be to standard dimensions.

Forged (weld elbows - or similar) : 1.5 pipe diameter radius  
No limitation on pressure or temperature

Mitre bends : only in unlined pipes of 250 NB and above



- Design pressures up to and including 11.0 kg/cm<sup>2</sup> (g) and design temperatures up to 204°C or above 450 mm diameter

Pressed steel - Design pressures up to 21 bar (g) and design temperature up to 260°C

Suppression pipe work, a so-called protective double block - and - bleed valving arrangement, consisting of 2 (two) isolating valves and 1 (one) drainage valve shall be installed wherever necessary to prevent contamination of the various media e.g. chemicals pipelines on the exchangers, etc.

## 8.0.0 VALVES AND SPECIALTIES

### 8.1.0 Codes & Standards

The design, material, construction, manufacture, inspection, testing and performance of valves and specialties shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment shall be installed. The equipment shall also conform to the latest applicable standards. Nothing in this specification shall be construed to relieve the Supplier of this responsibility.

### 8.2.0 Design and Construction

The Bidder shall select valves and accessories which are suitable for the operating conditions of the systems. The selected components shall meet the requirements of trouble free and safe operation under maximum load, part load and transient conditions.

Valves and accessories which are of a similar make, size and type shall be interchangeable with one another.

All valve bodies shall be of the same nominal size as the adjacent piping, unless otherwise required.

All valves shall be arranged so that the hand wheel moves in a clockwise direction to close the valve. The face of each hand wheel shall be clearly marked with the words 'OPEN' and 'CLOSE' and shall be provided with an arrow to indicate the direction for opening.

All valve bodies with the exception of rubber lined / coated valves shall be of steel or cast steel. Stainless material shall be used for the spindles, cones and seats of all valves.

In addition, all manually operated valves shall have external rising spindles.

In the case of rubber lined / coated valves with diaphragms, care shall be taken to ensure that the diaphragms are adequate for the operational Waste pressure involved.



All valves and specialties shall be so located that they are readily accessible for both operation and maintenance. Wherever necessary, the valve spindles shall be extended and an approved type of pedestal hand-wheel shall be provided at the next higher floor level. The pedestals shall be fitted with chromium-plated scales and valve movement indicators for the main and bypass valves, where required. Adequate greasing facilities shall be provided for all valve pedestals and extended operating spindle attachment.

Valves that are to be kept locked in full 'OPEN' / 'CLOSE' position shall be provided with a non-detachable locking arrangement comprising a chain and padlock.

For handling heavy valves (or part of valves), eyebolts shall be provided.

All remote controlled valves shall be provided with limit switches in all cases where their open or closed position must be signaled to the control room and / or where these conditions must be fed to the interlock circuits for ensuring safe operation of the plant. All auto valves shall be provided with a manual override hand wheel.

The solenoid control valves for pneumatic-operated valves shall be grouped together and fitted near the exchangers (e.g. in distribution boxes). These distribution boxes shall also contain the terminal strips for the solenoid valves and the terminal boards for the valve position signaling circuits. The solenoid valves must be individually fused and also permit manual override directly at the solenoid valve. All pump valves fitted on the discharge side shall be suitable for throttling.

## 9.0.0 PUMPS

### 9.1.0 General

All pumps shall be designed, manufactured in accordance with the latest editions of codes and standards. They shall be suitable for continuous operation unless otherwise specified.

Lifting lugs, eyes and other special tackles shall be provided to permit easy handling of the pump and its associated equipment.

Pumps of manufacturer's standard production type which are nearest to the exact pump characteristics required shall be used wherever practical. Only proven makes and models supplied by pump manufacture having extensive experience are accepted.

The pumps for handling degassed water shall be of SS 316. Associated bolts, nuts and washers are also to be of stainless steel. Pumps handling raw water, clarified water, service water / potable water shall be of Cast Iron.

Neutralized Effluent Disposal pumps shall be corrosion-proof plastic against all possibly expected combinations of hydrochloric acid, caustic soda and the salts of both.

Dosing pumps for the supply of Chemical solutions shall be of the Plunger / Diaphragm type, with adjustable stroke and constructed generally in PP. Valves and associated equipment shall have the same quality of material.



All pumps shall be fitted with dry-run protection, check and minimum-flow valves on the discharge and suction sides.

#### 9.2.0 Pump Types

Centrifugal pumps shall be used wherever possible.

Positive displacement pumps of rotary type shall be acceptable when handling viscous liquids and reciprocating pumps shall be accepted for chemical dosing and metering purposes.

#### 9.3.0 Design and Construction

All pumps shall be designed to withstand 1.5 times the pump shut-off pressure, under maximum suction pressure conditions.

Pumps shall be designed for 110% of nominal flow and shall be capable of at least 10% head increase at rated condition by installing new impeller. Best efficiency point for rated impeller diameter shall be on the right side of the rated capacity.

All pumps shafts shall be of ample size to transmit the full output from their drivers. The drivers shall be rated for the maximum power requirement of the pumps. For motor driven pumps, the rated flow and head shall be achieved with a variation of  $\pm 10\%$  in voltage and  $\pm 5\%$  in frequency of the power supply.

Renewable wear rings shall be fitted to the casing and impeller.

All pumps shall be constructed of materials specifically designed for the conditions and nature of the pumped fluid and to resist cavitation, erosion and corrosion.

Teflon Bellows (GFT / Ceramic) shall be provided for pumps. The seal provided shall be of approved make and it shall have interchangeability with other makes of equivalent standard. The arrangement of the pump glands and mechanical seals shall permit repacking or fitting or replacement seals, with minimum of disturbance.

Centrifugal pumps shall preferably be of the horizontal shaft type unless specified otherwise. Each horizontal pump shall be mounted with its driving motor on a combined bed plate of rigid construction. The bed plate shall be complete with drip tray fitted with a drain plug. Bed plate material of construction shall be mild steel. Vertical shaft centrifugal pumps may also be employed.

Centrifugal pumps shall be of rigid shaft design and shall be designed such that the first critical speed of the pump, when coupled to its driver, is at least 10% higher than the maximum operating speed. The shaft diameter and distance between two consecutive bearings must include a sufficient margin to satisfy this condition. The entire rotor assembly shall be statically balanced and dynamic balancing of the impeller is required if either of the following applies:

- i. Pump speed exceeds 1500 rpm, and impeller diameter exceeds 150 mm.



- ii. Pump speed exceed 1500 rpm for pumps having 2 or more stages.

Pumps shall operate smoothly throughout the speed range in reaching their operating speed.

Where necessary the pumps are to be fitted with devices to ensure a minimum through flow.

#### 9.4.0 Pump Characteristics

Where multiple pumps are installed for the same service, they shall be suitable for parallel operation.

The pump head characteristics shall be such that the head shall continuously increase with decreasing flow quantity with a maximum head reached at zero flow. Generally a head increase of 15% above the duty point to no flow shall be acceptable.

Full pump characteristic curves giving differential head vs. capacity, efficiency vs. capacity, power absorbed vs. capacity, net positive suction head required vs. capacity shall be provided for all pumps.

#### 9.5.0 Fittings

All pumps shall be installed with isolating valves, a discharge non-return valve and discharge pressure gauges unless otherwise stated. All positive displacement pumps shall be fitted with a discharge relief valve. Pulsation dampers shall be provided on the discharge piping.

All couplings and any intermediate shafting shall be supplied with removable type coupling guards. Couplings must have a rated capacity of at least 110% of maximum power transmission requirement.

Air release valves shall be fitted to all pumps at suitable points on the pump casing unless the pump is self-venting due to the arrangement of the suction and discharge nozzles. Drainage facilities shall be provided on the pump casing or adjacent piping to facilitate the dismantling of pumps.

Water discharged from air cocks, drains and glands or seals shall be piped to the nearest convenient drain trench or pump sump.

#### 9.6.0 Bearings

All bearings shall be of ample surface area and for large pumps shall be of the automatic oil lubricated sleeve type. On pumps utilizing ball or roller bearings the inner race shall be fitted directly on to the shaft and positively located by a Sheller on the shaft.

Bearings on vertical shaft pumps shall be spaced to prevent vibration under any mode of operation.



Bearing housing on horizontal shaft pumps shall be designed to enable the bearings to be replaced without removing the pump or motor from its mounting. Outboard bearing shall be double roll ball bearing and inboard shall be roller bearing.

Bearing housing on horizontal shaft pumps shall be effectively protected against the ingress of water, pumped fluid and dust with suitable non-ferrous deflectors.

All bearing oil wells shall be fitted with visual oil level indicators. Non-pressure oil lubricated bearings shall be equipped with constant level oilers. Means of draining bearing housings shall be provided.

#### 9.7.0 Blowers

Roots type blowers shall be equipped with air filter; safety valve; solenoid valve to open the drain when the blower is out of operation; and silencers on the intake and delivery sides. The output and discharge head of the air blowers shall be determined by the bidder. Minimum discharge head shall be 4 mWC. Anti-vibration mountings and cork insulation as well as flexible pipe joints on the discharge sides and surge vessels etc. shall be provided as required.



**ANNEX 2.2.1**  
**SPECIFIED DATA SHEET**

S. No.	Description	Data
I	<b>COOLING TOWER MAKE UP WATER SYSTEM</b>	
A.	<b>Cooling Tower Make Up Pumps</b>	
1)	Type	Horizontal centrifugal
2)	Capacity (Each)	450 m <sup>3</sup> /h
2)	Location	Indoor
3)	MOC	Casing: 2% Ni Cast Iron IS 210 FG 260, Impeller/wearing rings: ASTM A351 CF8M / SS 316, Shaft, coupling and sleeves: AISI 410/SS 316 or Equivalent
4)	Quantity	3 x 50 %
5)	Head	Bidder to calculate based on the layout with 10% margin on the frictional loss.  <b>Note:</b> The existing pipe (500 NB) available between Clarifier-1 area and cooling water pump house shall be utilized as Unit#5 CT make-up line.
II	<b>CW TREATMENT SYSTEM</b>	
A.	<b>Scale Inhibitor Tank</b>	
1)	Type	Vertical
2)	MOC	MSRL / FRP
3)	Quantity	Two (2) nos.
4)	Capacity	Suitable to meet one day dosing requirement
B.	<b>Scale Inhibitor Dosing Pump</b>	
1)	Type	Positive displacement, diaphragm type
2)	MOC	PP
3)	Quantity	2 x 100%
4)	Capacity for each pump	As per system requirement



S. No.	Description	Data
C.	<b>Corrosion Inhibitor Tank</b>	
1)	Type	Vertical
2)	MOC	MSRL / FRP
3)	Quantity	Two (2) nos.
4)	Capacity	Suitable to meet one day dosing requirement
D.	<b>Corrosion Inhibitor Dosing Pump</b>	
1)	Type	Positive displacement, diaphragm type
2)	MOC	PP
3)	Quantity	2 x 100%
4)	Capacity for each pump	As per system requirement
E.	<b>Bio-Dispersant Dosing Tank</b>	
1)	Type	Vertical
2)	MOC	MSRL / FRP
3)	Quantity	Two (2) nos.
4)	Capacity	Suitable to meet one day dosing requirement
F.	<b>Bio-Dispersant Dosing Pump</b>	
1)	Type	Positive displacement, diaphragm type
2)	MOC	PP
3)	Quantity	2 x 100%
4)	Capacity for each pump	As per system requirement
G.	<b>Piping</b> [For Scale Inhibitor/ Corrosion Inhibitor/ Dispersant]	SS 304/CPVC
H.	<b>Valves</b> [For Scale Inhibitor/ Corrosion Inhibitor/ Dispersant]	SS 304/CPVC
I.	<b>Bulk Sulphuric Acid Storage Tank</b>	
1)	Type	Horizontal



S. No.	Description	Data
2)	MOC	MS
3)	Quantity	One no.
4)	Capacity	Adequate to hold 30 days acid requirement or min.one tanker capacity
J.	<b>Sulphuric Acid Unloading Pumps</b>	
1)	Type	Horizontal, Centrifugal
2)	MOC	Casing and Impeller - Alloy 20 Shaft - EN 8 to BS 970
3)	Quantity	2 x 100%
4)	Capacity	10 m <sup>3</sup> /hr
5)	Head	20 mlc
K.	<b>Piping [Acid Dosing]</b>	IS 1239 Heavy Duty ERW
L.	<b>Valves [Acid Dosing]</b>	Alloy 20
M.	<b>Sulphuric Acid Dosing Pumps</b>	
1)	Type	Positive displacement, diaphragm type
2)	MOC	Alloy 20
3)	Quantity	2 x 100%
4)	Capacity for each pump	As per system requirement
N.	<b>Sulphuric acid dosing Tank</b>	
1)	Type	Vertical
2)	MOC	MSRL / FRP
3)	Quantity	One(1) no.
4)	Capacity	Suitable to meet one day dosing requirement
O.	<b>Side Stream Filtration</b>	
1)	Type of filters	Dual media filter, Horizontal Type
2)	Number of filters	Four (4) nos. (3W+1S) (Indicated is only for unit 5, typically to be considered for each unit i.e. Unit 6 & 7 )
4)	Capacity per filter	As per system design basis, however min. Gross capacity shall be 250 cu.m/hr



S. No.	Description	Data
5)	Design Pressure	10 Kg/cm <sup>2</sup> minimum
6)	Type	Horizontal
7)	Design surface flow rate	14 m <sup>3</sup> /m <sup>2</sup> /hr (max)
8)	Minimum bed depth	1.0 m
9)	MOC of shell & dished ends	IS 2062 Gr B with epoxy coating inside
10)	Inlet TSS & Turbidity	60 ppm & 60 NTU
11)	Guaranteed TSS & Turbidity	2 ppm (max) & 2 NTU
12)	Design code for pressure vessels:	IS 2825
P.	<b>AIR SCOURING BLOWERS</b>	
1)	Type	Rotary, twin lobe oil-free
2)	Quantity	2 x 100% ( Indicated is only for unit 5, typically to be considered for each unit i.e. Unit 6 & 7 )
3)	Capacity and Head	As per the system Requirement
4)	MOC	CI - IS 210 Gr. FG 260
5)	Suction filters and silencer	Provided
Q.	<b>SSF BACK WASH WATER COLLECTION SUMP</b>	
1)	Capacity	Suitable to Collect at least one Filter's Backwash water.
2)	MOC	RCC (underground) with epoxy coating inside
3)	Quantity	One (1) no. ( Indicated is only for unit 5, typically to be considered for each unit i.e. Unit 6 & 7 )
R.	<b>SSF BACK WASH WASTE TRANSFER PUMP</b>	
1)	Capacity	Suitable to empty the Backwash collection Sump in one hour.
2)	Head	Suitable head to pump the Back wash waste to Effluent collection tank to ETP RO plant.
3)	MOC	2% Ni Cast iron casing/ SS 304 impeller.
4)	Quantity / Type	Two (2) x100% / Vertical Non Clog ( Indicated is only for unit 5, typically to be considered for each unit i.e. Unit 6 & 7 )
S.	<b>CHLORINE DI-OXIDE SYSTEM</b>	
1)	<b>Bulk Sodium Chlorite storage tank</b>	



S. No.	Description	Data
	Type	Vertical cylindrical
	MOC	FRP/UV Stabilized
	Quantity	One(1) no.
	Capacity	Adequate to hold 30 days acid requirement or min.one tanker capacity
2)	<b>Sodium Chlorite Unloading Pumps</b>	
	Type	Horizontal, Centrifugal
	MOC	PP
	Quantity	2 x 100%
	Capacity	10 m <sup>3</sup> /hr
	Head	20 Ic
3)	<b>Bulk Hydrochloric acid storage tank</b>	
	Type	Vertical cylindrical
	MOC	FRP/UV Stabilized
	Quantity	One(1) no.
	Capacity	Adequate to hold 30 days acid requirement or min.one tanker capacity
4)	<b>Hydrochloric acid Unloading Pumps</b>	
	Type	Horizontal, Centrifugal
	MOC	PP
	Quantity	2 x 100%
	Capacity	10 m <sup>3</sup> /hr
	Head	5 mlc
5)	<b>Sodium Hypochlorite dosing pumps</b>	
	Type	Positive displacement, diaphragm type
	MOC	PP
	Quantity	2 x 100%
	Capacity	As per system requirement



S. No.	Description	Data
	Head	As per system requirement
6)	<b>Hydrochloric acid dosing pumps</b>	
	Type	Positive displacement, diaphragm type
	MOC	PP
	Quantity	2 x 100%
	Capacity	As per system requirement
	Head	As per system requirement
7)	<b>Dilution water/Booster water pumps</b>	
	Type	Horizontal centrifugal
	MOC	2% Ni Cast iron casing/ SS 304 impeller.
	Quantity	2 x 100%
	Capacity	As per system requirement
	Head	As per system requirement
8)	<b>Onsite ClO<sub>2</sub> Generator</b>	
	Type	Under water generator/Encapsulated type
	MOC	FRP/PVDF
	Quantity	2 x 100%
	Capacity(Each)	Suitable to dose 1 ppm based on recirculation rate or 33 kg/hr whichever is higher
9)	<b>Neutralization Pit</b>	
	Qty	1 no. each for hydro chloric acid dyke area and sodium chlorite area
	MOC	RCC with acid/alkali/chemical resistant tiles
	Capacity (Each)	5 cu.m
	Type	Below ground
10)	<b>Neutralization waste transfer pumps</b>	
	Qty	2 x 100% for each pit
	MOC	PP



S. No.	Description	Data
	Capacity(Each)	5 cu.m/hr
	Type	Submergible
11)	<b>Service Water Storage Tank</b>	
	Capacity	5 m3
	Location	Above chemical house
	MOC	FRP/GRP/HDPE
	Quantity	One (1) No.
	Level gauge	Required
	Level switch	Required.
	Over flow and drain	Required.

## Note:

1. Bidder shall verify the existing dosing facilities of Unit -6 and Unit- 7 with respect to COC of 6 and the required modification in the existing facilities or if any system required like dosing pumps, instruments, tanks etc. are in bidder's scope. The MOC of the system shall be in line with the data sheet specified above.
2. Bidder shall install the required Auto acid dosing facilities like pH transmitter, auto stroke controller for Unit-6 and Unit-7.



## VOLUME – II

### SUB-SECTION 2.3

#### HANDLING FACILITIES

##### 1.0.0 GENERAL

This part of the specification covers the requirements for Cranes and Hoists.

This section of the specification shall be read in conjunction with other sections of the specification as appropriate and the equipment offered shall meet the requirements as spelt out therein.

The capacity of existing Crane in Unit#6 Cooling Water Pump house is as follows:

- 25/5 Ton EOT Cranes

The above said crane shall be utilized for handling the CW/ACW pumps of Unit#5.

##### 2.0.0 CODES AND STANDARDS

The equipment to be provided shall specifically conform to the latest editions of the following codes, standards, specifications and regulations. Also the system design shall conform to the requirements of applicable codes as specified in the General Technical Specification

IS 807	: Code of practice for design, manufacture, erection, testing (structural portion) of cranes and hoists
IS 3938	: Hoist
IS 3177	: Crane
IS 3832	: Manual Hoist
IS 2266	: Steel Wire Ropes for General Engineering Purposes
IS 15560	: Point Hooks with Shank up to 160 Tonne - Specification
IS 13834 (Part-5) Cranes	: Overhead travelling and portal bridge cranes - Classification
IS 325	: Three Phase Induction Motors



### 3.0.0 DESIGN REQUIREMENTS

Crane / hoist shall be provided in the areas where the handling of the equipment / components shall have requirement in both transverse and longitudinal direction. Otherwise, hoist shall be considered. Curved monorail with hoist shall also be considered, if the equipment / components are not located in line with the monorail. Height of the building shall be finalized considering the required lift over other equipment, piping etc.

Each crane or hoist shall be complete with its accessories, supporting structure, monorail beams, rails, girders, power supply, safety devices and controls and shall conform to local statutory rules and regulation.

- a) The crane and hoist shall be rigid in construction and all movements shall be smooth and non-jerky, acceleration for cross travel and long travel motors shall be limited to reasonable values as to prevent any swinging of the load.
- b) In the design of components on the basis of strength, factor of safety shall not be less than Five (5) based on ultimate strength, impact, fatigue, wear and stress concentration factors shall be taken into account wherever applicable.
- c) Drives shall be designed with adequate margin to give best performance and efficiency. Safety arrangement shall be incorporated to prevent damage to the motors on account of mechanical overload and electrical faults and to gearing and shaft etc. due to over stressing and other detrimental condition.
- d) Casting and forging shall be of tested quality and shall confirm to their respective material specifications and shall be free from flaws and objectionable imperfection, machine true and in a workman like manner.
- e) Design shall provide easy maintenance of crane and hoist.
- f) Cranes and hoists capacity shall be selected by considering 10% margin over the weight of the component to be lifted.
- g) Crane and hoist selection criteria

Type of Handling equipment	Crane & Hoist's Safe working load (SWL)
Electric hoists	$\geq 2000$ Kg
Manual hoists with trolley	$> 500$ Kg and $< 2000$ Kg

**Note:** Electrical hoists shall be provided at all equipment / components location which has a lift more than 10 m (for all  $> 500$  kg and  $< 2000$  kg). Hook shall be provided for all possible maintenance location for the weight less 500kg.

- h) For guidance purposes the following speeds shall be considered:-

Hoisting speed : 3.5 m/min to 5 m/min



Travel speed : 5 m/min to 10 m/min

Creep speeds : 10% of operating speeds for all motion through VVVFD

- i) Minimum 3 meter length of Cantilever from edge of building/cladding shall be provided in monorails coming out of the building to lower the equipment to ground level clearing the building sidewalls / cladding and any other facilities beneath the floor up to ground level.
- j) Monorails shall be extended outside the building to handle the equipment to ground level. For monorail/hoist routed inside the buildings, suitable machinery well and removable hand railing and grating shall be provided on various floors of buildings, as necessary, to handle the equipment.
- k) For electric hoists, trolley movement and hoisting shall be effected by using two separate motors.
- l) An electromechanical brake shall be provided for hoisting as well as cross travel. Brake lining shall be of asbestos free.
- m) All parts requiring replacement/inspection/lubrication shall be accessible without need for dismantling of other parts/structures and crane component.
- n) All components of hoists of identical capacity and duty shall be interchangeable.
- o) For Inspection / maintenance of hoist components a fixed platform (of min 1.5 x 1.5m) with ladder shall be provided for each electrical hoist.

#### 4.0.0 PERMITS AND INSPECTION

The contractor shall obtain and pay for necessary permits as required including license fees for installation and inspection of the same equipment, also make such tests as called for by the regulations of such authorized representatives of such authorities as well as in the present of the Employer's representative. The contractor shall be responsible to obtain license, certificate for operating at site.

#### 5.0.0 QAP: MONORAIL AND HOISTS

##### 5.1.0 Hooks

- i) All tests including proof load test as per relevant IS shall be carried out.
- ii) MPE or DPT shall be done after proof load test.

##### 5.2.0 Steels castings

Steel castings shall be subjected to DPT on machined surface.

##### 5.3.0 Forgings

- i) All forgings (wheel, gears, pinions, axles, hooks and hook trunion) greater than or equal to 50mm diameter or thickness shall be subjected to ultrasonic testing.
- ii) DPT or MPE shall be done after hard facing and machining.



#### 5.4.0 Wire rope

Wire rope shall be tested as per relevant standard.

#### 5.5.0 Electric hoists

All electric hoists shall be tested as per IS-3938 and chain pulley blocks shall be tested as per IS-3832.



### ANNEX 2.3.1

#### SPECIFIED DESIGN DATA

SI. No.	Description	Unit	Data
A	<b>ELECTRIC HOIST</b>		
<b>1.0</b>	<b>General</b>		
1.1	Design according to standard service class/ load class		IS 3938 Class II
1.2	Location (Indoor/ Outdoor)		(Based on the location)
1.3	Type of control		Pendant
<b>2.0</b>	<b>Hoisting System</b>		
2.1	Wire Rope		
a)	Rope construction		IS 2266 / 6 x 36 / 6 x 37 multi strand construction Fibre core.
b)	Rope quality (material)		Extra flexible plough steel
c)	Factor of safety		Not less than 5
2.2	Rope drum		
a)	Drum material		Fabricated from carbon steel as per IS 2062, Grade B and stress relieved or seamless pipe as per ASTM A 106 Grade A or B.
b)	Whether stress relieved		Yes (if fabricated)
c)	Bearing type		Antifriction ball or roller
2.3	Hook		
a)	Hook type		Swivel "C" type single shank of suitable grade of either circular or standard trapezoidal section, point hook suitably heat treated with adequate lifting capacity. Swivel lock pin shall be provided.
b)	Hook material		Forged steel
c)	Safety latches provided		yes
d)	Hook suspension		Thrust Bearing
e)	sheave material		Fabricated from cast steel / steel plate IS 2062 Gr A or B / CS Gr 280-520 IS 1030
2.4	Hoist Brake		
a)	Type		DCEM "fail to safe"
b)	Torque	Nm	150% of rated torque or greater than the torque transmitted to the brake drum from the suspended load up-to the test load.
2.5	Gear box		Fabricated Fe 410w IS:2062 Gr A/B & stress relieved
a)	Material of gears		EN 9 / 55C8
b)	Material of pinions		EN 19 /EN 24



Sl. No.	Description	Unit	Data
c)	Type of gears & pinions		Spur / helical
2.6	Type of Limit Switch		Rotary geared + gravity type
<b>3.0</b>	<b>Travel</b>		
<b>3.1</b>	<b>CT brake</b>		
a)	Type		DCEM " fail to safe"
b)	Torque	Nm	125% of rated torque
c)	Gear box		Fabricated Fe 410w IS:2062 Gr A/B & stress relieved
i)	Material of gears		EN 9 / 55C8
ii)	Material of pinion		EN 19 / EN 24
iii)	Type of gears & pinion		Spur / Helical
d)	<b>Wheels</b>		
i)	Materials		Forged steel
ii)	Hardness	BHN	Not more than 200BHN
iii)	Type		Single flanged
iv)	Wheel bearing type		Antifriction Ball / Roller
e)	Type of Limit switches		Lever
4.0	Rating		S4, 40% CDF
5.0	Number of starts/hour		150 starts / hr
<b>B</b>	<b>MANUAL HOIST</b>		
1	Standards		IS 3832 / Class-II
2	Application		(Based on location)
3	Trolley and hoist operation		Hand operated
4	Material of construction		
4.1	Trolley frame		Cast steel / Mild steel
4.2	Gears (Trolley)		Machine cut cast steel / Forged steel / C40 / C50
4.3	Lifting hook (Swivel)		Shank 'C'. Forged steel. Safety latch and swivel lock pin.
4.4	Gears		IS 3681/4460
5	Trolley wheel		Forged / cast steel / C40 with minimum 200BHN and single flanged to suit standard I beam section.
6	Brake		Screw and disc friction type
7	Hand chain		IS:2429 grade 30 pitched and polished
8	Load chain		IS:6216 grade 80



## VOLUME – II

### SUB-SECTION 2.4

#### FIRE PROTECTION SYSTEM

#### 1.0.0 INTRODUCTION

This section covers minimum requirements for design, engineering, fabrication, manufacture & assembly, inspection, erection, testing and commissioning of complete fire protection system for all the system included in the scope of work. The fire protection and detection system is an extension of the fire detection and protection system of the existing plant.

#### 2.0.0 CODES AND STANDARDS

The entire fire protection system shall be designed and installed as per the regulations of Tariff Advisory Committee (TAC) / Indian Standards (IS). For areas not covered or inadequately covered by TAC / IS, the system shall be in accordance with the requirements of the National Fire Protection Association (NFPA) Codes. The fire protection system shall comply with the following latest standards/codes:

IS 3034	Code of practice for fire safety of industrial buildings - Electrical Generating & Distributing Stations.
TAC - Manual	Fire Protection Manual
TAC - Manual	Rules for Fire Alarm System
NFPA 850	Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations Electric Generating Plants
NFPA 72	National Fire Alarm Code

All equipment in the entire fire detection system shall have the approval from one of the followings TAC/BIS-India, UL of USA, LPCB-UK and FM-USA.

#### 3.0.0 SCOPE OF WORK

Contractor is the whole responsible to interact with TAC/LPA/approving accredited agency through Insurance company or directly for getting the design and the installation approved. Any changes or additional requirements specified by TAC approving agency shall be carried out by the bidder without any additional/extra cost to the Purchaser.



Bidder shall consider the minimum of following items. However to comply with safety and TAC/NFPA requirement any additional item which bidder may feel necessary shall also be considered in scope of supply.

## I. Hydrant system

Fire water for Hydrant system shall be tapped off from the existing fire water ring main network in the plant.

- a) One (1) lot of below ground and above ground mains (piping) up-to the individual hydrant outlet and above ground branch header from the existing fire water ring main at terminal point with isolating valves and complete with fittings & supports.
- b) One (1) lot of above ground pipe work including with stand posts duly painted and complete with fittings & supports.
- c) One (1) lot of underground pipe work complete with coating & wrapping.
- d) One (1) lot of above ground isolation gate valve.
- e) One (1) lot of single headed hydrant valve for outdoor complete with all accessories.
- f) One (1) lot of male and female instantaneous couplings for external hydrants.
- g) One (1) lot of (2nos. x 15m long) reinforced rubber lined (RRL) type hoses (minimum) with male and female instantaneous couplings for outdoor application.
- h) One (1) lot of hoses, triple purpose branch pipes, Quick coupling ends, spanner spray nozzles and including with all accessories shall be provided inside the hose box as per TAC recommendation.
- i) One (1) lot of M.S. painted Hose box complete with all accessories for outdoor located alongside of each hydrant.
- j) One (1) lot of restriction orifice plates (pressure break-down orifices as required for hydrant system).
- k) One (1) lot of drain valves in the risers (drain valves shall be lockable type and terminated to nearest surface drain).

## II. Portable and mobile extinguishers

Bidder shall supply the following fire extinguishers (minimum) and install the same at various locations and in quantities as per TAC/NFPA with latest applicable standards.

- a) One (1) lot of Carbon dioxide of 4.5 kg capacity conforming to IS: 15683
- b) One (1) lot of Dry chemical powder type 6 kg capacity conforming to IS: 15683.



### III. Fire detection and alarm system for Control room, UPS room, and Switchgear room

- a) One (1) no. Fire alarm panel shall be provided at control room to receive fire alarm signals from detectors located in control room, UPS room, switchgear room and manual call points.
- b) One (1) lot of Multi sensor detector.
- c) One (1) lot of Indoor & outdoor manual call points.
- d) One (1) lot of Hooters/horns.
- e) One (1) lot of Response Indicators.
- f) One (1) lot of Addressable Interface Units.
- g) One (1) lot of emergency exit and warning signs.
- h) Instrumentation, control and power cable complete with double compression glands, lugs, ferrules, markers and other material as required etc.
- i) All interface cabling between Fire alarm system and HVAC / other system complete with double compression glands, lugs, ferrules, markers etc.
- j) Erection hardware materials shall be supplied as required for installing the instruments
- k) All other required field instrumentation as required

#### 4.0.0 DESIGN REQUIREMENTS

The design and installation of complete fire protection system shall comply with regulations of Tariff Advisory Committee (TAC) of India. In the absence of TAC regulations, the National Fire Protection Association (NFPA) standard shall be adopted. All equipment, special purpose fittings, couplings or accessories shall be approved and certified for use in fire protection system application by TAC/UL/FM.

##### 4.1.0 Hydrant system

- a) The system shall consist of a network of piping installed above ground or if not possible underground including with wrapping and coating around areas to be protected, hydrant valves (external), hoses, hose cabinets, couplings, branch pipe and nozzles.
- b) Outdoor/External hydrant shall be provided near the buildings, equipment and entire CT & CW Treatment area.
- c) Hose pipes of suitable lengths fitted with standard accessories like hose coupling, branch pipes and nozzles shall be located in the 'HOSE BOXES'.
- d) Outdoor hydrant for power transformer shall be tapped off from the existing fire water ring main network located near the CT & CW treatment area fire water ring main.



- e) The hydrant network shall be sized to ensure that about 3.5 kg/cm<sup>2</sup>(g) pressure is available at the hydrant point (as per TAC) in the system.
- f) Hydrant heads shall be positioned at distances not less than 2m from the face of the building and not exceeding 15M.
- g) External hydrants shall be located all around the periphery of buildings.
- h) Hydrant valves are only oblique hydrants conforming to IS: 5290, Type-A with outlets angled towards ground shall be used as per the TAC requirement.
- i) Each hose cabinet shall be free standing type of M.S. sheet construction with a glass front. The hose cabinet shall be of suitable size to contain two (2) lengths of 15m long, 63mm diameter hose pipes, branch pipe, nozzle and spanner for outdoor installation.
- j) All outdoor piping shall be buried such that the top of the pipe is atleast 1.0 M below the finished ground level.
- k) Pressure break-down orifice shall be provided as necessary to restrict pressure of all hydrant point upto 3.5 kg/cm<sup>2</sup>(g).
- l) Hume pipes shall be used for road crossing area. RCC Hume pipes shall be provided as per IS:458, NP class III for road crossings.

#### 4.2.0 Portable Fire Extinguishers

Portable extinguishers with suitable capacity, rating and medium such as CO<sub>2</sub> and Dry chemical powder (DCP) and with standard accessories and in adequate numbers as per TAC covering all the buildings in the CT & CW Treatment area shall be provided.

All the extinguishers offered by the Bidder shall be of reputed make and shall be ISI marked.

All the portable extinguishers shall be of free standing type and shall be capable of discharging freely and completely in upright position.

Each extinguisher shall have the instructions for operating the extinguishers on its body itself.

All extinguishers shall be supplied with initial charge and accessories as required.

Portable type extinguishers shall be provided with suitable clamps for mounting on walls or columns.

All extinguishers shall be painted with durable enamel paint of fire red colour conforming to relevant Indian Standards.



#### 4.3.0 Fire Detection and Alarm System

The Fire Detection and Alarm System shall provide instantaneous audio alarm when Fire is detected, in order to prevent loss of life, property and valuables etc by warning inhabitants in the affected premises immediately, so as to obtain necessary help from Fire Fighting and Salvage Staff.

The Fire detection and Alarm System may be activated by automatic detection devices or by manual operation. Fire Detection and Alarm System performs the function of monitoring the areas from Fire continuously and giving an Audible Alarm in case of sensing of "Fire". The sensing of the Fire is accomplished through various types of Detector etc.

Various areas shall be provided with the adequate number of Detectors for continuous monitoring.

The system shall consists of addressable Multi-sensor and smoke detector to detect any abnormal change in smoke, heat level and provide signal to the Fire alarm panel to actuate the corresponding output devices (Hooters & Relays) as programmed to take appropriate extinguishing measures.

When any of the detectors detects any fire inside the protected premises through any type of detector, then the Fire Alarm Panel shall display the corresponding location on the LCD & the Fire LED of the panel shall start glowing. The audio-visual alarm comes ON in Panel indicating that the fire condition has been detected. Also, "EVACUATION" display unit (Hooter) located at strategic location shall start sounding.

One (1) no Fire alarm panel (FAP) shall be provided in the control room. The FAP shall be Microprocessor based analogue addressable type complete with power supply, LCD colour monitoring display unit, matrix key pad, all input, output & control modules, built-in hooters etc. The Fire Alarm Panel shall be equipped with battery backup using lead acid type 24Volt sealed maintenance-free batteries and suitable battery charger unit. The entire signal shall be interfaced with fire alarm panel in the control room.

The entire signal shall be interfaced with CT fire alarm panel to main fire alarm panel in the central control room of main plant TG building. The same data points shall be interfaced to repeater Fire alarm panel (RFAP) in the power plant.

All interface cabling between fire alarm system complete with double compression glands, lugs, ferrules, markers etc.

Area	Type of Fire Detector
Electrical Switchgear / MCC room	Microprocessor based addressable analog type Multisensor detectors and manual call points.
Control room, UPS room	Microprocessor based addressable analog type Multisensor detectors and manual call points.



Area	Type of Fire Detector
Battery and battery charger rooms	Microprocessor based addressable analog type Heat detectors and manual call points.

## 5.0.0 CONSTRUCTION REQUIREMENTS

### 5.1.0 Under Ground Piping (Normally Filled with Water)

- a) Fire water pipe shall be of IS: 1239 (part I) – Heavy grade ERW MS Black pipes for sizes 150 NB and below and IS: 3589 – Grade Fe 410 ERW MS Black pipes for sizes 200 NB and above.
- b) Pipe to pipe joint shall be of Butt welded for size 65 NB & higher as per ANSI B16.9 and socket welded for sizes upto 50 NB as per ANSI B16.11.
- c) Pipe to valve joint shall be of Flanged and drilled to ANSI B16.5 - 150# with neoprene gaskets between flanges for sizes 50NB & above. Screwed sockets for sizes below 50NB.
- d) Pipe fittings shall be of IS 1239 (Part II) – heavy grade MS for sizes upto 150 NB Fabricated from parent material for sizes above 150 NB. Butt welded as per ANSI B 16.25 for sizes 65 NB and above socket welded as per ANSI-B16.5.
- e) Bolts, nuts & washers shall be of Hot dip galvanised MS.
- f) Corrosion protection properly lagged with corrosion protective tapes of minimum thickness of 4 mm (in two layers) of coal tar type as per AWWA C 203 / IS :15337.

### 5.2.0 Above Ground Piping (Normally Filled with Water)

- a) Fire water pipe shall be of IS: 1239 (part I) – Heavy grade ERW MS Black pipes for sizes 150 NB and below and IS: 3589 – Grade Fe 410 ERW MS Black pipes for sizes 200 NB and above.
- b) Pipe to pipe joint shall be of Butt welded for size 65 NB & higher as per ANSI B16.9 and socket welded for sizes upto 50 NB as per ANSI B16.11.
- c) Pipe to valve joint shall be of Flanged and drilled to ANSI B16.5 - 150# with neoprene gaskets between flanges for sizes 50NB & above. Screwed sockets for sizes below 50NB.
- d) Pipe fittings shall be of IS 1239 (Part II) – heavy grade MS for sizes upto 150 NB Fabricated from parent material for sizes above 150 NB. Butt welded as per ANSI B 16.25 for sizes 65 NB and above socket welded as per ANSI-B16.5.
- e) Bolts, nuts & washers shall be of Hot dip galvanized MS.



### 5.3.0 Above Ground Piping (Normally Empty)

- a) Fire water pipe shall be of IS: 1239 (Part I) – Heavy class galvanized ERW MS pipes.
- b) Pipe to pipe joint shall be of Screwed flange as required for sizes 65 NB & above and screwed socket for sizes 50 NB and below. Welding on GI Pipes shall not be carried out. All GI Pipe joint connections shall be threaded type only with sealant Teflon.
- c) Pipe to valve joint shall be of Flanged for sizes 50NB & above, screwed for sizes below 50NB.
- d) Pipe fittings shall be of IS:1239 (Part II) Heavy grade galvanized MS Screwed flanged for sizes 65 NB & above and screwed socketed as per ANSI B 16.11 or IS:1239, Part II for sizes 50 NB and below. All fittings and flanges for galvanized pipes shall be galvanized.
- e) Bolts, nuts & washers shall be of Hot dip galvanized MS.



## ANNEX – 2.4.1

### SPECIFIED DATA FOR FIRE PROTECTION SYSTEM

#### I. VALVES & SPECIALITIES

Sl. No.	Description	Specification Requirement
1.0	<b>C.I GATE VALVES</b>	
1.1	Type	Rising spindle type
1.2	Sizes	65 NB to 600 NB
1.3	Rating	PN 1.6
1.4	End connection	Flanged and drilled to ANSI 150# B 16.5
1.5	Code / Standard	CI:IS 14846 rising spindle TAC approved upto 300 NB
1.6	Material of construction	
a)	Body	CI IS : 210 Gr. FG 260
b)	Bonnet	CI IS : 210 Gr. FG 260
c)	Stem	Stainless steel to AISI-410 13% Cr
1.7	Testing	As per IS : 14846
1.8	Test pressure	Body - 24 kg/cm <sup>2</sup>
		Seat - 16 kg/cm <sup>2</sup>
1.9	Approval	ISI marked/ TAC approved
2.0	<b>C-I CHECK VALVES</b>	
2.1	Type	Swinging disc type
2.2	Size	50 NB to 600 NB
2.3	Rating	PN 1.6
2.4	End connection	Flanged and drilled to ANSI 150# B 16.5
2.5	Code / Standard	BS-1868
2.6	Material of construction	
a)	Body	ASTM-A-216 Gr. WCB
b)	Cover	ASTM-A-216 Gr. WCB
c)	Disc	ASTM-A-216 Gr. WCB
d)	Back seat & Hinge pin	13%Cr.Steel as per ASTM-A-182 Gr.F6.
e)	Gasket	CAF IS 2712
2.7	Testing	As per latest BS / IS code.



Sl. No.	Description	Specification Requirement
2.8	Test pressure	Body : 24 kg/cm <sup>2</sup> Seat : 16 kg/cm <sup>2</sup>
2.9	Approval	ISI marked and TAC approved
<b>3.0</b>	<b>BUTTERFLY VALVES</b>	
3.1	Type	Wafer upto 300 NB
3.2	Sizes	100 NB and above
3.3	Rating	PN 1.6
3.4	End connection	Flanged and drilled to ANSI B16.5-150#
3.5	Code / Standard	IS: 13095
3.6	Material of construction	
a)	Body	SA 216 Gr. WCB, casting
b)	Shaft	SS 40, stub shaft
c)	Disc	SA 216 Gr. WCB, casting
d)	Hand wheel / lever	CS
3.7	Testing	AWWA-C 504
3.8	Test pressure	Body - 24 kg/cm <sup>2</sup> Seat - 16 kg/cm <sup>2</sup>
3.9	Approval	ISI marked / TAC approved
<b>4.0</b>	<b>HYDRANT VALVE</b>	
4.1	Type	Single headed, female oblique type
4.2	Code / Standard	IS : 5290 Type A
4.3	End connection	
	Inlet	Flanged and drilled to ANSI 150# B 16.5
	Outlet	Female instantaneous coupling with spring lock type coupling with blank cap & chain.
4.4	Size	63 mm
4.5	Testing	As per IS : 5290
4.6	Test pressure	Body - 21 kg/cm <sup>2</sup> Seat - 14 kg/cm <sup>2</sup>
4.7	Material of construction	
a)	Body	SS-304
b)	Female outlet	SS-304



Sl. No.	Description	Specification Requirement
c)	Stop valve	SS-304
d)	Spindle	SS-304
e)	Seat	SS-304
4.8	Approval	ISI marked / TAC approval
<b>5.0</b>	<b>BRANCH PIPE &amp; NOZZLE</b>	
5.1	Size	63 NB with 20 NB nozzle
5.2	Nozzle Type	Hexagonal, detachable ( Triple purpose, solid jet and fog type)
5.3	Code / standard	IS : 2871 for branch pipe and IS-952 for fog nozzles
5.4	Material of construction	
a)	Branch pipe / nozzle	SS AISI-304
b)	Diffuser/Fog Nozzle	SS AISI-304
5.5	Approval	ISI marked/ TAC approved
<b>6.0</b>	<b>HOSE COUPLING</b>	
6.1	Type	Instantaneous male and female
6.2	Size	63 NB
6.3	Code / standard	IS : 903
6.4	Material of construction	
a)	Female half coupling	SS304
b)	Male half coupling	SS304
6.5	Approval	ISI marked/ TAC approved
<b>7.0</b>	<b>FIRE HOSE</b>	
7.1	Type	RRL
7.2	Size	63 mm
7.3	Code / standard	IS:636 Type B
7.4	Length	2 nos. of 15 m for external & 2nos. of 7.5m for internal hydrant
7.5	End fittings	Instantaneous spring lock type coupling at both ends.
7.6	Testing	As per IS : 636
7.7	Hose weight (gm/m)	IS : 636
7.8	Bursting pressure	IS : 636
7.9	Proof pressure	IS : 636



Sl. No.	Description	Specification Requirement
7.10	Kink test pressure	IS : 636
7.11	Change in length test pressure	IS : 636
7.12	Change in diameter test pressure	IS : 636
7.13	Approval	ISI marked/ TAC approved
<b>8.0</b>	<b>HOSE CABINET</b>	
8.1	Type	Fabricated out of 16 G MS sheet
8.2	Size	Approx. 750 x 600 x 250
8.3	Mounting	- Wall / column mounted for internal hydrant pedestal mounted for external hydrant
8.4	Special requirement	(i) Each cabinet shall accommodate 2 nos. of 15 m long hoses and 1 no. branch pipe & nozzle.  (ii) Cabinet to have double door having toughened glass panel (3 mm) with rubber lining and marked 'Fire' on it in 80 mm size letters.  (iii) Approved lock with duplicate keys kept wired in a break glass key cabinet in the hose box itself.  (iv) A spanner and a set of spare rubber rings packed in fresh chalk to be kept inside the hose box.  (v) Clamp for holding branch pipe to be provided.
	Accessories	-Fastening nuts, bolts and hardware - Hammer for breaking the glass to take out the keys



## II. PORTABLE AND MOBILE FIRE EXTINGUISHERS

Sl. No.	Parameter	Unit	Description
A	<b>Carbon Di-Oxide Type Portable Fire Extinguishers</b>		
1	Type		Carbon Di-Oxide type
2	Design standard		IS:15683
3	Quantity	Nos.	As per codal requirement
4	Guaranteed performance		
a	Capacity	kg	4.5
b	Max. effective range when tested in still air	m	2
c.	Min. period during which the continuous jet shall be maintained.	S	8
d	Maximum period for discharge of 95% of the charge	S	10
5	Constructional features		As per design code
6	Material of construction		As per design code
7	Physical data		DDE
8	Accessories		
a	Chemical charge		Yes
b	Mounting Brackets complete with all hardware		Yes
c	Carrying handle		Yes
d	Liquid level indicator		Yes
e	Any other as per design code		Yes
9	Approvals		ISI
10	Painting and testing		As per manufacturer.
B	<b>Dry Chemical Powder Type Portable Fire Extinguishers</b>		
1	Type		Dry chemical powder type
2	Design standard		IS:15683
3	Quantity	Nos.	As per codal requirement



Sl. No.	Parameter	Unit	Description
4	Guaranteed performance		
a	Capacity	kg	6
b	Max. effective range when tested in still air	m	<4
c	Min. period during which the continuous jet shall be maintained.	s	15
d	Maximum period for discharge of 95% of the charge	s	20
5	Constructional features		As per design code
6	Material of construction		As per design code
7	Physical data		DDE
8	Accessories		
a	Chemical charge		Yes
b	Mounting brackets complete with all hardware		Yes
c	Carrying handle		Yes
d	Liquid level indicator		Yes
e	Any other as per design code		Yes
9	Approvals		ISI
10	Painting and testing		As per manufacturer.



**VOLUME – II**  
**SUB-SECTION 2.5**  
**AIR CONDITIONING & VENTILATION SYSTEM**

#### **1.0.0 INTRODUCTION**

This section covers minimum requirements for design, engineering, fabrication, manufacture & assembly, inspection, erection, testing and commissioning of complete air conditioning and ventilation system for all the system included in the scope of work.

#### **2.0.0 CODES AND STANDARDS**

Design, Manufacture, inspection and testing of equipment covered under this specification for HVAC system shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment is to be installed. The equipment shall also confirm the latest applicable Indian/British/American standards. Some of the applicable standards are listed below.

ISHRAE	Industrial Ventilation Application
ISHRAE	HVAC System Handbook
IS 325	Three phase induction motors
IS 655	Metal Air ducts
IS 2312	Propeller type AC ventilation fans
IS 3588	Electric axial fans
IS 4894	Centrifugal fans
UL 555	Fire dampers

#### **3.0.0 DESIGN CRITERIA**

- a) Suitable capacity of air cooled split type air-conditioning units with hermetically sealed compressor and its drive motor, Air cooled condenser with fan, Refrigerant pipes and fittings for interconnecting the equipment for Control room, UPS room and Laboratory room.
- b) Wall mounted fan-filter unit for supply of fresh air, comprising of tube axial fan, drive motor, intake louver, inlet and outlet cowl, bird screen, ducting and pre filters, protective screen, complete with supports and hardware and wall mounted gravity dampers for exhausting the air from switchgear room.
- c) Wall mounted axial flow exhaust fans comprising of drive motor, cowl with bird screen and Gravity dampers, protective screen, complete with supports and hardware and wall / door mounted intake louvers for chemical house and propeller fan for toilets.
- d) Any other rooms not mechanically ventilated but important from the operation point of view shall be provided with air-conditioning system.
- e) Outdoor Design Conditions: As per ASHRAE. Nearest site shall be considered.



## I. Air-conditioning system

### a) Indoor Design Conditions:

Dry bulb temperature :  $22^{\circ}\text{C} \pm 1^{\circ}\text{C}$   
Relative humidity :  $50 \pm 10\%$ .

- b) For fresh air quantity, number of air changes per hour shall be min.1.5 or 35 CMH/person or suitable to maintain over pressure of 2 mmWC, whichever is higher.
- c) Lighting load - 2 watts/ft<sup>2</sup> or actual whichever is higher shall be considered for heat load calculations.
- d) The occupancy for general area shall be minimum one person per 10m<sup>2</sup>. In the control rooms, control equipment rooms the occupancy shall be considered one person per 25m<sup>2</sup> (Minimum) or part thereof.
- e) Minimum design margin of 12.5% on sensible heat, 10% on latent heat and 10% margins for overall heat respectively shall be considered while calculating heat load.
- f) Heat dissipation of panels shall be considered in the equipment sizing calculation for summer and monsoon season. 50% of equipment load shall be considered for winter load calculations.
- g) To reduce the air conditioning load, the exposed roof slabs (Including beams and column etc.) of air conditioning control room shall be insulated with 50 mm thickness fiber glass insulation of density 48 kg/m<sup>3</sup> finished with 26 swg aluminum cladding.
- h) Noise level within the air conditioned space shall be restricted to 35-45 NC level with suitable acoustic attenuation (with duct silencer / acoustic insulation etc.).

## II. Ventilation system

- a) The ventilation system shall be designed to maintain the dry bulb temperature not exceeding  $5^{\circ}\text{C}$  above design ambient summer temperature (heat load basis) or based on number of air changes per hour, whichever is higher.
- b) No. of air changes per hour shall be as follows:

Area description	Air changes/hour
Switchgear/MCC room	15
Chemical house	20
Toilets	30
Battery room/Areas where gaseous fumes/vapors are generated	30



- c) All the equipment of ventilation system shall be designed for continuous duty for continuous operation of 24 hours a day, all indoor and outdoor installed units.
- d) A minimum 10% margin shall be considered while sizing the equipment capacity.
- e) All ventilation system shall operate on 100% fresh air. All mechanically ventilated areas shall be positively ventilated by means of supply air fans fitted with filters and/or gravity operated back draft dampers and exhaust fans. MCC room, electrical equipment room etc. shall necessarily be pressurized condition. Supply air fan catering for electrical areas shall be provided with fine filters and for other areas, supply air fans shall be provided with pre-filters only.
- f) Supply air fans, exhaust air fans for ventilations of each area shall be provided with local starter panels.
- g) The openings required for fan fixing and duct crossing shall be 50 mm larger than the fan fixing frame and duct size respectively including insulation.

#### 4.0.0 TECHNICAL REQUIREMENTS OF AIR CONDITIONING SYSTEM

Required number of High wall type split AC units complete with air cooled outdoor condensing unit having hermetically sealed compressor and high wall type indoor evaporator unit with cordless remote controller.

Copper refrigerant piping complete with insulation between the indoor and outdoor units as required shall be provided. First charge of refrigerant and oil shall be supplied with the unit.

GSS sheet air distribution ducting for distributing conditioned dehumidified air along with supply air diffusers and return air grilles with volume control dampers and necessary splitters etc., suitable fixtures for grilles/diffusers and supports for ducting complete with insulation shall be provided.

Power and control cable and earthing, all instruments and local control panels along with controls and interlock arrangements and accessories as required for safe and trouble free operation of the units shall be provided.

MS Brackets for outdoor condensing units, condensers as required and insulated PVC drain piping from the indoor unit upto the nearest drain point shall be provided.

##### 4.1.0 High wall type split AC units:

The split type air conditioning system units shall be complete with indoor evaporator unit, outdoor condensing units and cordless remote control units.

Outdoor unit shall comprise of hermetically/semi hermetically sealed compressors mounted on vibration isolators, propeller type axial flow fans and copper tube aluminium finned coils all assembled in a sheet metal casing. The casing and the total unit shall be properly treated and shall be weatherproof type. They shall be



compact in size and shall have horizontal discharge of air. The indoor units shall be high wall type.

Indoor unit shall be compact and shall have elegant appearance. They shall have low noise centrifugal blowers driven by suitable motors and copper tube aluminium finned cooling coils. Removable and washable polypropylene filters shall be provided. They shall be complete with multi-function cordless remote control unit with special features like programmable timer, sleep mode and soft dry mode etc.

It shall have energy efficiency rating of 5 star.

#### 5.0.0 TECHNICAL REQUIREMENTS OF VENTILATION SYSTEM

##### 5.1.0 General

Each Axial fan comprises of fan, fan motor, inlet and outlet cone (for Tube axial), filters (supply air fans), cowl with bird screen, gravity dampers (exhaust fan), grouting frame, cadmium plated fixed bolts and supporting arrangement.

The speed of the fans shall be 1500 rpm for impeller diameter 450 mm or less and 1000 rpm for impeller diameter above 450 mm.

The wall mounted supply air fan shall be of axial flow type with cast aluminium impellers with blades of aerofoil design. The fan unit shall be complete with air filters and casing shall be of galvanized sheet steel construction. The fan is directly driven through three phase induction motor.

The wall mounted exhaust fan is of axial flow type with cast aluminium impellers with blades of aerofoil design. The fan is directly driven through three phase induction motor. Wall mounted exhaust fans for toilets are driven by single phase motor. The fan casing is of galvanized sheet steel construction.

In switchgear room, ventilation system shall consist of multiple fan units. To ensure that the air being supplied is free from dust particles, a minimum two stage dust filtration process shall be supplied with pre filters and fine filters. All the filters shall be panel type. Easy access should be available to the filters for replacement/cleaning.

The ventilation of the switchgear room shall be of a positive pressure type. The pressure inside the room shall be maintained 5 mm of water column above the atmospheric pressure.

The ventilation system for each area shall be sized based on either air flow rate calculated considering a room temperature of 5°C (Maximum) above ambient DBT during peak summer considering all heat loads or air flow rate calculated considering minimum number of air changes / hour, whichever results in higher air flow rate shall be considered.

##### Wall/roof mounted axial flow exhaust fan

Each wall/roof mounted axial flow exhaust fan complete with,

- Fan impeller & casing/short duct as required.



- Electric drive motor with coupling if any, including motor brackets.
- Grouting frame work, if any and nuts, bolts, foundation bolts etc.
- Rain protection cowl with bird-screen, made of GI, louvered shutter.

#### Wall mounted axial flow exhaust fan for Battery room

The battery room shall be maintained at negative pressure to prevent leakage of fumes to outside from the battery rooms. The hot air from the battery rooms shall be exhausted by means of 2 x 50% bifurcated tube axial fans with flame proof motor to avoid direct contact of motor with toxic gases / acid fumes. Ducting, grilles, fans, motors provided for battery rooms shall be painted with acid and fume resistant paint.



## ANNEXURE -2.5.1

### SPECIFIED DATA SHEET

#### A. AIR CONDITIONING SYSTEM

S.no.	Description	Unit	Data
<b>1.0</b>	<b>Split Air Conditioners</b>		
a)	Areas Served		As per specification requirement
b)	Redundancy		100% redundancy shall be considered
c)	Type		Air cooled type
d)	Capacity		*
e)	<b>Indoor unit</b>		
	Cooling coil		Internally grooved copper tubing with aluminum fins
	Fan type		Centrifugal
f)	<b>Filters</b>		
	Filter media		Non-oven synthetic type, washable
	Efficiency		90% down to 20 microns
g)	<b>Outdoor unit</b>		
	Condenser coil		Copper coil with aluminum fins
	Compressor		Semi/Hermetically sealed Scroll
	Fan type		Propeller

#### B. VENTILATION SYSTEM

S.no.	Description	Unit	Data
<b>1.0</b>	<b>Axial Flow Fans</b>		
a)	Areas Served		Switchgear room
b)	Type		Tube axial
c)	Flow	CMH	*
d)	Requirement		Supply air
e)	Casing Material		Heavy gauge galvanized sheet steel construction.
f)	Casing Thickness		3 mm up to fan diameter of 750 mm. 5 mm for fans with impeller above 750



S.no.	Description	Unit	Data
			mm diameter.
g)	Impeller		Cast Aluminum with aerofoil design
h)	Shaft		EN8
i)	Shaft Sleeve		SS 316
j)	Critical Speed		The first critical speed of rotating assembly be at least 25% above the operating speed
k)	Other Accessories		Cowl with Bird Screen, supporting structure.

(\*) TO BE FURNISHED BY BIDDER



**VOLUME - II**  
**SUB-SECTION - 2.6**  
**PIPING, VALVES AND SPECIALITIES**

#### **1.0.0 GENERAL**

The Contractor is responsible for the design, supply and construction of all piping equipment and accessories which must be in accordance with the latest editions of the specified standards.

The basic and detailed design of all pipe work and related components must be carried out by the Contractor in such a way that there is good coordination and cooperation between the Contractor, the sub contractors and the Owner.

The Contractor is responsible for ensuring that no mistake is made with regard to the materials used either in the workshop or during erection on site. This applies especially to pipes from which the material marking put on at the pipe mill and / or workshop is removed by such processing as bending, forging etc. In case of doubt the Contractor is responsible for suitable quality checks.

All pipe components manufactured by the Contractor and parts on which he has worked, are to be marked clearly with an item number and material marking, this marking shall be permanent.

For reasons of easy availability in India for future replacement, ANSI / ASTM materials and dimensional standards are preferred.

#### **2.0.0 DESIGN CRITERIA**

The pipework shall be designed and erected in accordance with the American National code for Pressure Piping ANSI B31.1 'Power Piping' or an expressively approved equivalent standard.

The present specification will prevail against that of the code whenever the former is more restrictive.

The following approximate flow velocities should not be exceeded:

Type of Pipework	Max. Flow Velocity
------------------	--------------------

##### **Water and Condensate Lines**

Pump suction lines	1.0 m/s
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Water discharge lines	2.5 m/s
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##### **Air Lines**

Suction and delivery lines for rotary compressors	15 m/s
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Slurry Lines	1.8 m/s
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The Nominal Diameters (DN) can be used for piping components are given below:

DN (mm)	(in)	DN (mm)	(in)	DN (mm)	(in)
20*	3/4	150	6	700	28
				750	30
25	1	200	8	800	32
		250	10	900	36
40	1 1/2	300	12	1000	40
		350	14		
50	2	400	16	1200	48
		450	18		
80	3	500	20	1400	56
100	4	600	24		

- \* The DN 20 and lower only for dosing pipelines and pipelines for gaseous hydrogen, carbon dioxide and other mediums if required and applicable.

All rules of the art considering technical and economic parameters shall be carefully followed, namely:

- For lines conveying liquids the design pressure must be equal to maximum operating pressure including the pressure reached during transients (water hammer.)
- The calculation of the pipe work shall consider also the highest possible temperature that can occur during any mode of operation together with the highest corresponding pressure.
- Also operational defects are to be considered.
- In addition to the required wall thickness in accordance with calculations a corrosion allowance of 3 mm must be added for unprotected lines where corrosion is to be expected.
- Proper care shall be taken for thermal expansion of pipe systems.
- For all systems subject to thermal expansion of pipe size larger than DN 100 the pipe manufacturer shall submit the necessary test certificates.



### 3.0.0 GUIDELINES FOR THE DESIGN AND CONSTRUCTION OF PIPE WORK AND ACCESSORIES

The pipe work and its accessories shall be designed and arranged so that all parts can be mounted and replaced without difficulty. All important parts, such as valves must be accessible from platforms.

The platform must be able to withstand the weight of the valve removed as well as the weight of the appropriate number of persons handling the valve and must be sized adequately providing both working space for the men and space for the valve.

The piping should be an integral system including all supporting frame, connection parts and valves installed for safety, discharge and fill-in system, to ensure safe and effective operation. Piping is designed mainly in unit system, while units are interconnected, it is necessary to make sure the main unit can operate separately from the reserve unit. Piping shall be assigned with supply isolation valves in segments to turn off pipe for maintenance while the whole system can operate continuously.

High pressure pipes and piping with thick wall that need hot bending can only be supplied to site in the prefabricated form. The prefabricated pipe shall be hydraulically tested before acceptance.

A pipe stress and flexibility analysis shall be made. The calculation of pipe stress and flexibility shall be based on operating conditions of the pipe.

All control valves shall be bypassed by hand operated control valves. The control valve must be blocked for maintenance by isolation valves.

No tubes with nominal diameters less than 25 mm shall be used, except for impulse measuring lines and dosing pipelines.

For all system parts subject to acceptance retests relevant provision shall be made so that they can be separated to allow for those retests.

None of the forces and moments transmitted by the pipes to adjacent machines, apparatus and platforms must exceed the maximum permissible values, given by the manufacturers of these items.

The design of pipe work supports must not permit any vibrations or undue stresses on the pipe, connected equipment or structures in any operation and test conditions.

Overhead piping/ Ducting is to have a minimum vertical clearance of 3 metres above walkways and working areas and 8 meters above roadways.

Equipment and piping systems shall be protected against excess pressure caused by thermal expansion of locked-in fluids.

All piping shall be provided with a sufficient number of vents and drains at its highest and lowest points. All vents, drains or dumps points shall lead to the flash tanks or into funnels at visible points with covers. They shall be grouped together where possible.



The Contractor shall furnish and install suitable thimbles at all points where pipelines pass through building floors and walls.

The Contractor shall provide effective flashing rings with rain-tight hoods for all pipes passing through the roofs or exterior walls.

As many welds as possible shall be carried out in the workshop.

The supplier shall furnish and install suitable sleeves at all points where pipes pass through building floors and walls.

Hangers and supports shall be standardized and the number of types and component assemblies shall be reduced to the minimum. Each pipe hanger and support component shall be of steel suitable for the maximum operating temperature. Spring support assemblies shall be equipped with a means of locking the springs against movement. Sliding surfaces shall be constructed of non-corrodible materials that do not rely on coatings for corrosion protection.

The use of counterweights as a substitute for support spring assemblies will not be permitted.

After plant start-up, all supports shall be checked to confirm that spring load indicators have assumed the proper hot load position and that all hangers and supports which do not incorporate springs are in the correct position. After all required adjustments have been made, all threads shall be fully engaged and locked and all spring ties shall be disengaged.

### **Guidelines for the Design and Construction of Valves**

For reasons of plant standardization the Contractor shall standardize the valves, to reduce number of types and manufacturers to a minimum.

Design, construction, fabrication and testing of the valves shall be in accordance with the applicable standards. The requirement of this clause will apply if they are more stringent than the approved standards. All valves shall be suitable for the media and for the service conditions and those performing similar duties shall be interchangeable. All valves shall conform at least with pressure class 150 according to ANSI B16.5 or equivalent. All Valves must meet the maximum design demands for pressure and temperature of the joint piping system. All valves must bear 1.5 times of the maximum design pressure.

Pipe line under gravity flow shall be restricted to a flow velocity of 1 m/sec generally. Channels under gravity flow shall be sized for a maximum flow velocity of 1.2 m/sec.

The following "C" Value shall be used in HAZEN William's formula for calculating the friction loss in piping systems.

- i) Steel pipe : 100
- ii) C.I Pipe / Ductile Iron : 100
- iii) Rubber lined steel pipe : 120



- iv) PVC / HDPE pipes : 140
- v) GRP pipes : 150
- vi) RCC Conduits : 100

The design, material, construction, manufacture, inspection and testing of valves & specialties will comply with all currently applicable standards, regulations and codes.

### Valve types

The isolation valves provided in all the slurry lines shall be of knife gate type/butterfly type. For other lines Basically the following types of valves will be used.

Valve Types	Sizes and services
Globe valves	Up to and including 50 NB. All Sizes for miscellaneous system.
Gate valves	All sizes for Raw water, Service water and miscellaneous system.
Butterfly valves	150 NB and above for Raw water, Cooling water, Auxiliary cooling water.
Lift check valves	Up to and including 50 NB
Swing check valves	Above 50 NB
Diaphragm valves	Up to and including 80 NB for chemical lines, waste water
Ball valves	All sizes for chemical, Compressed air, service and potable Water services.

All valves shall be suitable for the fluid media, different service conditions and those performing similar duties for interchange ability. All valves shall meet maximum design demands of pressure and temperature considered for the piping system.

All valves and specialties will be located in accessible locations as far as possible and where not possible suitable approach (such as ladders or platforms) will be provided. Wherever necessary, the valve spindles will be extended and an approved type of pedestal hand wheel will be provided at the next higher floor level. For vacuum service valves, the valves will be provided with extended glands or water sealing arrangement.

Valves are to be kept locked in full 'OPEN'/'CLOSE' position will be provided with a non-detachable locking arrangement comprising a chain & padlock.

Motor operated valves will be provided with hand-operated device for operating the valves during power failure.

Gear operation for valves will be provided for the sizes as indicated in Table C.



**TABLE - C**

Valve Type	Class	Sizes
Gate & Globe	up to 300#	350NB & larger
	600# - 900#	150 NB & larger
	1500# - 2500#	100 NB & larger
Ball	Up to 300#	150 NB & larger
	600# to 1500#	80 NB & larger
Butterfly Valves	150#	200 NB & larger
	300#	150 NB & larger

Effort to operate valves will not exceed 20 kg at hand wheel periphery / lever end.  
Hand wheel diameter will not exceed 700 mm and lever length 500 mm.

#### Bypass valve arrangement:

For gate valves, integral bypass arrangement will generally be provided for following sizes:

Rating	Size
150#	700 NB & larger
300#	400 NB & larger
600# - 2500#	100 NB & larger

The bypass valve will be a globe valve and the bypass arrangement to main valve will not be screwed. For storage tanks, isolation valves will be provided directly on the tank nozzle.

#### Valve Selection Criteria

The valve selection criteria are generally as below:

FLUID SERVICE	Type	Material of construction	
		<=NB50	>=NB65
Cooling Water / Auxiliary cooling water/ Raw Water	Gate valve , Globe valve (for size <= 50)	ASTM A105	ASTM A216 Gr. WCB
	Butterfly valve (for size >= 150 )	-	Below NB600: CI IS 210 FG Gr. 260 / ASTM A216 Gr. WCB Above NB 600: IS 210 FG Gr. 260 / IS 2062 Gr. B
Instrument Air, Potable water	Ball	ASTM A105, Galvanised	ASTM A216 Gr. WCB Galvanised



FLUID SERVICE	Type	Material of construction	
		<=NB50	>=NB65
Service Air	Ball	ASTM A105	ASTM A216 Gr. WCB
Service water	Gate valve , Globe valve (for size <= 50)	ASTM A105	ASTM A216 Gr. WCB

### Materials requirements for Piping Components and Valves

The main materials and special requirements specified under this title shall be seen as the minimum requirement.

The following guideline represents minimum requirements. In case of intended deviations 'Deviation from Enquiry Documents' applies.

SL. NO	SYSTEM / SERVICE	ANSI CLASS #	DESIGN PRESSURE kg/cm <sup>2</sup> (g)	DESIGN TEMP. °C	PIPING MATERIAL
A	<b>COOLING WATER SYSTEM</b>				
1	Pipe sizes upto 150 NB	150	10.0	60.0	IS 1239
2	Pipe sizes above 150 NB	150	5	60.0	IS 3589 Fabricated form IS 2062 plates
B	<b>PLANT WATER SYSTEM</b>				
1	Service water system upto 150 NB	150	10.0	60.0	IS 1239
2	Potable water system upto 150 NB	150	10.0	60.0	IS 1239 (Galvanised)
3	Service water system above 150 NB	150	10.0	60.0	IS 3589 Fabricated from IS 2062 plates
4	Raw water system upto 150NB	150	10.0	60.0	IS 1239
5	Raw water system above 150NB	150	10.0	60.0	IS 3589 Fabricated from IS 2062 plates



# **RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD**

## **Cooling Water System Package for Kota Super Thermal Power Station Unit # 5 (1 x 210 MW) Kota, Rajasthan, India**

[ Doc. No. . FCE-1117155-ME-DOC-SPC-3000-033]

### **VOLUME II SECTION 3 DETAILED TECHNICAL SPECIFICATION – ELECTRICAL**

**FICHTNER Consulting Engineers (India) Private Limited**  
Chennai-Bengaluru, India



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**VOLUME – II**  
**SECTION – 3**  
**DETAILED TECHNICAL SPECIFICATION – ELECTRICAL**

**SECTION-3.0: GENERAL**

**1.0.0 INTENT OF SPECIFICATION**

This section covers the requirements of the following electrical equipment for efficient and trouble-free operation of the proposed plant.

The Scope shall include design, engineering, supply, installation, testing and commissioning of the following electrical equipment complete with all accessories:

- a) LV service transformers
- b) Modification of existing 6.6kV Switchgear located in Unit#5 to suit the new CW and ACW pumps ratings.
- c) Modification of existing 6.6kV Switchgear existing motor feeders located in Unit#5 used for CT MCC to suit as per the transformer or tie feeders ratings.
- d) Modification of existing Clarified Water MCC with suitable rating and to accommodate newly proposed CT Make up pumps in Clarifier-1 area.
- e) 415V Power Control Centers, Motor Control Centers , Distribution Boards, Local starters and Local Push Button Stations.
- f) Extension / Modification of existing PMCC / MCC based on the geographic location of the pump loads.
- g) HT and LT Motors
- h) Electric actuators
- i) LT Power cables and control cables for all the equipment supplied by the Vendor
- j) HT, LT Power cables, control cables and signal cables between existing switchgear, control panel and CT Make-up Water Treatment & CW System Switchgear / Control panel / Motors / equipment.
- k) Cabling system complete with cable trays, supports, conduits, glands, lugs etc for all the cables covered in the Bidder's scope.
- l) Illumination system (Indoor & outdoor) complete with lighting distribution boards, lighting panels, lighting fixtures, lighting poles, receptacles, fans, conduits, wires, switch boxes etc
- m) Fire sealing system for cable penetrations in the walls/floors.
- n) Complete earthing system including, equipment earthing.
- o) Electronic earthing system with earth pits
- p) Lightning protection system for all the buildings, structures and equipments, if applicable.
- q) Safety equipments such as Rubber mats, First aid box, Danger plate, Sand buckets etc.



- r) Engineering of complete Electrical system including preparation of required sizing calculations, layouts, scheme diagrams, cable schedules, Interconnection schedules, relay setting calculation etc.
- s) Mandatory spares .
- t) Recommended spares for three (3) years of operation and maintenance
- u) Any other electrical equipment and accessories required to complete the system

## 2.0.0 TERMINAL POINTS

HT Power Supply : HT power supply envisaged at 6.6 kV existing Unit-5 Switchgear

415 V AC Supply : Power supply envisaged at 415 V existing MCC panels. Necessary modification in the existing PCC shall be in the bidder scope.

415 V AC Emergency Supply : Power supply envisaged at 415 V Emergency Switchgear.

220 V DC Supply : 2 nos. 220 V DC supply will be provided at existing DCDB. Necessary feeder installation in the existing DCDB shall be in the Bidder Scope.

UPS Supply : 2 nos. UPS supply will be provided in existing UPS DB. Necessary feeder installation in the existing UPS DB shall be in the Bidder Scope.

Earthing : 2 nos. earth rod riser will be provided near CW system Panels for above ground earthing.

It is not the intent to specify completely herein all details of the design and manufacture. However, the equipment shall conform in all respects to high standards of design engineering and workmanship and shall be capable of performing in continuous commercial operation up to bidder's guarantee.

The general terms and conditions, instruction to bidders and other attachment referred to elsewhere be hereby made part of the technical specification. The bidder shall be responsible for and governed by all requirements stipulated in the specification.

Deviations if any, should be brought out very clearly on deviation sheet enclosed with the specification only. Otherwise it will be construed that the bidder's offer is in line with what has been stated /asked for in this specification.

## 3.0.0 GENERAL REQUIREMENTS

- 3.1.0 All the materials and equipment furnished for permanent installation shall be new, unused, and undamaged. Asbestos containing materials are not allowed.



- 3.2.0 All equipment shall be boxed, crated, or otherwise protected during shipment, handling, and storage. Coated surfaces shall be protected against impact, abrasion, discoloration, and other damages. Surfaces which are damaged shall be repaired. Electrical equipment, controls, and insulations shall be protected against moisture and water damage. All equipment during storage shall be protected against damage due to acts of nature or accidents. The storage instructions of the equipment manufacturer/Owner shall be strictly adhered to.
- 3.3.0 Similar equipment and components shall be of same make. Equipments of same type and rating shall be interchangeable.
- 3.4.0 The successful bidder shall be responsible for safety of human and equipment during the working.
- 3.5.0 The manufacturer whose equipment are offered should have designed, manufactured, tested and supplied the same for the specified system voltage and which are in satisfactory operation for at least Five (5) years as on date of bid opening.
- 3.6.0 Electrical installations shall fully comply with the following:
- Indian Electricity Act and Rules
  - Regulations laid by the office of the Chief Electrical Inspector of the Government (CEIG)

### 3.7.0 Power Supply

- 3.7.1 Feeders for HT motors will be envisaged from 6.6kV existing Unit-5 Switchgear. Two numbers of feeders will be envisaged at existing 415V PCC for CW System MCC. Similarly two numbers of feeders will be envisaged for DC and UPS system in existing DB's In case, CW system loads are located at various locations, power supply to such loads needs to be catered from nearest available switchgears.
- 3.7.2 To supply LT motors (rated up to 160 kW) and other loads, required numbers of PMCC shall be provided. PMCC shall comprise two incomers and a bus coupler. Each incomer shall be rated to feed both the bus sections.
- 3.7.3 Required number of Motor control centres (MCC) shall be provided. MCCs shall receive power from PMCC. Each MCC shall comprise two incomers and a buscoupler. Each incomer shall be rated to feed both the bus sections.
- 3.7.4 To provide Uninterrupted power supply to PLC and other Control Panels, 230V AC UPS supply will be provided from existing UPS DB.
- 3.7.5 To feed Control Supply to Switchgears / Panels, Emergency DC lighting etc, 220V DC supply is envisaged. , A separate DCDB shall be provided with two incomers and a bus coupler. Redundant 220 V DC supply will be provided to the Bidder from existing 220V DCDB .
- 3.7.6 Power cables & control cables between Switchgear located at Unit-6 and CW system switchgear shall be laid on overhead cable trays / cable trenches with cable trays.



**3.7.7** For new Cooling Water System of Unit#5, the HT loads are to be decided. The existing ratings are as follows:

- a. CW pump - 1500kW - 2 Nos.
- b. ACW pump - 665kW - 2 Nos.
- c. CT transformers to feed CT MCC - 2500kVA - 2 Nos.

**3.7.8** The feeders for new 2 nos. of CW and 2 nos. of ACW pumps can be taken from existing 6.6kV switchgear of Unit#5. The switchgear details are:  
SSIIIA-Panel Nos.3, & 5  
SSIIIB- Panel Nos.4 & 6

**3.7.9** For 2 nos. of CT transformers, the existing 6.6kV switchgear of Unit#5. The switchgear details are:  
SSIIIA-Panel Nos.7  
SSIIIB- Panel Nos.5

**3.7.10** Bidder to quote the minimum load requirement of CW system during his offer submission.

**3.8.0** Equipment offered shall be capable of delivering the rated output continuously without exceeding the specified temperature limits under the following operating conditions.

- Voltage variation of  $\pm 10\%$  of rated voltage of that particular tap.
- Frequency variation of  $+3\% - 5\%$  of rated frequency.
- Combined voltage and frequency variation of 10% (absolute sum).

**3.9.0 Power supply voltage proposed are as follows:**

Motors rated above 160 kW	: 6.6 kV supply, 50Hz
Motors rated $> 0.2$ kW and $\leq 160$ kW	: 415V, 50Hz
Motors rated up to 0.2 kW	: 240V, 50Hz
Lighting	: 240V, 50Hz
Panel lighting & Space Heater	: 240V, 50Hz
DC Motors	: 220V DC
UPS Supply	: 230V, 50 Hz
Control Supply for HT Switchgear	: 220V DC
415V Breaker Control Supply	: 220V DC
Control & Relay panels	: 220V DC
415V MCC Control Supply	: 110V, 50Hz

**Short circuit withstand rating**

HT Switchgear	: 40 kA for 3 second
415V PMCC, MCC	: 50 kA for 1 second

**3.10.0 Neutral Grounding System**

Neutral of the LV winding (433V) of Service Transformer shall be solidly grounded. 220V DC systems shall be ungrounded.



### **3.11.0 Spare feeders**

For HT Switchgear/ 415V PMCC/MCC/DBs, 10% spare feeders with a minimum of one each of each type and rating shall be provided.

10% spare terminals shall be provided in terminal blocks for control circuits.

### **3.12.0 Controls of Plant Electrical:**

**3.12.1** Electrical system shall be controlled from PLC. Required Analog and digital signals 415V PMCCs and MCCs shall be wired to PLC.

**3.12.2** In PLC, the controls shall be provided for the following.

- 415V PMCC/MCC - incomers, buscoupler, all motor feeders and outgoing breaker feeders.

**3.12.3** Synchronising of supplies at LT boards shall be carried out from PLC.

**3.12.4** Auto / Manual changeover shall be envisaged at 415V PMCC/MCC level. Selector switches with suitable scheme shall be provided.

**3.12.5** Auto changeover: If there is an under voltage (dipped to 30-40% voltage) on any one of the buses, sensed through under voltage relays, the respective incomer breaker shall trip automatically and the bus coupler shall close, if the voltage is available on the other bus section, thereby establishing voltage at motor terminals before motor reaches standstill condition. The auto changeover shall be blocked if any of the following condition exists:

- Any of the involved breakers is in the test or withdrawn position.
- Source voltage is not available.
- Source breaker is tripped due to bus fault.

**3.12.6** For 415V PMCCs, manual changeover shall be on dead bus and live bus. During live bus changeover, the breaker to be brought in shall be closed after checking synchronism between the incomer and running bus and the breaker to be taken out shall be tripped out automatically through a trip selector switch. In the event of selected breaker failing to trip, the incoming breaker shall be tripped after a time delay.

**3.12.7** For motors, Local Emergency Start/Stop Pushbuttons (LPB) shall be provided. Stop push button shall be latched type mush room.

**3.12.8** For Motor feeders, Local / Remote selector switch shall be provided in MCC / switchgear. Local selection is envisaged for trial start of motor from LPB. Remote selection shall enable starting from PLC.

**3.12.9** For feeders, Local / Remote/MCC selector switch shall be provided in MCC / switchgear. Local selection is envisaged for operation from LPBS. Remote selection shall enable operation from PLC.



**3.12.10** Operation of electrical system including breaker operation, auto/manual changeover, Synchronization, metering, annunciation, indication of various parameters / signals of electrical system including display of complete single line diagram of electrical system shall be carried out in PLC. For further details, C&I section of the specification shall be referred.

**3.12.11** Electrical motor operated actuators shall have integral starters.

### **3.13.0 Layout Aspects**

**3.13.1** Separate switchgear room shall be provided to accommodate 415V PMCC/MCCs near cooling tower area.

**3.13.2** Dry type transformers, if any, shall be located indoor.

**3.13.3** For Single front switchboards wherever provided the minimum clearance of 1500mm shall be provided on rear of panel where rear door width is less than 1500mm. For double front boards, clearance from wall/column shall be 1500 mm.

**3.13.4** For installations with two rows of LT boards facing each other, minimum clearance of 2000 mm will be maintained in between fronts of boards. For installation of two rows of HT switchgear or one row of HT and one row of LT switchboard facing each other minimum clearance of 3000mm shall be maintained in between front boards. Clearance between adjacent panels in a row shall not be less than 800 mm. However actual clearance shall be firmed up during detailed engineering stage.

**3.13.5** Switchgear/MCC rooms shall have two doors. For switchgear rooms, doors shall be fire rated.

**3.13.6** All Switchboards, distribution boards, UPS, Charger, Control panels, Battery shall be located indoor.

**3.13.7** Battery shall be located in separate room & shall not be located at the ground floor. The acid/alkaline resistant protective coating for the battery room floor and 4 feet high on the wall surfaces. Exhaust fans shall be provided for Ventilation. An eye wash basin shall be provided in each battery room.

**3.13.8** In cable vault provision for circulation of clean air shall be made with ventilation fans. Cable spreader room shall have a minimum height of 3.5 m and switchgear room shall have a minimum height of 4.5 m. Cable vault floors shall have all openings properly ridged to prevent water drainage into the room below. In addition proper facilities shall be provided at cable vault floor to drain the water in case of operation of sprinkler system. Cable vault shall be used for cable laying purpose only. No other installation shall be permitted in it. Effort shall be taken to accommodate other installation on switchgear/control room floor or next higher floor.

**3.13.9** Flexibility shall be kept for handling of equipment without obstruction both during erection and maintenance. Adequate handling facilities, space, door/rolling shutter of adequate width and height shall be provided for the purpose.

**3.13.10** All LT busduct shall enter the PMCC/MCC from top



- 3.13.11 Generally all electrical room shall be provided with 2 doors in addition to the shutters provided for handling transformer, switchgear, panels etc. Air-conditioned rooms shall be provided with double door.
- 3.13.12 Switchgear shall be arranged to minimize interference with floor beam. Where interference is unavoidable dummy panels shall be provided.
- 3.13.13 Minimum clearance from top of busduct to all type of obstructions shall be at least 1000mm and minimum clearance between LT Switchgear to LT dry type transformers shall be maintained as 1500mm.
- 3.13.14 Two nos. of CW and two nos. of ACW pumps are to be installed in the space available in CWP#6.
- 3.13.15 All the 6.6kV breakers to be considered for CW and ACW should be retrofitted with suitable ratings to meet the purpose.
- 3.13.16 Existing motor feeders used for CT MCC are to be modified suitably as per transformer / tie feeders rating by suitably changing the protection scheme.

#### 4.0.0 VENDOR LIST

- 4.1.0 The equipment supplied shall be of proven design, incorporating the latest generation technology, best engineering practice and of reputed make.
- 4.2.0 Makes of all electrical equipment and accessories are subject to prior approval by the Owner. Similar equipment and components shall be of same make. Equipment of same type and rating shall be interchangeable. For various other items, proposed vendor list is attached in Table-A.

#### Electrical Drawings & Documents for approval

- a) Design basis for Electrical system
- b) Technical Data sheets
- c) Feeder list & SLD of LT switchgear.
- d) LT Switchgear (PMCC/MCC/DB)
  - i. Single line diagrams
  - ii. Control Schemes
  - iii. Technical particulars
- e) LT Motors:
  - i. General Arrangement Drawing for Motor
  - ii. GA drawing for Terminal box
  - iii. Technical Datasheet for Motors
  - iv. For LT Motors above 90KW rating:
    - Torque Vs Speed curve of motor with driven equipment torque speed curve superimposed.
    - Locked rotor curves (HOT & COLD)
    - Starting characteristics (at 80% & 100% rated voltage)
    - Performance curve (Output Vs efficiency, Output Vs Current, Output Vs Slip)



- f) Cables
  - i. Sizing calculation
  - ii. Technical particulars
  - iii. BOQ
- g) Cable trays & cabling accessories
  - i. Technical particulars
  - ii. GA Drawings
  - iii. BOQ
- h) Illumination System
  - i. Technical particulars
  - ii. GA Drawings
  - iii. Lighting design calculation
  - iv. Lighting layouts
- i) Earthing & Lightning protection system
  - i. Technical particulars
  - ii. Earthing design calculation
  - iii. Earthing & Lightning protection layouts
- j) Electrical equipment layout
- k) Cable Tray Layout.
- l) Interconnecting Cable Schedule
- m) Quality Plan
- n) Type test certificates



**TABLE-A**  
**VENDOR LIST**

SL. NO.	ITEMS	VENDORS
1	MOTOR ACTUATORS	ROTORK
		AUMA
		LIMITORQUE
		ANTIREB
		EMCO
2	LT POWER AND CONTROL CABLES	UCL
		CCI
	.	KEI INDUSTRIES LTD
		FINOLEX
		FORT GLOSTER
		POLYCAP
		DELTON
		ASIAN
		NICCO
		PARAMOUNT CABLE CORPN.
		PARAGON CABLE
		KRISHNA ELECT. INDUSTRIES
		DASHMESH CABLES
		INCOM WIRES & CABLES LTD.
		TERACOM LTD. (P) RALLISON ELECT
3	CABLE TRAYS	VENUS STEEL,
		INDIANA,
		VATCO
		RATAN PROJECTS & ENGG LTD. KOLKATA
		KANADE ANAND UDYOG, MUMBAI,
		PATNY SYSTEMS(P) LTD. HYD, DOLPHIN
		INDUSTRIAL PERFORATION (I) PVT LTD., KOLKATA
		PREMIER POWER PRODUCTS (CAL) PVT LTD, KOLKATA
		UNITECH FABRICATORS AND ENGINEERS PVT LTD., KOLKATA



SL. NO.	ITEMS	VENDORS
		ASSOCIATED POWER STRUCTURES PVT. LTD., GUJRAT
		JAMNA METAL CO. PVT LTD., DELHI
		RUKMANI ELECTRICALS & COMPONENTS PVT LTD., KOLKATA
4	VFD (LT MOTORS)	ABB
		SIEMENS
		L&T
		ALLEN BRADLEY
5	ANNUNCIATOR	PROCON
6	HOOTER	KHERAJ
		TULLU
		VAISHNO
7	CONTROL PANELS/ LIGHTING	POSITRONICS.
	PANELS/ JBS	CONTROL & SCHEMATIC
		VIMAC ELECTRIC
		PRITHVI TECHNOLOGY
		POWEROL PANEL & CONTROL
		L&T
		SIEMENS
		SCHNEIDER
8	CIRCUIT BREAKER	L&T
		SIEMENS
		ABB
		SCHNEIDER
		GE
9	POWER CONTACTOR/ AUXILIARY CONTACTOR	SIEMENS
		L&T
		ABB
		SCHNEIDER
10	NUMERIC PROTECTION RELAYS	ABB
		GE
		SCHNEIDER
		AREVA



SL. NO.	ITEMS	VENDORS
		SIEMENS
11	AUXILIARY RELAY	GEC
		SIEMENS
		JYOTI RE-300
		L&T
		ABB
		SCHNEIDER
12	THERMAL O/L RELAYS	L&T
		SIEMENS
		ABB
		SCHNEIDER
13	PUSH BUTTONS/INDICATING LAMP	SIEMENS
		L&T
		CANDS
		TEKNIC
		SCHNEIDER
14	ELECTRICAL PANEL METER / INDICATING INSTRUMENTS (AMMETER / VOLTMETER)	AEP
		IMP
		MECO
		RISHABH
15	CT	KAPPA
		SILCON
		PRAYOG
		PRAGATI
		CANDS
		PRECISE
16	PT	KAPPA
		SILCON
		PRAYOG
		PRAGATI
		CANDS
		PRECISE
17	CONTROL TRANSFORMERS	KAPPA
		SILCON



SL. NO.	ITEMS	VENDORS
		POWER PACK
		PRAGATI
		CANDS
		PRECISE
18	POWER SWITCH	SIEMENS
		L&T
		GE
		ABB
		SCHNEIDER
19	SELECTOR SWITCHES AND CONTROL SWITCHES	KAYCEE
		SIEMENS
		L&T
		RECON
		SWITRON
20	TIMERS	GEC
		ABB
		SCHNEIDER
		L&T
		EIPL
21	FUSES	GEC
		SIEMENS
		L&T
		STANDARD
		BUSSMANN
22	MCCB	L&T
		SIEMENS
		AEG
		SCHNEIDER
23	MCB	MDS
		SIEMENS
		SCHNEIDER
24	TERMINAL BLOCKS & ACCESSORIES, SIDE CLAMP	CONNECT WELL IND.
		ELMEX CONTROLS
		WAGO AND CONTROLS



SL. NO.	ITEMS	VENDORS
25	DOUBLE COMPRESSION	COMET
	CABLE GLAND	ELECTRO MAG
		COSMOS
		POWER ENGG
26	CRIMPING LUGS	DOWELL
27	LIGHTING FIXTURES	PHILIPS
		CGL
		BAJAJ
		GE
28	CONDUIT	SENCO
		M. CHANDRA
		NAGARJUNA
		K. K. IND. KOLKATA



## SECTION : 3.1- MOTORS

### 1.0.0 INTENT OF SPECIFICATION

This section covers the technical requirements of HT and LT Motors.

### 2.0.0 CODES AND STANDARDS

The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest edition (including amendments) of the following Indian Standards (IS), IEC publications and other codes except where modified and /or supplemented by this specification.

- a) IS: 325 Three phase induction motors
- b) IS: 12615 Energy efficient induction motors
- c) IS: 900 Code of practice for installation and maintenance of induction motors
- d) IS: 996 Single-phase AC induction motor for general purpose
- e) IS: 1231 Dimensions of three-phase foot-mounted induction motors
- f) IS: 2223 Dimensions of flange mounted AC induction motors
- g) IS: 4029 Guide for testing three-phase induction motors
- h) IS: 8789 Values of performance characteristics for three-phase induction motors
- i) IS: 13555 Guide for selection and application of 3-phase AC induction motors for different types of driven equipment
- j) IS: 5571 Guide for selection of electrical equipment for hazardous areas
- k) IS: 12065 Permissible limits of noise level for rotating electrical machines
- l) IS: 12075 Mechanical vibration of rotating electrical machines
- m) IS: 9334 Electrical motor operated actuators
- n) IS 60034-5 Degree of protection provided by Integral design of rotating electrical machines
- o) IS 60034-8 Terminal marking and direction of rotation
- p) IS 60079-1 Equipment protection by flame proof enclosure
- q) IS 60034-1 Rotating electrical machines.
- r) IS 60079 Explosive atmospheres
- s) IS/IEC 60529 Degrees of protection provided by enclosures (IP code)
- t) IEC 60034 Rotating electrical machines.

### 3.0.0 TECHNICAL REQUIREMENTS

#### 3.1.0 Design ambient temperature

Motors shall be suitable for an ambient temperature of 50 degree C and relative humidity of 95% and shall deliver the rated output without exceeding its guaranteed temperature limits.



### 3.2.0 Supply voltage

Motors rated up to and including 415V are termed as LT motors and the motors rated higher than 415V are termed as HT motors.

Motors shall be capable of delivering the rated output under following voltage and frequency variations without exceeding its guaranteed temperature limits.

- Frequency variation : (+) 3% and (-) 5%
- Voltage variation for LT motors : ( $\pm$ ) 10%
- Voltage variation for HT motors : ( $\pm$ ) 10%
- Combined variation of voltage and frequency : 10% (absolute sum)

All the motors shall be so designed that maximum inrush currents, locked rotor torque and pullout torque developed at extreme voltage and frequency variations do not endanger the motor and the driven equipment.

### 3.3.0 System Parameters

Sl. No.	Description	HT System	LT System
1.	Voltage level	6.6 kV Above 160 kW	240 V : up to 0.2 kW 415 V : >0.2 kW and up to 160 kW.
2.	System earthing	Unearthed System	415V: Solidly grounded.
3.	System fault level	40 kA for 3 sec	50 kA for 1 second
4.	Fault withstand rating of motor terminal box (Breaker operated)	40 kA for 0.25 sec	50 kA for 0.25 second

### 3.4.0 Type

- AC Motors shall be squirrel cage induction type unless otherwise it is specified.  
All the motor shall be bi-directional.

### 3.5.0 Duty

- All AC motors shall be squirrel cage three phase/single phase induction motors.  
All the motor shall be designed for bi-directional rotation.
- Motors shall be suitable for installation in hot, humid and tropical atmosphere and polluted at places with coal ash and or fly ash.

### 3.6.0 Design margin

- Motor rating shall be selected higher than the maximum load demand of the driven equipment, as per the criteria stated in mechanical section of this specification, under entire operating range, including voltage and frequency variation.



- The motor name plate rating shall have more than 10% margin over the input power requirement of the HT driven equipment and 15% for LT driven equipment at rated duty point.
- The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating; pull up, breakdown and full load torques are available for the intended service.
- Service shall be considered as 1.0 only.

### 3.7.0 Method of Starting

- All the motors shall be suitable for direct on-line starting on full load.
- HT Motors will be controlled through vacuum circuit breaker.
- LT motors rated up to 90kW will be controlled through MPCB/MCCB and contactor. LT motors rated more than 90 kW will be controlled through air circuit breaker

### 3.8.0 Efficiency

All the continuous duty motors shall be energy efficient type. For LT motors, it shall be IE3 class as per IS 12615.

### 3.9.0 Temperature rise

- Winding Insulation shall be Class F.
- Temperature rise of motors shall not exceed 70°C over air temperature of 50°C by resistance method, while delivering its maximum rated output.

### 3.10.0 Starting voltage

- a) Motors shall be capable of starting and accelerating the load at following starting voltage, with direct on line starting, without exceeding specified winding temperatures.
  - HT Motors : 85% of rated voltage
  - LT motors : 80% of rated voltage
- b) During fast changeover of power supply source, vector difference between the motor residual voltage and the incoming supply voltage will be about 150% of the rated voltage and the motors shall withstand voltage stress and torque stress developed during that time, which may last for a period of one (1) second.
- c) The motor shall be capable of operating at full load at a supply voltage of 80% of the rated voltage for 5 minutes.
- d) The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.
- e) Motor shall not stall if the supply voltage drops to 70% of the rated voltage two (2) second duration



### 3.11.0 No. of Starts

Continuous duty motors shall be suitable for the following starting requirements under the specified conditions of load, torque and inertia.

- No. of consecutive hot starts shall be 2 (with initial temperature of the motor at full load operating level).
- No. of consecutive cold starts shall be 3 (with initial temperature of the motor at ambient temperature).

### 3.12.0 Starting current

- Motor shall be designed for direct online starting at full voltage. Starting current shall not exceed 6 times full load current for all auxiliaries. No further tolerances are applicable on starting current specified above for HT motors.
- For LT motors, the applicable starting current shall be limited to 7.2 times of full load current including all tolerance.

### 3.13.0 Locked rotor withstand time

- The locked rotor withstand time for HT motors under hot conditions at 110% rated voltage shall be more than the starting time at minimum permissible voltage specified above by atleast three seconds or 15% of the accelerating time whichever is greater.
- For the LT motors having starting time upto 20 seconds at minimum permissible voltage, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 seconds more than the starting time.
- For the motors having starting time more than 20 seconds and up to 45 seconds at minimum permissible voltage, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 seconds more than the starting time.
- For motors having starting time more than 45 seconds at minimum permissible voltage, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.
- The motors shall be designed to withstand 120% of rated speed for 2 minutes without any mechanical damage

### 3.14.0 Torque Requirements

- Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.
- Pull out torque at rated voltage shall not be less than 205% of full load torque.
- Motors subjected to reverse rotation shall be designed to withstand the stresses encountered when starting with non-energized shaft rotating at 125% of rated speed in reverse direction.
- The motor shall be designed to withstand momentary overload of 60% of full load torque for 15 second without any damage.



### 3.15.0 Enclosure

- a) All motor enclosures shall conform to the degree of protection IPW 55 unless otherwise specified. Motor for outdoor or semi outdoor service shall be of weather proof construction.

### 3.16.0 Cooling

- LT motors shall be totally enclosed fan cooled (TEFC), type IC411. The cooling shall be effected by self driven bi-directional centrifugal fan protected by fan cover.
- HT motors can be totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or closed air circuit air cooled (CACA) type.
- Motors rated >3000kW can be closed air circuit water cooled (CACW).
- Motors with CACA/CACW heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate the following:
  - Hot and cold air temperatures of the closed air circuit for CACA motors.
  - Hot and cold, air and water temperatures for CACW motors.
- The Alarm switch contact rating shall be minimum 0.5 A at 220 V DC and 5A at 240 V AC.

### 3.17.0 Winding

- Winding shall be class F insulation with temperature limited to class B. Insulation shall be Non-hygroscopic, oil resistant, and flame resistant. Winding, fittings and hardware shall be corrosion resistant. Winding shall be tropicalized and suitably varnished, baked and treated for operating satisfactorily in humid and corrosive atmosphere.
- For the VFD operated drives, insulation shall be designed to take care of stresses due to high dV/dt. Motors shall be wound with dual coated winding wires and impregnated with VPI process. Further for such application, insulated bearings shall be provided to avoid circulating current caused by shaft induced voltages.
- Space heaters rated for 240V AC, 50 Hz supply shall be provided for motors rated 30kW and above to maintain windings in dry condition when motor is standstill.
- For HT motors, insulation shall be Vacuum Impregnated (VPI).
- HT motors shall withstand 1.2/50 microsec impulse Voltage wave of 4U+5 kV (U=Line voltage in kV). The coil inter-turn insulation shall be as per IEC-60034 – Part 15 followed by 1 min power frequency high voltage test of appropriate voltage on inter turn insulation.

#### Temperature Detectors

- All 6.6 kV motors shall be provided with six (6) nos. duplex, or twelve (12) nos. simplex type winding temperature detectors, i.e. two (2) nos. duplex or four (4) nos. Simplex per phase.
- 11kV motor bearing shall be provided with duplex type temperature detectors.



- The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0°C.
- Leads of all simplex type motor winding RTDS and motor bearing RTDS shall be wired up to respective switchgear metering & protection compartment. From which one set of RTDS will be connected to numerical protection relay and another set shall be kept free for PLC connectivity.

### 3.18.0 Bearings

- Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application. Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.
- Sleeve bearings shall be split type, ring oiled with permanently aligned, close running shaft sleeves. Grease lubricated bearings shall be pre-lubricated and shall have provisions for in-service positive lubrication with grease nipple and relief holes.
- Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred. However, if anti-friction bearings can take vertical thrust, thrust and guide bearings are not required.
- Lubricant shall not deteriorate under all service conditions. The lubricants shall be limited to normally available types. For motors rated 30kW and above re-lubrication facility shall be provided.
- For motor with forced lubrication, a shaft driven oil pump shall be provided along with an electrical auxiliary pump. Alternatively, two motor driven pumps may be provided, one working and one standby. All necessary auxiliaries and accessories shall be provided to complete the system. A pressure gauge and pressure switch for low oil pressure warning and to start the standby oil pump automatically shall also be provided. A motor driven jacking oil pump may be provided, for heavy shaft loads.
- Flow switches shall be provided for monitoring oil flow of forced lubrication bearings, if used. Alarm switch contact rating shall be minimum 0.5 A at 220 V DC and 10A at 230 V AC.
- For bearing temperature measurement, duplex RTDs shall be provided for each bearing and shall be wired upto the terminal box.
- Each bearing shall be provided with dial type thermometer.
- For all VFD operated motors and other motors rated above 1000KW having shaft length more than 1.5M shall have insulated bearings to prevent flow of shaft currents.

### 3.19.0 Terminal Boxes

- Separate terminal boxes of IP 55 degree of protection shall be provided for stator leads. For single core cables, gland plate shall be non-magnetic material. Terminal box shall be capable of being turned 360° in steps of 90°, unless otherwise approved. The terminal boxes shall be split type with removable cover with access to connections.



- Terminals for motors shall be stud type, thoroughly insulated from the frame. The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.
- The terminal box shall be capable of withstanding maximum system fault current for 0.25 sec for all breaker operated motors and shall be provided with explosion vent.
- For contactor operated LT motors, the terminal box shall be capable of withstanding the fault current for 0.2 sec minimum and operating time of MPCB/MCCB.
- Removable gland plates of thickness not less than 2.5 mm sheet steel or 3 mm aluminium (for single core cables) shall be provided for cable boxes.
- Cable spreader box shall be provided for larger cable sizes.
- Cable boxes of HT motors shall be phase segregated type. The terminals of three phases shall be segregated by barriers of metal or fibre glass. For HT motors, cable box design shall be suitable for accommodating cable termination kits.
- Separate terminal box for space heaters shall be provided.
- A separate terminal box of IP 55 degree of protection shall be provided for temperature detectors.
- Motor 1000 KW and above shall be provided with three differential current transformers mounted over the neutral leads within the enclosure. Required CT for mounting on switchgear side shall be provided. The arrangement shall be such as to permit easy access for C.T. testing and replacement. Neutral terminal box shall have IP 55 degree of protection.
- The secondary leads of CT shall be wired to separate auxiliary terminal box of IP 55 degree of protection
- All the accessory terminal boxes shall be located on the same side of the main (power) terminal box.
- For LT motors, terminal box shall be located on top, unless otherwise specified.

### 3.20.0 Earthing Terminals

The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer. The terminal box shall have a separate grounding terminal.

The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.

The grounding connection shall be suitable for accommodation of ground conductors as follows :

- Motor above 90 KW : 75 x 10 mm GS Flat
- Motor above 30 KW up to 90 KW : 50 x 6 mm GS Flat
- Motor above 5 KW up to 30 KW : 25 x 3 mm GS Flat
- Motor up to 5 KW : 8 SWG GI Wire



### 3.21.0 Noise and Vibration

- Motors shall be selected with low noise levels in accordance with IS 12065.
- The peak amplitude of the vibration shall also be within the specified limits of IS: 12075.
- All HT motors shall be provided with vibration pads for mounting monitoring & recording system .

### 3.22.0 Name Plates

Motor shall have stainless steel nameplate(s) showing diagram of connections, all particulars as per IS: 325 / IS: 12615 and shall also have 'BEE' marking.

In addition to the minimum information required by IEC/IS, the following information shall be shown on motor rating plate:

- Temperature rise in °C under rated condition and method of measurement.
- Degree of protection.
- Bearing identification no. and recommended lubricant.
- Location of insulated bearings.

### 3.23.0 Drain plug

Motor shall have drain plugs so located that they will drain the water, resulting from the condensation or other causes from all pockets of the motor casing.

### 3.24.0 Lifting provision

Motor weighing 25 Kg. or more shall be provided with eyebolt or other adequate provision of lifting.

### 3.25.0 Dowel pins

The motor shall be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment

## 4.0.0 INSTALLATION

Installation shall be carried out as per IS: 900.

## 5.0.0 PAINTING

Painting shall be carried out by an approved process. Pretreatment shall conform to applicable standard. The equipment shall be subject to a coat of red oxide primer paint. All inside and outside surface shall be painted with epoxy based paint. The final thickness of paint film on steel shall not be less than 100 microns. Paint Shade for the Motor shall be RAL 7032 (Siemens Grey). Sufficient quantity of touch-up paint shall be furnished for application at site.



## 6.0.0 TESTING AND INSPECTION

- 6.1.0 Tests shall be performed in presence of Owner's representatives. Successful Bidder shall give atleast fifteen (15) days advance notice for witnessing the tests. Copies of certified reports of all tests carried out at the works shall be furnished. The equipment shall be dispatched from works, only after receipt of Owner's written approval of the test reports.
- 6.2.0 Routine and Type Tests are to be conducted for all HT motors and for LT motors above 60 KW rating in presence of customer's representative as per IS:325 and required copies of test certificates are to be furnished for approval.
- 6.3.0 Test certificates for Routine tests conducted as per IS-325 for motors of rating 60 KW and below shall be submitted for review, approval and dispatch clearance.



## SECTION-3.2: ELECTRICAL ACTUATORS

### 1.0.0 INTENT OF SPECIFICATION

This section covers the requirements of motor operated electrical actuators.

### 2.0.0 CODES AND STANDARDS

The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest edition (including amendments) of the applicable Indian Standards (IS), IEC publications and other codes except where modified and /or supplemented by this specification.

### 3.0.0 TECHNICAL REQUIREMENTS

Electric actuators shall be provided where specified/required. It shall be equipped with 3 phase induction motor, rated for intermittent duty S4-25%.

Motor shall be class F insulated with temperature rise limited to class B.

Motor shall be surface cooled designed for enclosure protection class of IP 68. Motor shall be suitable for starting direct on line.

For installation in potentially hazardous areas, the actuators shall have suitable explosion proof / flame proof type enclosure.

Actuators shall be suitable for operation at an ambient temperature of 50 degree C and relative humidity of 95%.

Motors shall be capable of operating under following supply variations without exceeding its guaranteed temperature limits.

- Frequency variation : (+) 3% and (-) 5% of 50 Hz
- Voltage variation for LT motors : ( $\pm$ ) 10% of 415 V
- Combined variation of voltage and frequency: 10% (absolute sum)

All actuators shall be of integral type. Duty cycle of actuators shall suit the system requirement. The actuators shall be capable of giving the required torque at the output shaft. The actuators shall be designed to take the full thrust.

Actuators shall be of totally enclosed weather proof and dust proof construction with NEMA-6/IP 68 enclosure and shall be suitable for outdoor application without the necessity for a canopy. The actuator shall be suitable for mounting directly on the valve. The actuator shall be capable of giving the required torque, rpm and thrust without the help of any spur gear arrangement. The actuator shall be suitable for mounting in any position. Actuators shall be provided with integral starters.



The actuator shall be complete with motor, reduction gears, change gears, terminal compartment, switch compartment with limit switches and torque switches, local position indicator, position transmitter for remote position indicator, thermistor, space heaters, cable glands, mechanical position indicator, hand wheel for manual operation, valve attachment etc.

Each actuator shall have a hand wheel fitted on it for emergency operation. The hand wheel shall be designed such that it is declutched automatically when the power supply to the motor is restored. The material of the hand wheel shall be either malleable iron or steel. The hand wheel shall have adequate clearance from housing for each gripping and operation. Actuators offered shall be with self-locking worm.

Two number adjustable torque switches (one for open and one for close) each with 2 NO and 2 NC potential free contacts shall be provided. It is required to have calibration for the torque switches so that the switches can be easily set to any value desired.

Two numbers of position limit switches (one for open and one for close) each with 2 NO and 2 NC potential free contacts shall be provided. Two auxiliary limit switches (one for open and one for close) with 2 NO and 2 NC potential free contacts shall also be provided. The limit switches shall be of independently adjustable type. Limit switches and actuating mechanism shall be rust proof suitable for damp atmospheres. Limit switch compartment shall be weather proof and spacious enough for easy setting. The limit switches shall be suitable for the following ratings, both 240 Volts AC, 10 A and 220 V DC, 0.5 Amps.

Each actuator shall have a space heater in the limit switch compartment suitable for 240 V AC 50 Hz single phase supply.

The wiring from the limit switches, torque switches etc. shall be brought out in a separate terminal box of adequate size, so as to easily terminate the control cables.

Each actuator shall have a hand wheel fitted on it for emergency operation. The hand wheel shall be designed such that it is declutched automatically when the power supply to the motor is restored. The material of the hand wheel shall be either malleable iron or steel. The hand wheel shall have adequate clearance from housing for each gripping and operation. Actuators offered shall be with self-locking worm.

Actuators shall be supplied with integral starter which shall have sophisticated electronic controls with field programming feature.

A three position selector switch (marked as LOCAL-OFF-REMOTE) and push buttons OPEN-STOP-CLOSE (for local operation) with indication lamps for running OPEN and running CLOSE shall be provided.

The Remote command signal (OPEN-STOP-CLOSE) from PLC/Control panel shall be isolated from control electronics through opto-isolator.



The following individual status annunciation LED's (Colour-Green) shall be provided locally (Integral to actuator) to annunciate the following for easy local monitoring.

- Actuator in local mode
- Actuator in remote mode
- Actuator running in OPEN direction
- Actuator running in CLOSE direction
- Actuator in inching mode.
- Actuator in self-retaining mode
- Limit switch OPEN trip
- Limit switch CLOSE trip
- Control voltage availability

View port shall be provided on integral starter unit to monitor the above status annunciation.

The following individual fault annunciation LED's (Colour-Red) shall be provided locally. (Integral to Actuator)

- Torque switch OPEN
- Torque switch CLOSE
- Thermo switch trip
- Electronic overload relay trip
- Motor single phasing
- Common fault (Inclusive of any one or combination of above fault)

View port shall be provided on integral starter unit to monitor the above status annunciation.

Electronic overload relay shall be provided to trip actuator in case of overload.

Plug in connections/design shall be provided between:-

- Integral starter unit and basic actuator
- Between external customer connections and actuator.

OPEN-CLOSE indication /LED shall be provided for indication of full open/close position.

Automatic phase correction facility and potential free contact for annunciation of power failure shall be provided.

The following individual potential free relay contacts shall be provided in the actuator for remote annunciation to facilitate continuous monitoring of the actuator.

- Actuator (valve) running in OPEN direction.
- Actuator (valve) running in CLOSE direction.
- Actuator in remote mode.
- Actuator in local mode.
- Actuator power switched off /single phasing.
- Torque switch trip, thermo switch trip and thermal overload relay trip



#### 4.0.0 TESTING AND INSPECTION

Equipment offered shall be of type tested and proven type. Routine tests shall be carried out for all the equipment as per applicable standards.

Tests shall be performed in presence of Owner's representatives. Successful Bidder shall give atleast fifteen (15) days advance notice for witnessing the tests. Copies of certified reports of all tests carried out at the works shall be furnished. The equipment shall be dispatched from works, only after receipt of Owner's written approval of the test reports.



## SECTION : 3.3 LOW VOLTAGE SWITCHGEAR

### 1.0.0 INTENT OF SPECIFICATION

This section covers the technical requirements of low voltage switchgear.

### 2.0.0 CODES AND STANDARDS

The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest version of the relevant IS/IEC standards including amendments, if any, except where modified and/or supplemented by this specification. Some of the applicable standards are listed below:

- a) IS 12021 Specification for control transformers for switchgear and control gear for voltages not exceeding 1000V
- b) IS 13032 Miniature circuit breaker boards for voltages not exceeding 1000V
- c) IS/IEC 61439 Specification for low voltage switchgear and control gear
- d) IS 694 Specification for PVC insulated cables for working voltage upto and including 1100V
- e) IS 2705 Specification for current transformers
- f) IS 3156 Specification for voltage transformers
- g) IS 11353 Guide for uniform system of marking and identification of conductors and apparatus terminals

### 3.0.0 TECHNICAL REQUIREMENTS

3.1.0 Power cum Motor Control Centre (PMCC) shall have two incomers, two bus sections and a bus coupler. Each incomer / bus section shall be rated for full rating of the transformer.

3.2.0 Motor Control Centre (MCC) shall have two incomers, two bus sections and a bus coupler. MCC shall be fed from PMCC. Each incomer / bus section shall be rated to feed 100% load of MCC.

3.3.0 Distribution boards shall be provided to feed non motor loads.

3.4.0 Redundant mechanical loads shall be fed from separate MCC buses.

3.5.0 PMCC/MCC/ DB shall be rated for 415 V, 50Hz, 3-phase, 4 wire supply.



### 3.6.0 Current Rating

- 3.6.1 Ambient temperature prevailing inside the switchgear while carrying rated current, when the outside air ambient temperature is 50°C shall be considered as design ambient temperature for sizing the equipment/device/bus rating. Temperature rise shall be as per applicable IS/IEC standards. Continuous current rating shall be such that the temperature does not exceed 90°C. For silver placed joints the temperature shall not exceed 105°C.
- 3.6.2 The continuous current rating of the feeders shall be based on the name plate current rating of the connected equipment with 20% margin at design ambient condition, rounded off to next higher standard rating unless specified otherwise.
- 3.6.3 The continuous current rating of the incomers/tie feeders/main bus bars of Power Cum Motor Control centre (PMCC) shall be based on the name plate rating of the upstream transformer with 20% margin at design ambient condition, rounded off to next higher standard rating unless specified otherwise.
- 3.6.4 The continuous current rating of the incomers/tie feeders/main bus bars of other switchboards shall be based on the name plate rating of the all the connected loads with 20% margin at design ambient condition, rounded off to next higher standard rating unless specified otherwise.
- 3.6.5 For switchboards having two bus sections, each bus section, bus coupler and incomer shall be rated for the combined load requirements of both the bus sections.
- 3.6.6 MCCB / MPCB, contactor and Electronic overload relay for motor feeders shall meet type-2 coordination as per applicable standard.
- 3.6.7 Similar equipment and components shall be of same make. Equipment of same type and rating shall be interchangeable.

### 3.7.0 Protection

- 3.7.1 The Vendor shall be responsible for selection of protective devices so as to provide optimum protection and discrimination of various circuits and equipment including the safety of the devices. For motor feeders, coordination of overload relay and MPCB/MCCB with the thermal characteristics of the motor shall be ensured.
- 3.7.2 The incomer modules shall be interlocked with their upstream breaker such that they can be closed only when upstream breaker is closed and trip automatically when upstream breaker is tripped.
- 3.7.3 Each breaker module shall be provided with multifunction numerical relay for protection. Relays shall have built in protection, control & metering and communication modules shall be suitable for IEC-61850 protocol.
- 3.7.4 ACB controlled motor feeders shall be provided with Numerical motor protection relay along with the above protections as applicable.



- 3.7.5 Separate hand reset lockout relay (86) to be provided for each Breaker. In addition self reset type lockout relay to be provided on Bus PT Panel for Under voltage tripping the motor feeders.

### 3.8.0 Control

- 3.8.1 Incomers and bus sections of PMCCs shall be breaker controlled. Outgoing feeders of PMCC shall be controlled by breakers / moulded case circuit breakers (MCCBs) / Motor protection circuit breakers (MPCBs) /contactors depending on their ratings / applications.
- 3.8.2 Incomers and bus sections (if applicable) of MCCs shall be breaker controlled. Outgoing feeders of MCCs shall be controlled by MCCBs / contactors / applications.
- 3.8.3 Incomers feeders & outgoing feeders rated up to and including 400A shall be MCCB / MPCB controlled. Above 400 A, all incomers and outgoing feeders shall be breaker (ACB) controlled.
- 3.8.4 Motors rated below 90 KW shall be contactor operated and shall be fed from MCCs. All motors rated 90 KW up to and including 160 KW shall be breaker controlled. For motors rated 75 kW up to and including 160 KW shall be given with numerical motor protection relay.
- 3.8.5 Feeders of 415V PMCC/MCC shall be controlled from PLC or Local Push Button (LPB) Station or Local Control Panel (LCP) as per the requirement.
- 3.8.6 The design of the switchboard shall include all facilities/equipment required for remote control/monitoring of circuit breaker feeder from PLC system.
- 3.8.7 All motors shall be controlled and monitored from the PLC system.
- 3.8.8 The control/interlock schemes for various types of feeders shall be commensurate with their applications.

### 3.9.0 Changeover Scheme

- 3.9.1 All PMCCs and ACB operated MCCs will be normally operated with the bus section breakers open. Auto-changeover facility shall be provided for all such switchboards such that if there is a prolonged under voltage on any one of the bus sections, the respective incoming breaker shall trip and the bus section breaker shall close, provided voltage is available on the other bus section. This auto-changeover shall be blocked if the incoming breaker had tripped either on a bus fault or manually. Changeover back to the normal source of supply shall be done manually.
- 3.9.2 Planned changeover facility shall be provided for PMCC. When planned outage of one of the normal incoming supplies is required, the respective incomers shall be tripped automatically after the bus section breaker is closed manually through synchro-check relay. For this purpose, a trip selection shall be provided in PLC for selecting the incomer to be tripped. Thus, depending on the selection made, incomer to bus section A or to bus section B will be tripped once bus section breaker is closed manually, thus maintaining continuity of supply. A timer for annunciation of the running breaker failing to trip within a pre-set time, (i.e. if the two sources remain



paralleled for more than a pre-set time) shall be provided. When the normal supply is to be brought back into operation, the incomer breaker shall be closed through synchro-check relay whereupon the bus section breaker shall trip automatically. All hardware required for meeting the functional requirements stated above, whether specifically listed out in the specification or not, shall be included in the scope of supply.

#### 4.0.0 CONSTRUCTIONAL FEATURES

##### 4.1.0 General

- 4.1.1 PMCC/MCC/DB shall be metal enclosed, indoor, floor mounted and free standing type. Switchboard frames, load bearing members, doors and covers and gland plates shall be fabricated using CRCA sheet steel. The thickness of sheet shall be not less than 1.6mm for non-load bearing members and 2.0mm for load bearing members. Gland plate thickness shall be minimum 3.0mm.
- 4.1.2 PMCC/MCC shall be drawout type and distribution boards shall be fixed type with compartmentalized construction.
- 4.1.3 PMCCs/MCCs shall be double front type, unless specified otherwise. However, breaker feeders shall be single front type.
- 4.1.4 The switchboard shall be provided with an integral base frame /channel of at least 100mm height. Switchboard shall be mounted on channels embedded in concrete by tack welding base channels.
- 4.1.5 In switchgear room and control room, all PCC/PMCC/MCC/DB/SVB/FB enclosures shall conform to the degree of protection IP-54. For ampere rating up to 2000A – degree of protection of PCC/PMCC/MCC shall be IP-54 and above 2000A the degree of protection will be IP-42. Minimum thickness of sheet metal used shall be 1.6mm for non load bearing end and 2mm for load bearing end. The design shall be such that the specified degree of protection is achieved even after a breaker control module has been taken out of the panel.
- 4.1.6 Working height shall be limited between 200mm and 1800mm. However, for MCC modules minimum height shall be limited to 400mm..
- 4.1.7 The switchboards shall be arc proof tested. In the event of an internal fault in a functional unit, the damage shall be confined to that unit alone, so that the busbar system and all other functional units remain fit for further service. Switchgear assemblies shall comply with IEC 61641 with regard to internal arc testing.
- 4.1.8 The arrangement of feeders in the switchboard shall take into consideration the number and size of cables required for the feeders. Incomer and bus section ACB shall be limited to one per panel. ACB outgoing feeders shall be limited to two per panel for ratings upto 1000A. For higher ratings, the number of outgoing feeders shall be limited to one per panel.
- 4.1.9 Bus duct entry shall be from top and cable entry shall be from bottom. Switchboards shall be divided into distinct vertical sections (panels), each comprising of the following compartments:



- Main bus bar compartment
- Switchgear/feeder compartment
- Cable alley of at least 300mm width
- Auxiliary bus bar compartment
- Control compartment for relays for ACB feeder

4.1.10 Switchboard shall be of modular design, consisting of units or modules, segregated into single or multi-tier compartments. Each unit shall be placed in individual compartment. All units grouped together shall form the complete switchboard. Completed switchboard shall be of flush-fronted design having a neat appearance and shall be readily extensible.

Door shall be provided at the front of each compartment to give full access to all the components and the compartment. The switchboard shall consist of dust and vermin-proof cubicles.

Switchboard covers (including doors without interlock) shall be bolted on type and shall be designed to give access to individual circuits without exposing other circuits, which may be live. Alternatively, circuits exposed by the removal of the cover shall be individually shrouded.

4.1.11 The switchboards shall be designed to prevent contact with live parts both within the modules and in the cable alley. Following are the minimum segregations to be provided amongst the different parts of the switchboard:

- a) Main horizontal bus bar chamber and vertical bus bar chamber
- b) Between different modules
- c) Between modules and cable chamber
- d) Between auxiliary bus bars and the rest of the switchboard
- e) Between vertical bus bars and modules

All insulating materials used as partitions guards and shrouds shall be non-hygroscopic and flame retardant.

4.1.12 Interlock between compartment door and modules shall be provided such that the door cannot be opened without switching off the power supply to the module. Defeat interlock shall be provided for the units comprising of MCCB/MPCB as a means of isolation, such that it is possible to open the door with device ON and the unit in 'SERVICE' position. The following shall apply under these conditions:

- a) It shall not be possible to close the door till the interlock has been reinstated
- b) Attempted withdrawal of the unit under such conditions shall be cautioned against by providing warning label affixed at an appropriate place

4.1.13 Switchboards shall be equipped with thermostatically controlled space heaters in each panel (separate for front and rear in case of double fronted panels having separate cable alleys) so as to maintain interior temperature 5°C above the ambient. They shall have manual disconnect switch and MCB for protection.

4.1.14 All LT switchgear modules shall be provided with Pad lock and Key arrangement with Key rack located in Unit control room/ respective offsite area control room.



4.1.15 At least 20% of feeder modules covering the range of motors/ outgoing feeders used subject to minimum of one module in each bus section shall be provided as spare. Spare modules shall be completely wired up.

4.1.16 20% of control terminals in each module shall be provided as spare subject to a minimum of 2 terminals.

#### 4.2.0 Feeder Modules

4.2.1 Drawout modules shall have the following features:

- a) Withdrawal of units shall be possible without disconnecting wires.
- b) Drawout units of similar type and rating shall be interchangeable.
- c) Secondary connections to the drawout unit shall be through self-aligning and self-isolating contacts. In case of circuit breakers, easily disconnecting type plug and socket shall be acceptable in place of self-aligning and self-isolating type contacts.
- d) With the drawout module fully removed from its housing, live parts exposed shall either be finger proof or shall have means to shroud them totally to prevent contact. Suitable add-on type shrouds shall be provided where automatic shutters or in-built shrouds are not provided.

4.2.2 All single front switchboards shall be provided with single leaf, hinged or bolted covers at the rear. The bolts shall be of captive type. The covers shall be provided with 'DANGER' labels.

4.2.3 Drawout modules shall have distinct 'SERVICE' and 'TEST' positions. The equipment pertaining to a drawout type module shall be mounted on a fully withdrawable chassis, which can be drawn out without having to unscrew any wire or cable connection. Suitable arrangement with cradle/rollers and guides shall be provided for smooth movement of the chassis.

4.2.4 Each switchboard shall be provided with removable type gland plate, which shall cover the entire cable alley. For all single core cables, gland plate shall be of non-magnetic material.

4.2.5 The minimum clearance in air between phases and between phases and earth for the entire run of horizontal and vertical busbars shall be 25mm.

4.2.6 Switchboard shall be of unit construction suitable for splitting into sections for shipping to site and to be correctly re-erected on prepared foundations without skilled supervision. The individual shipping section shall comprise not more than three verticals. For each shipping section adequate lifting facilities such as hooks or lugs for ease of handling on site shall be provided. Removal of such hooks or lugs shall leave no opening in the switchboard.

4.2.7 The switchboard shall be easily extensible on either side by the addition of vertical sections. It shall be possible to extend the switchboard, irrespective of the type of end panel and the design shall be such as to permit addition of extension panels of a type other than the type of end panel. End bus bar fish plates shall be provided and the same shall be shipped as loose items.



- 4.2.8 Front access shall be available to all components in each cubicle which require adjustment, maintenance or replacement. Checking and removal of components shall be possible without disturbing adjacent equipment. All auxiliary equipment shall be easily accessible. Setting of relays shall be possible without de-energizing other equipment. Access shall be available to all cable glands and multi-core terminal blocks by means of sheet steel hinged doors, designed to give the maximum possible access to the cable terminations.
- 4.2.9 All interior barriers shall be manufactured from sheet steel. Each compartment shall be constructed and segregated to confine any damage caused by an internal fault to that compartment. Adequate barriers shall permit personnel to work safely within an empty switching device compartment or one from which the switching device assembly has been temporarily removed with bus energized.
- 4.2.10 The arrangement of feeders in the switchboard shall take into consideration the number and size of cables required for the feeders. Removable type un-drilled gland plates shall be provided on bottom of the panel. Suitable provision shall be made for clamping cables inside the switchboard. The cable terminations inside the cable alley shall be completely shrouded, so that it shall be possible to work on any one of the terminations by switching OFF the corresponding feeder switch only.
- 4.2.11 The arrangement of the feeders shall ensure that operating handle of the switch/breaker shall be above 350mm but below 1800mm from finished floor level.
- 4.2.12 Unless otherwise stated, equipment rating and module size shall be as per Annexure s as attached. Module selection chart is specified for guidance of Bidder in respect to requirement of module space and component rating.

#### 4.3.0 Bus Bars and Insulators

- 4.3.1 Each PMCC/MCC/DB shall be provided with three phase bus bars and one neutral bus bar as specified. DC distribution boards shall have two bus bars.
- 4.3.2 Bus bars (including neutral bus bar) shall be capable of carrying the short time current for the duration as specified, without any damage. Current carrying capacity of neutral bus bar shall be minimum half that of the phase bus bar.
- 4.3.3 Main bus bars shall be of interleaved type and connections shall be prominently marked and displaced for standard sequence counting from rear to front, top to bottom, or left to right as viewed from the switching device operating mechanism side. For double front switchboards, the 'front' for the purpose of counting the phase sequence of bus bars shall be as per the approved general arrangement drawings.
- 4.3.4 For double front type of board, separate vertical bus bars for each front shall be used.
- 4.3.5 Bus bars shall be made of high conductivity copper/aluminium alloy. Vertical bus bar for all multi tier modules shall be of copper /aluminium. They shall be supported on insulators of material such as fiber reinforced polyester or epoxy cast resin. The insulation level of neutral bus bar shall be same as that of phase bus bars. The maximum temperature of busbars and bus connections shall be limited to 85°C i.e.



35°C rise over 50°C ambient. No diversity factor shall be allowed for temperature rise.

4.3.6 All bus bars shall be adequately supported by non-hygroscopic, non-combustible, track-resistant and high strength insulators. All bus bar joints shall be provided with high tensile steel bolts, Belleville/spring washers and nuts. All bus bars and bus taps shall have HRPVC sleeves, colour coded as follows:

- Red, yellow & blue for R, Y & B phases respectively
- Black for neutral
- Grey & white for positive and negative respectively

4.3.7 Contact surfaces at all joints shall be silver plated or properly cleaned and anti-oxide grease applied to ensure an efficient and trouble free connection. In case of dissimilar metal connections (copper to aluminium), proper treatment shall be given to minimize bimetallic effect. All such joints shall be silver/tin plated or suitable bimetallic washers shall be provided.

4.3.8 All horizontal and vertical bus bars and joints shall be covered by insulating shrouds.

4.3.9 Bus bar shall have minimum cross section corresponding to current density of 0.8A/sq.mm at rated current and maximum permissible temperature. All bus bars and their main current carrying connections shall have the same sectional area throughout their length. The bus bars shall be colour coded such that on removal of any door the phases shall be identifiable.

4.3.10 Bus bars and connections shall be secured in such a manner that the insulators are not subjected to bending forces under short circuit conditions. When multiple switching devices are combined in tiers for a vertical unit, the droppers shall be able to carry the total current resulting from the combination of all switching devices. The vertical bus bars shall be completely shrouded with the cutout for connection tapping. The tap offs from vertical bus bars to the switch terminals must be able to withstand the board fault level.

4.3.11 Panels which receive bus duct at the incomer shall have the main bus bars extended on the top of the panel of about 150mm to 175mm for enabling connection to bus ducts.

4.3.12 Auxiliary bus bars each of minimum 25sq.mm thick electrolytic tough pitch copper shall be provided for the following applications.

- 240V AC supply for panel space heater/motor space heater/panel illumination
- 220V DC control supply for breaker tripping and closing, spring charging motors, indication circuits
- 110V AC control supply for contactor operated motor starter control circuits as applicable

#### 4.4.0 Control Supply and Space Heater Supply

4.4.1 PMCC and ACB operated MCC shall receive 2 nos. 220V DC feeders for control supply. Suitable diodes shall be provided to derive control supply through diode auctioneering. Each panel shall receive control supply through bus wires tapped off



from auxiliary copper bus bar through MCCBs/MCBs provided in the respective panel. It shall be possible to isolate any panel without disturbing the power supply to other panels. Each sub-circuit shall have separate MCB.

- 4.4.2 An under voltage relay to monitor control supply shall be provided. A contact of the relay shall be wired to the terminal for external use. Control Supply Failed' indication shall be provided.
- 4.4.3 PMCC/MCC shall derive 230V AC control supply through 415/230V transformer. 2 nos. 415V/230V transformers shall be provided with changeover arrangement. Changeover shall be blocked for control bus bar fault. The control transformers shall be of insulation class 'B' or better. The sizing of control transformers shall be carried out by the Vendor considering the actual load of power contactors, auxiliary contactors, indicating lamps and other equipment including remote auxiliary relays and lamps in the circuit with 20% design margin. One pole of secondary winding shall be earthed.
- 4.4.4 240V AC Space heater supply shall be derived from 415/230V control supply transformer located one in each bus section. Necessary MCB to isolate and distribute the supply shall be provided. The control transformers shall be of insulation class 'B' or better. The sizing of control transformers shall be carried out by the Vendor considering the actual load of space heaters, panel lighting & sockets. One pole of secondary winding shall be earthed.
- 4.4.5 For ACB feeders the 220V DC supply shall be extended in test position also for testing of the ACB operation.
- 4.4.6 All motors rated 30kW and above shall be provided with power supply for space heater. Circuit for motor space heater shall be wired through auxiliary NC contact of breaker/contactor/MCB.
- 4.4.7 Each panel of PMCC/MCC/DB shall be equipped with the following as required:
  - Thermostatically controlled space heater(s).
  - Illumination lamp with door switch
  - 16A 3pin socket with MCB protection.

#### 4.5.0 Air Circuit Breakers

- 4.5.1 Air circuit breakers shall be stored energy, trip free, air break and horizontal drawout type and shall have fault making and breaking capacities as specified. There shall be 'SERVICE', 'TEST' and 'ISOLATED' positions for the breakers. In 'TEST' position the circuit breaker shall be capable of being tested for operation without energizing the power circuits i.e. the power contacts shall be disconnected, while the control circuits shall remain undisturbed. Locking facilities shall be provided so as to prevent movement of the circuit breaker from the 'SERVICE', 'TEST' or 'ISOLATED' position. It shall be possible to close the door in 'TEST' position.
- 4.5.2 Air circuit breakers shall be provided with minimum 6 normally open (NO) and 6 normally closed (NC) potential free auxiliary contacts. These contacts shall be in addition to those required for internal mechanism of the breaker and shall be directly operated from breaker operating mechanism. Separate limit switches, each having



required number of contacts shall be provided in both 'SERVICE' and 'TEST' positions of the breaker.

- 4.5.3 Breakers of different ratings shall not be interchangeable. Front fascia cut-outs for all ratings of breakers shall be identical.
- 4.5.4 The spring charging mechanism of the circuit breaker shall be motor operated. The close/trip control switch shall be interlocked to trip before close. The closing and tripping circuits shall be self-opening on completion of their respective functions irrespective of the position of the control switch. Manual closing devices shall also be provided. The circuit breaker shall be electrically and mechanically trip free. For all circuit breakers electrical anti-pumping device shall be provided.
- 4.5.5 The main and secondary isolating contacts of the circuit breaker shall be of self-aligning type. The main isolating contact shall have continuous rating equal to the rating of the breaker. The secondary isolating contact shall be of wiping contact type.
- 4.5.6 The fixed portion of the circuit breaker shall have rail arrangement over which the chassis can move smoothly. Proper mechanical indication shall be provided for the three positions ('SERVICE', 'TEST' and 'ISOLATED') without opening the compartment door. It shall be possible to bring the circuit breaker to isolated position with the help of external lever without opening the compartment door. A stop block shall be provided on the slide rails to prevent the movement of the circuit breaker out of the compartment when it reaches the isolated position so that any accidental fall can be avoided. No control and metering equipment shall be mounted on breaker compartment door (i.e. access to control and metering equipment shall be available at all time without opening breaker compartment door). The circuit breaker can be padlocked in OFF position with door interlock defeat facility.
- 4.5.7 The following interlocks shall be provided on the circuit breaker:
  - It shall not be possible to withdraw the circuit breaker from the service position with the contacts of the breaker closed
  - It shall not be possible to close the circuit breaker unless any one of the three positions is located
  - It shall not be possible to open the compartment door when the circuit breaker is ON
- 4.5.8 It shall not be possible to close the breaker under following conditions:
  - Stored energy mechanism is not charged
  - Shunt release is energized
  - OFF push button is locked in OFF position
- 4.5.9 The circuit breaker shall be provided with mechanical ON/OFF, 'TRIP', 'SPRING CHARGED/ DISCHARGED', 'READY TO CLOSE' and breaker position indications and mechanical trip push button. An operating handle shall also be provided to charge the spring manually.



- 4.5.10 The circuit breaker shall be provided with automatic safety shutters, so that before the breaker reaches 'ISOLATED' position the main isolating contacts are completely shrouded. In the drawout condition, it shall be possible to inspect the breaker fixed contacts condition by lifting the shutters.
- 4.5.11 When the circuit breaker compartment door is open, it shall not be possible to touch the live parts. All removable covers protecting live parts shall be clearly labeled with warning notices reading 'LIVE PARTS. ISOLATE ELSEWHERE BEFORE REMOVING COVER'. It shall be possible to readily remove the arc chutes for routine inspection of the contacts with the circuit breaker in the withdrawn position. Contact erosion indicator shall be provided on moving contacts of breaker for visual indication of contact life.
- 4.5.12 The circuit breaker compartment shall be so designed that hot gases produced during fault shall be let away from the operator.
- 4.5.13 The protective relays and instruments shall be mounted in separate compartment. This compartment shall be along side and immediately next to the breaker.
- 4.5.14 All the non-conducting metal parts of the circuit breaker trolley shall be bonded together and shall make perfect electrical connection to earth through substantial sliding contacts at 'SERVICE' and 'TEST' positions. Such sliding contacts shall be arranged to make before power plug-in and interrupt after power draw-out.
- 4.5.15 Circuit breaker operation shall be independent of the motor, which shall be used only for charging of the spring. The mechanism shall preferably be such that:
- With the circuit breaker open and the springs charged, the circuit breaker can be closed and tripped
  - With the circuit breaker closed and the springs charged, there shall be sufficient energy to trip, close and then trip
- Tripping and closing circuits shall be provided with miniature circuit breaker in each pole on each unit and shall be independent of each other and all other circuits.
- 4.5.16 Each breaker feeder shall be provided with the following as a minimum:
- An anti-pumping relay
  - Motor charged spring operating mechanism
  - Manual spring charging and manual closing mechanism
  - Mechanical indication of spring charge
  - Mechanical position indicator (to show whether the breaker is in the 'ON' or 'OFF' positions and in the 'SERVICE', 'TEST' or 'ISOLATED' positions)
  - Closing coil
  - Shunt trip coil
  - CTs for protection
  - Manual trip push button
  - Phase barriers
  - Shutter assembly
  - Door interlock kit
  - Operation counter



4.5.17 The closing coil and spring charging motor shall operate satisfactorily for all values of control supply voltage between 80% and 110% of the rated voltage. But, the shunt trip coil shall be designed such that it will operate satisfactorily for all values of control supply voltage between 70% and 110% of the rated voltage. One open-close-open operation of the circuit breaker shall be possible after failure of power supply to motor.

4.5.18 Spring charging motor shall be provided with overcurrent protection. Motor windings shall be provided with class B insulation or better.

4.5.19 Following is a list of minimum circuit breaker malfunctions that shall be prevented by the use of mechanical interlocking devices:

- a) The circuit breaker being withdrawn from or inserted into the primary isolating contacts when the circuit breaker is closed or the plug for secondary disconnection, where provided, is not fully engaged
- b) The closing of the circuit breaker unless correctly located in the 'SERVICE', 'ISOLATED' or 'TEST' position
- c) The circuit-breaker being closed in the 'SERVICE' position without completing the auxiliary circuits via the secondary isolating devices, where self-aligning secondary isolating contacts have not been provided
- d) The breaker cubicle door being opened unless the breaker is in the 'OFF' or 'ISOLATED' condition
- e) Closing of circuit breaker in 'SERVICE' position with the door open
- f) Removal of the plug for secondary disconnection when the breaker is in 'SERVICE' position and is ON

Locking facilities shall include the following:

- a) Circuit breaker control switch in the neutral position
- b) Mechanical trip on circuit breakers so as to prevent manual trip
- c) Access flaps for operating or withdrawing of circuit breakers

Breakers controlling motors shall operate satisfactorily under the following conditions:

- a) Direct-on-line starting of induction motors rated above 125kW with a locked rotor current of six times the rated current with 20% tolerance and starting time of upto 30 seconds
- b) Breaking no load, full load and locked rotor current of induction motors as stated above
- c) No harmful overvoltage shall be produced during switching off of induction motors. If required, surge protective device shall be provided to limit over voltages

4.5.20 Telescopic trolley or suitable arrangement shall be provided for maintenance of circuit-breaker module in a cubicle. The trolley shall be such that the topmost breaker module can be withdrawn on the trolley and can be lowered for maintenance purpose. Also, it shall be such that all types, sizes and ratings of breakers can be withdrawn / inserted in the switchboard.



#### 4.6.0 Contactor Starter Unit

- 4.6.1 All motors rated up to 90kW shall be controlled by direct-on-line contactor starters. MPCB shall be used for motor feeders rated below 30kW. For feeders rated 30kW and above and upto 90kW, MCCB shall be used. The starting circuit shall consist of the following:
- a) Isolating device (MCCB/MPCB)
  - b) Contactor as main means of starting and stopping of motor
  - c) A short circuit protective device (Inbuilt feature of MPCB/MCCB)
  - d) Electronic overload protection relay with current display unit & built-in single phasing prevention feature
  - e) CT operated numerical relay for motor feeders rated 75kW and above
- 4.6.2 Withdrawable contactor starter units shall be provided with means for mechanically indicating the 'SERVICE' and other positions.
- 4.6.3 The starter units shall carry designation labels in terms of module type codes, signifying the function of the unit. Labels indicating these shall be affixed on fixed and withdrawable portion of the unit.
- 4.6.4 The units shall be designed to ensure safety of operating personnel. Interlocks shall be provided to ensure that the unit access door can only be opened when the associated isolating device is open. Defeat interlock facility shall be provided.
- 4.6.5 The starters shall be readily interchangeable with each other. Combination starters shall be drawout.
- 4.6.6 Electronic overload relays shall have reset push button.

#### 4.7.0 Moulded case Circuit Breakers(MCCB) / Motor Protection Circuit Breakers (MPCB)

MCCBs shall be of three / four pole construction for panel mounting. The MCCBs shall be provided with front operating handles and mechanical ON / OFF indicators.

MCCBs shall be provided with spring assisted quick-make, quick-break, current limiting type manually operated trip free mechanism, mechanical ON/OFF/TRIP position indicators, thermal tripping devices of inverse characteristics, instantaneous short circuit tripping devices and necessary auxiliary and alarm contacts. The MCCB module shall be provided with service, test and isolated position. The thermal and short circuit tripping device shall be adjustable type.

MPCB's shall be in generally similar to that of MCCB's in all the features mentioned above.

MCCBs/MPCBs shall be provided with overload thermal release setting range of 50% to 100% of rated current and adjustable short circuit magnetic release of 5 to 10 times rated current.



MCCBs/MPCBs shall be capable of withstanding the thermal stresses caused by overloads and locked rotor currents of values associated with protective relay settings of the motor starting equipment and the mechanical stress caused by the peak short circuit current of value associated with the switchgear rating. The maximum tripping time under short circuit shall not exceed 20 ms. When used for motor circuit, shunt trip devices shall be provided and the let through power of controlling MCCB/MPCB shall be lower than the respective contactor, Contactor and overload relays shall be selected so as to withstand the let-through energy of the connected MCCB/MPCB in the feeder and consequent thermal and dynamic effects. All power feeder module MCCBs shall be equipped with earth fault release.

The DC circuits shall be provided with DC rated MCCB / MCBs.

MCCBs/MPCBs shall have following accessories and features:

- a) Shunt trip release
- b) Auxiliary contact set of 1 NO + 1 NC
- c) Fault signaling contact set of 1 NO + 1 NC
- d) Insulation shields to isolate the connection between each pole
- e) Finger protection plate to prevent accidental contact
- f) The compartment door shall be interlocked with handle of MCCB/MPCB.

#### 4.8.0 Control and Selector Switches

- 4.8.1 All circuit breaker operating switches shall be of the pistol grip type, spring return to neutral and lockable in that position. They shall be arranged to close the breaker by being turned clockwise and to trip it by being turned anti-clockwise. The trip, neutral and close positions shall be clearly indicated. The movement shall be such that the switch cannot be operated inadvertently and that it is mechanically interlocked to trip before close. The control switch shall be located at a suitable height for ease of operation.
- 4.8.2 Ammeter and voltmeter selector switches shall have four stay put positions with adequate number of contacts for 3 phase 4 wire system. These shall have oval handles. Ammeter selector switches shall have make before break type contacts to prevent open circuiting of CT secondary. The arrangement for front mounting of these devices shall be such as to make them reasonably dust free so as not to interfere with normal operation.
- 4.8.3 Local/Remote selector switch shall be provided in switchboard.

#### 4.9.0 Contactors

- 4.9.1 Motor starter contactors shall be of air break, electromagnetic type rated for uninterrupted duty. Contactors shall be double-break, non-gravity type and their main contacts shall be silver faced copper.
- 4.9.2 Direct-on-line contactors shall be of utilization category AC3. Full voltage reversing starters shall comprise of forward and reverse contactors mechanically and electrically interlocked with each other. These contactors shall be of utilization category AC4. DC contactor shall be of utilization category DC3.



- 4.9.3 All springs shall be made out of corrosion-proof material.
- 4.9.4 The number of NO and NC auxiliary contacts of a contactor shall be as per requirement shown in the respective module drawings. It shall, however, be not less than 2 NO+2 NC.
- 4.9.5 The contactor shall operate satisfactorily between 85% and 110% of the rated voltage. The contactor shall not drop out at 70% of the rated voltage but shall definitely drop out at 20% of the rated voltage.
- 4.9.6 The contactor rating shall be chosen to provide type-2 discrimination. However, the minimum rating shall be 16 A.

#### 4.10.0 Miniature Circuit Breaker (MCB)

- 4.10.1 MCB shall be rated for 10kA short circuit rating. It shall be quick make, quick break, and independent manual type with trip free feature. MCB shall have the following :
  - a) Overcurrent protection
  - b) ON/OFF position indicators
  - c) Auxiliary contact block for ON/OFF/Trip positions.

#### 4.11.0 Instrument Transformers

All current and voltage transformers shall be completely encapsulated, cast resin insulated type suitable for continuous operation at the temperature prevailing inside the switchgear enclosure, when the switchboard is operating at its rated condition and the specified ambient temperature. The class of insulation shall be 'B' or better.

All instrument transformers shall be able to withstand the thermal and mechanical stresses resulting from the maximum rms short circuit breaking and peak making current ratings of the associated switchgear.

Current transformers may be multi or single-core type. All voltage transformers shall be single phase type. Accuracy class & VA burden shall be as specified in single line diagram.

The bus VTs shall be housed in a separate compartment. All VTs shall have readily accessible MCCB and MCBs on primary and secondary sides respectively.

##### 4.11.1 Current Transformer

- a) Current Transformers shall be cast-resin type. Separate cores shall be used for metering and protection. All secondary connections shall be brought out to terminal blocks where wye or delta connection will be made. Shorting links shall be provided for the secondary of the CTs when wired to terminals. CT secondary terminals shall be easily accessible and shall be provided on front LT compartment. One side of CT secondary shall be earthed in the compartment with the meters or relays which they serve and each CT group shall be earthed with a separate identified lead which may be disconnected for testing. CT secondary shall be rated for 5 A for metering and 1A for protection.



- b) Accuracy class of the current transformers shall be: -
  - Class 5P20 & PS for relaying.
  - Class 1 & ISF <5 for metering
  - Class PS for differential
- c) Motor feeders rated 30 KW to below 75KW, shall be provided with CTs for metering. Motor feeders rated 75KW and above, separate CTs shall be provided for metering and protection.
- d) Earthing of CT circuit shall be done at only one point i.e. in switchgear panel.

#### 4.11.2 Voltage Transformer

- a) Voltage transformers shall be cast-resin and shall have an accuracy class of 0.2 for MEAA, class 1.0. for other VT. Voltage transformer mounted on breaker carriage is not acceptable..
- b) The burden of VT shall be 50VA for protection core and 100VA for metering core. The primary of the VT shall be rated for 415 volts and the secondary for 110 volts. It shall have a continuous voltage factor of 1.2 with short time over voltage factor of 1.5 for 30 seconds. The VT shall be provided with MCCB on the primary side and MCBs on secondary side.
- c) The voltage transformer shall be completely disconnected and visibly grounded in fully drawout position.
- d) For proper relaying, one side of VT secondary shall be earthed at the transformer and the earth connection shall be identified and removable for testing. Test terminals shall be provided for VT circuits.

#### 4.12.0 Relays and Timers

4.12.1 Relays and timers in protective circuits shall be flush mounted on panel front with connections from the inside. They shall have transparent and dust tight covers removable from the front. They shall either have built-in test facilities, or shall be provided with necessary test blocks and test switches located immediately below each relay.

Relays shall have lock-out facility with manual reset. Each circuit breaker feeder shall be provided with separate latched lockout relay (86), trip circuit supervision relay, necessary auxiliary relays, timers, etc. to meet circuit requirements. In addition self-reset type lockout relay to be provided on Bus PT Panel for Under voltage tripping the motor feeders.

4.12.2 Lock out relay contacts shall only be provided for protection trip & reset status for use in close and trip interlocks of the circuit breaker.

4.12.3 Auxiliary supply voltage for relays and transducers shall be 220V DC. Relays shall be capable of satisfactory continuous operation between 80-120% of the rated voltage.

4.12.4 Failure of a control or auxiliary supply and de-energisation of a relay shall not initiate any circuit breaker operation. All relays shall withstand a minimum test voltage of 2 KV AC Rms for one minute.



- 4.12.5 The relays shall have provision of both current and voltage inputs. The current operated relay shall have provision for 5 sets of CT inputs, 3 nos. for phase fault and 1 CT input for earth fault & 1 CT input for CBCT. Relay shall be suitable for both residually connected CT input as well as CBCT input. Relays shall be suitable for CT secondary current of 1A/5A selectable at site. The voltage-operated relay shall have provision for 3 PT inputs. Relays shall be rated for operation on 110V VT secondary voltage. Relays used in Incomers and bus couplers shall have provision of two sets of voltage signal inputs for the purpose of synchronization.
- 4.12.6 All CT and PT terminals shall be provided as fixed type terminals on the relay to avoid any hazard due to loose connection leading to CT opening or any other loose connection. In no circumstances Plug In type connectors shall be used for CT/ PT connections.
- 4.12.7 All numerical relays shall have key pad / keys to allow relay settings from relay front. All hand reset relays shall have reset button on the relay front. Relay to be self or hand reset shall be software selectable. Manual resetting shall be possible from remote. Relays shall have suitable output contact for breaker failure protection.
- 4.12.8 Relays shall have self-diagnostic feature with self-check for power failure, programmable routines, memory and main CPU failures.
- 4.12.9 The numerical relay shall be able to provide supervisory functions such as, circuit breaker state monitoring, PT and CT supervisions and recording facilities with Post fault analysis
- 4.12.10 The numerical processor shall be capable of measuring and storing values of a wide range of quantities, all events, faults and disturbance recordings with a time stamping using the internal real time clock. Battery backup for real time clock in the event of power supply failure shall be provided.
- 4.12.11 Relays shall have event recording feature, recording of abnormalities and operating parameters with time stamping.
- 4.12.12 Numerical relays shall be capable of storing Minimum of 150 time tagged events/ records with time stamping. The numerical relays shall be able to store last 5 faults including the indication, waveforms, protection operated, fault location relay and operating time, currents, voltage and time. All Setting parameters, Fault data, waveforms & event logs shall be stored in Non-volatile memory only.
- 4.12.13 Sequence of events shall have 1ms resolution at device level.
- 4.12.14 Measurement accuracy shall be 1 % for RMS Current and voltage.
- 4.12.15 Relay shall be immune to capacitance effect due to long length of connected control cables. Any external hardware, if required for avoiding mal operation of the relay due to cable capacitance shall be included as a standard feature. All IOs shall have optical isolation. Analog inputs shall be protected against switching surges, harmonics etc.



- 4.12.16 The alarm/status of each individual protection function and trip operation shall be communicated to PLC/PC. The numerical relay system shall have built-in features/hardware interface to provide such inputs to PLC for analog/digital values.
- 4.12.17 Relays shall have at least two sets or groups of two different sets of adaptable settings. Relays shall have multiple IEC/ ANSI programmable characteristics.
- 4.12.18 Numerical relays shall have two level pass word protections, one for read only and other for authorization for modifying the setting etc.
- 4.12.19 Timer functions shall be programmable for on/off delays.
- 4.12.20 The protective relays shall have at least 10 nos. potential free contacts (Programmable) Auxiliary relays shall have contacts as required. Relay output contacts shall be suitable for directly wiring in the breaker closing and trip circuit operating from 220 V DC control voltage.
- 4.12.21 Making, carrying and breaking current ratings of their contacts shall be adequate for the circuits in which they are used. Interrogation voltage for the binary inputs shall be suitably selected to ensure avoidance of mal operation due to stray voltages.
- 4.12.22 No separate earth bus shall be required for the relays. It shall be possible to connect the relay earth to the common earth bus in the switchgear panel which shall be connected to the plant earth mat.
- 4.12.23 All protective relays shall be latest numerical type, having following features/functions:
- Protection functions as required
  - IEC IDMT characteristics
  - Measurements
  - Event/fault/disturbance recording
  - Binary input/output relays as required
  - LEDs to indicate status of the relay
  - LCD display for measurements, settings, faults etc
  - Key pad on the front of the relay
  - Communication ports for transmitting settings, measurements, alarms, faults, events, disturbance records to PLC.
  - Communication port for software setting/access measurements/maintenance/fault analysis
  - Self-monitoring
- 4.12.24 All protective relays shall be latest numerical type with one USB port at the front for connecting to Laptop and one port (RJ45/FO port) at rear suitable for communication on IEC 61850 protocols. Bidder should supply a Laptop of latest configuration along with uploaded software of all relays and also provide CD or pen drive having all software of all relays along with communication cable



- 4.12.25 The Numerical relays shall be networked through Ethernet switch, Gateway/Data Concentrators and shall be further integrated with SCADA based electrical monitoring system (for monitoring, measuring, fault data analysis & relay parameterization).
- 4.12.26 All necessary hardware including Managed Ethernet switches, accessories and licensed software shall be supplied by the vendor.
- 4.12.27 Ethernet switches shall be 'substation hardened' and shall comply with IEC61850-3 for communications and environment requirements. The Ethernet switches shall be of managed type with two (2) no. of fibre optic cable ports for ring network and Fourteen/Sixteen of Copper ports to achieve the LAN configuration. These switches shall be mounted inside the switchgear Panel.
- 4.12.28 The switchboard shall be provided with DC fail relay and DC fail indication lamp.
- 4.12.29 Breaker auxiliary contacts used for interlocking purposes shall be multiplied using electrically latched relay.
- 4.12.30 Protection relays shall be provided as detailed in the Protection single line diagrams. The protection shall include, protection functions but not limited to the following:
- a) Incomer feeder from transformers:
    - O/C relays (50/51) for phase fault with timer (2)
    - O/C relay (50N/51N) for Earth fault with timer (2).
    - Under voltage relay (27)
  - b) Normal Incomer feeder ( Direct from Upstream switchboard):
    - O/C relays (50/51) for phase fault with timer (2)
    - O/C relay (50N/51N) for Earth fault with timer (2).
    - Under voltage relay (27)
  - c) Bus Coupler feeder:
    - O/C relays (50/51) for phase fault with timer (2)
    - O/C relay (50N/51N) for Earth fault with timer (2).
    - Check Synchronizing relay (25C)
  - d) Outgoing ACB operated Motor feeder:
    - O/C relays (50/51) for phase fault with timer (2)
    - O/C relay (50N/51N) for Earth fault with timer (2).
    - Comprehensive Motor protection relay with feature not limited that mentioned below:
      1. Thermal Over load (49)
      2. Negative sequence (46)
      3. Phase Reversal (46 R)
      4. Restart inhibit with startup counter (37)
      5. Locked rotor (48-LR)
      6. Under current (66)



e) Other Outgoing feeder:

- O/C relays (50/51) for phase fault with timer (2)
- O/C relay (50N/51N) for Earth fault with timer (2).

f) Bus PT:

- 3 phase Under voltage relay

No voltage relay O/C relay (50N/51N) for Earth fault with timer (2).

#### 4.13.0 Indicating Instruments

4.13.1 All indicating instruments and meters shall be capable of carrying continuously their full load currents and full voltage across their coils. They shall not be damaged by the passage of fault currents or the existence of over voltage on the primary side of their instrument transformers for the maximum permitted duration of fault conditions which may occur during normal operation. All instruments and meters shall be back connected.

##### 4.13.2 Meters and transducers for 415V PMCCs

For incomers feeders following Meters and transducers shall be provided:

- Current transducer on 'Y' phase
- Voltage transducer on 'Y-B' phase
- 1.0S class static energy meter with communication port
- 0.5 class digital multi-function Meter with communication port.
- 0.5 class Analog Ammeter
- 0.5 class Analog Voltmeter

For Bus Coupler following Meters and transducers shall be provided:

- Current transducer on 'Y' phase
- 0.5 class digital multi-function Meter with communication port.

For ACB outgoing feeders following Meters and transducers shall be provided:

- Current transducer on 'Y' phase
- 0.5 class digital multi-function Meter with communication port.

For ACB motor feeders following Meters and transducers shall be provided:

- Current transducer on 'Y' phase
- 1.0 class Analog meter on 'Y' phase

For contactor motor feeders 30kW & above following Meters and transducers shall be provided:

- Current transducer on 'Y' phase
- 1.0 class Analog meter on 'Y' phase
- Electronic overload relay with current display in switchgear.

For contactor motor feeders less than 30kW following Meters and transducers shall be provided:

- Electronic overload relay with current display in switchgear.



For Bus PT following Meters and transducers shall be provided:

- Digital Voltmeter measuring all three phases
- Voltage transducer on three phases
- Power factor transducer

#### 4.13.3 Meters and Transducers for 415V MCCs

For incomers feeders following Meters and transducers shall be provided:

- Current transducer on 'Y' phase
- Voltage transducer on 'Y-B' phase
- 0.5 class digital multi-function Meter with communication port.

For Bus Coupler following Meters and transducers shall be provided:

- Current transducer on 'Y' phase
- 0.5 class digital multi-function Meter with communication port.

For Bus PT following Meters and transducers shall be provided:

- Digital Voltmeter measuring all three phases
- Voltage transducer on three phases

#### 4.13.4 Meters and Transducers for 415V DBs

For incomers feeders following Meters shall be provided:

- Digital voltmeter measuring all three phases
- Digital ammeter measuring all three phases

For Bus PT following Meters shall be provided:

- Digital Voltmeter measuring all three phases

For contactor motor feeders 30kW & above following Meters and transducers shall be provided:

- Current transducer on 'Y' phase
- 1.0 class Analog meter on 'Y' phase
- Electronic overload relay with current display in switchgear.

For contactor motor feeders less than 30kW following Meters shall be provided:

- Electronic overload relay with current display in switchgear.

#### 4.13.5 Multifunction Meter shall be provided with LCD display for local indication and shall be provided with communication port suitable for communicating on MODBUS protocol.

#### 4.13.6 Multifunction Meters shall display various parameters like 3 phase currents, voltages, PF, MD, KW, KVA, Hz, harmonics, etc. for local indication and shall also be communicated to PLC for remote monitoring.

#### 4.13.7 Static Energy Audit Meters shall be provided with LCD display for local indication and shall be provided with communication port. The parameters shall also be communicated to PLC for remote monitoring.



4.13.8 Analog indicating meter shall have Accuracy class 1.0 and shall be 96x96mm square with 240° scale. Ammeters of motor feeders shall have cramped scale above 2 times to 6 times the rated current for indicating the starting current.

4.13.9 Transducers shall be of dual output type, class 0.5, 4-20mA DC linear output & 750 ohm load.

#### 4.14.0 Push Buttons

4.14.1 Push buttons shall be of heavy duty, spring return and push-to-actuate type. Their contacts shall be rated to make, continuously carry and break 10A at 240V AC and 1A (inductive) at 220V DC.

4.14.2 All push buttons shall have two nos. NO and two nos. NC contacts, unless specified otherwise. The contact faces shall be of silver alloy. All push buttons shall be provided with integral escutcheon plates marked with their functions.

4.14.3 The colour of the button shall be as follows:

- Green for motor START and breaker CLOSE
- Red for motor STOP and breaker OPEN
- Black for valve/damper OPEN/CLOSE commands
- Black for all annunciation functions, overloads, reset and miscellaneous commands

4.14.4 All push buttons on panels shall be located in such a way that red push buttons shall always be to the left of green push buttons. All emergency push buttons shall have mushroom knobs.

#### 4.15.0 Indicating Lamps

4.15.1 Indicating lamps shall be of the panel mounting clustered LED type. The lamps shall have escutcheon plates marked with their functions, wherever necessary. Bulbs and lamp covers shall be easily replaceable from the front of the cubicles. Low Voltage Glow Prevention (LVGP) feature shall be provided for indicating lamps. Lamps shall have translucent lamp covers of the following colours, as warranted by the application :

- Red for motor ON, valve/damper OPEN and breaker CLOSE
- Green for motor OFF, valve/damper CLOSE and breaker OPEN
- Amber for TRIP
- Blue for 'SERVICE' position indications
- White for all healthy conditions (e.g. control supply, lockout relay healthy, spring charged condition etc.)
- White for 'TEST' position indications
- Red, yellow, blue for R, Y and B phases respectively

4.15.2 Indicating lamps shall be located just above the associated push button/control switch. Red lamps shall invariably be located to the right of green lamps. When associated with push buttons, red lamps shall be directly above the green push button and green lamp shall be directly above the red push button.



4.15.3 All indicating lamps shall be suitable for continuous operation at 85% to 110% of their rated voltage.

4.15.4 For incomer and bus, indicating lamps for R, Y and B phases shall be provided.

#### 4.16.0 Secondary MCBs

4.16.1 Secondary circuit shall be protected by a set of MCBs as per requirements of schemes.

4.16.2 MCBs shall be provided with thermal overload and magnetic short circuit protection. MCBs shall be provided with auxiliary contacts for ON/OFF/Trip conditions. MCBs shall be selected for correct discrimination and adequate ratings. The protection tripping of these devices shall be adequately guaranteed when used in low fault level circuits viz. on the secondary of VTs.

#### 4.17.0 Wiring

4.17.1 Wiring shall be by 1100 volt grade multi-stranded PVC insulated copper wire having a cross-sectional area of not less than 1.5sq.mm. All connections from CT leads upto instruments, relays and terminal board shall be made by copper wires of minimum 2.5sq.mm size. The cables shall be tested for flammability test as per applicable standards and shall also withstand service temperature without deterioration.

All wiring shall use the colour codes specified below:

- 3 phase AC connections      Red, yellow & blue for R, Y & B phases respectively
- 1 phase AC connections      Red and black for phase and neutral respectively
- DC connections              Grey & white for positive and negative respectively
- Earth connection            Yellow-Green

4.17.2 Wiring shall be run mostly clear of all metal parts in insulated cleats, properly routed and neatly bunched. However, PVC wire holders and channels shall be preferred for running of wiring. Where wiring passes from one compartment to another, the aperture shall be 'bushed' to prevent damage of wires against sheet metal edges. Bushes may comprise of good quality rubber grommets.

4.17.3 Where single phase conductors are associated with the 3 phase system from which they are derived, the phase conductor shall use the same colour as the phase from which it is derived.

4.17.4 Inter-module bus wires shall be kept separate from all other wiring. AC or DC terminations shall be grouped function-wise as far as possible and labels of the function shall be affixed.

4.17.5 Terminal boards shall have separate terminals for incoming and outgoing wires with not more than two wires connected to any one terminal. Terminal boards shall be mounted vertically at the side of the cubicle or in horizontal rows and properly spaced to have clean wiring arrangement, adequate access for putting ferrules, making terminations etc. It shall be possible to read the ferrule numbers when the wiring is



complete. Where terminals may be live when the equipment is isolated from the main supply, these shall be clearly marked on the panel.

- 4.17.6 Extra flexible wires shall be used for wiring to devices mounted on moving parts such as hinged doors. The wire bunches from the panel inside to the doors shall be properly sleeved or taped. All internal wiring terminations shall be made with solderless crimping type heavy duty tinned copper lugs. Insulation sleeves shall be provided over the exposed parts of lugs.
- 4.17.7 Engraved core identification plastic ferrules marked to correspond with panel wiring diagrams shall be fitted at both ends of each wire.
- 4.17.8 Control terminal blocks shall be of 650V grade, rated for 10A and in one piece molding. It shall be complete with insulating barriers, clip-on type terminals and identification strips. Marking on terminal strip shall correspond to the terminal numbering on wiring diagrams. Terminal blocks for CT and VT secondary leads shall be provided with test links and isolating facilities. CT secondary leads shall be provided with short circuiting and earthing facilities. It shall be similar to 'Elmex' CATD type.
- 4.17.9 In all the panels, at least 20% spare terminals for external connections shall be provided and these spare terminals shall be uniformly distributed on all terminal blocks.
- 4.17.10 All interlocks shall be hardwired in the switchboard itself.
- 4.17.11 The wiring shall be complete in all aspects so as to ensure proper functioning of control, protection and interlocking scheme. All the wiring shall be complete up to terminal blocks on the side of each unit/module.
- 4.17.12 Adjacent rows of terminal blocks shall be spaced not less than 100mm apart.
- 4.17.13 The terminal blocks shall be mounted inside the module (and not in cable way) in a manner so as to provide easy access to terminals and to enable ferrule numbers to be read without difficulty.
- 4.17.14 All inter-panel wiring shall be carried out within the switchboard before dispatching the panel.
- 4.17.15 A typed circuit directory, card holder and card with clear plastic covering shall be provided on the inside of each cabinet door. The directory card shall provide space to identify each circuit in the panel board. An electronic copy of the circuit directory shall be provided to the Owner.

#### 4.18.0 Cable/Busduct Termination

- a) PMCC/MCC/DB shall be designed for cable entry from the bottom. Sufficient space shall be provided for ease of termination and connection. Add-on panels shall be considered for cables, if any.
- b) Cable termination compartment and arrangement for power cables shall be suitable for heavy duty, 1.1 kV grade, stranded aluminium conductor, XLPE insulated, armoured and FRLS PVC sheathed cables.



- c) Sufficient space and support arrangement shall be provided in the cubicles to accommodate cables.
- d) Cables shall be PVC insulated, armoured, extruded FRLS PVC overall sheathed with 2.5 sq.mm for control & current circuits and 1.5 sq.mm for voltage circuits and PVC insulated, armoured, extruded FRLS PVC overall sheathed with stranded copper / aluminium conductor for power circuits.
- e) All provisions and accessories shall be furnished for termination and connection of cables, including removable gland plates, cable supports, crimp type tinned copper lugs, brass compression glands with tapped washer and terminals blocks.
- f) The gland plates and supporting arrangement for 1/C power cable shall be such as to minimize flow of eddy current.
- g) For all service transformers rated 1000KVA and above shall be connected through bus ducts to the respective switchgear panel. Busduct entry shall be from the top.

#### 4.19.0 Nameplates and Labels

4.19.1 Nameplates shall be of 3 ply laminate with black lettering on white background. The following shall be provided with nameplates/warning labels as described below:

- Main nameplate for PMCC/MCC/DB on front and back sides
- All incomers and outgoing feeders indicating description, rating, equipment no., feeder no., etc
- All door mounted components
- Panel numbers on front and rear
- Warning labels for interlocks

All nameplates shall be fastened by means of screws to the panel.

Danger labels shall be provided for the following:

- MCC as per statutory regulations
- Bus bar chamber
- Cable alley housing live terminals

4.19.2 Nameplate or polyester adhesive stickers shall be provided inside the panel for all equipment (lamps, push buttons, switches, relays, auxiliary contactors etc.) mounted on the switchboard.

4.19.3 Special warning plates, one each on each front of a shipping section, shall be provided on removable covers of doors giving access to cable terminals and bus bars. Special warning labels shall be provided inside the switchboard also, wherever considered necessary. Identification tags shall be provided inside the panels matching with those shown on the circuit diagram.

4.19.4 All major components such as breakers, switches, contactors, CTs etc. shall be provided with labels indicating their ratings.

4.19.5 For single front switchboards, similar panel and board identification labels shall be provided at the rear also.



#### 4.20.0 Earthing

- 4.20.1 Two earth terminals shall be provided on each switch cubicle, at the rear side. An earth bar of at least 65 x 8 mm aluminium shall be fixed to these terminals. The earth bar shall be electrically continuous and shall run the full extent of each board. This earth bar shall be on the same side as the cable entry and shall be extended on both sides of the panel.
- 4.20.2 Each unit shall be constructed to ensure satisfactory electrical continuity between all metal parts not intended to be alive and earth terminals of the unit. Suitable holes with bolts and nuts shall be provided at each end of earth bar of switchboard for connection to a main earthing grid.
- 4.20.3 The earth bar shall be accessible in each cable entering compartment either directly or through a branch extension to earth the cable armour and shields. 10mm diameter holes shall be drilled and hardware for connection provided through the earth bus.
- 4.20.4 The cores of transformer (bus voltage transformer, control transformer, heating transformer etc.) shall also be earthed through copper wire. Doors shall have a copper wire for earth connection to fixed unit. VT and CT secondary neutral point earthing shall be at one place only on the terminal block.
- 4.20.5 All non-current carrying metal work of the switchboard/panel shall be effectively bonded to the earth bus. All metallic cases of relays, instruments and other panel mounted equipment shall be connected to earth bus by independent stranded copper wires of size not less than 2.5sq.mm. Insulation colour code of earthing wires shall be green. Earthing wires shall be connected to terminals with suitable clamp connectors and soldering shall not be acceptable. All hinged doors shall be earthed through flexible earthing braid.

#### 4.21.0 Wall Mounted Distribution Boards

- 4.21.1 Wall mounted distribution boards shall be metal enclosed, suitable for outdoor mounting on wall or steel structures with suitable hood on the top. The enclosure shall be cold rolled sheet steel of at least 1.6mm thickness. Gland plate shall be of 2mm thick. The board shall be dust and vermin-proof and shall have a degree of protection of IP-55. MCB/motor protection circuit breaker (MPCB) shall be rated for 10kA short circuit rating. MPCB shall have adjustable overload setting and short circuit release.

4.21.2 Wall mounted distribution boards shall comprise the following as a minimum:

- Adequately rated TPN MCB isolator as incomer
- 3 phase & neutral bus bar
- Required number of TPN/SP MCBs or MPCBs with contactor and start/stop PBs for outgoing feeders
- R,Y, B indicating lamps (LED)

#### 4.22.0 Local Motor Starters

- 4.22.1 Local motor starters shall be metal enclosed, suitable for outdoor mounting on wall or steel structures with suitable hood on top. The enclosure shall be cold rolled sheet



steel of at least 1.6mm thickness. The local motor starters shall be dust and vermin-proof and shall have a degree of protection of IP-55.

#### 4.22.2 Local motor starters shall comprise of the following:

- A 3-pole contactor, mechanically latched type
- Start push button, coloured green
- Stop push button, coloured red
- 'ON' indicating lamp
- Ambient temperature compensated thermal overload relay with single phasing protection

#### 4.23.0 Local Push Button (LPB) Stations

4.23.1 The local push buttons stations shall be FRP/flame-proof enclosure with hood on top suitable for outdoor mounting on wall or steel structures. The enclosure shall be provided with a protective guard, to avoid inadvertent operation of push buttons. The local push button stations shall be dust and vermin-proof sheet steel enclosure and shall have a degree of protection of IP-55 for outdoor and IP 54 for indoor as per IS 13947

4.23.2 LPB shall be of following types:

- Type-A: With Stop Push Button in FRP enclosure
- Type-B: With Start & Stop Push Buttons in FRP enclosure
- Type-C: With Forward, Reverse & Stop Push Buttons in FRP enclosure
- Type-D: With Stop Push Button in flame-proof enclosure
- Type-E: With Start & Stop Push Buttons in flame-proof enclosure
- Type-F: With Forward, Reverse & Stop Push Buttons in flame-proof enclosure

4.23.3 Push buttons shall be with two NO and two NC contacts. Emergency stop push buttons shall be mushroom, latched type. Start push button shall be self reset type.

### 5.0.0 PAINTING

Painting shall be carried out by approved process. After preparation of the under surface the equipment shall be painted with epoxy based paint by powder coating. The final thickness of paint film on sheet steel shall not be less than 85 microns. Final shade shall be RAL-7032 (Siemens grey)

### 6.0.0 TESTS

6.1.0 All tests shall be conducted as per relevant IS/IEC standards and shall be performed in the presence of Owner's representative, if so desired by the Owner. The Vendor shall give at least 15 days advance notice of the date when the tests are to be carried out.

6.2.0 All equipment/components/materials shall be of type tested and proven type. Relevant type test reports shall be submitted to the Owner for approval. Type tests should have been carried out within the last five years as on the date of opening of the bid on equipment of similar rating and on identical components/materials.



6.3.0 For the various bought out items, test certificates from the manufacturers shall be furnished.

6.4.0 Copies of certified reports of all tests carried out at the works shall be submitted. The equipment shall be dispatched from works only after receipt of Owner's written approval of the test reports.

#### 6.5.0 Type Tests

6.5.1 Type test reports for the following shall be submitted for switchgear panel of each current rating :

- Power frequency withstand test on power circuit and auxiliary and control circuits
- Temperature rise test
- Measurement of resistance of the main circuit
- Short time withstand current and peak withstand current test
- Degree of protection test

6.5.2 Type test reports shall be submitted for circuit breaker as per applicable standard by the Bidder for Owner's review. The list of type tests shall include the following:

- Dielectric tests
- Measurement of the resistance of the main circuit
- Temperature rise tests
- Short time withstand current and peak withstand current tests
- Electromagnetic compatibility tests
- Mechanical and environmental tests including mechanical operation test
- Short circuit current making and breaking tests
- Mechanical endurance test
- Electrical endurance test

6.5.3 The contactors, relays, switches, breakers, local push buttons, local motor starters, instruments, VTs, CTs and control transformers shall be subjected to type tests in accordance with the relevant IS/IEC standards.

#### 6.6.0 Routine Tests

6.6.1 The switchgear panel shall be subjected to routine tests in accordance with the relevant IS/IEC standards. The tests shall include the following:

- Power frequency voltage dry test on the main circuit
- Voltage test on control and auxiliary circuits
- Measurement of resistance of the main circuit
- Mechanical operating tests

6.6.2 The circuit breakers, contactors, switches, local push buttons, local motor starters, VTs, CTs and control transformers shall be subjected to routine tests in accordance with the relevant IS/IEC standards. Routine test reports shall be furnished by the Vendor for Owner's review.



## SECTION – 3.4 ILLUMINATION SYSTEM

### 1.0.0 INTENT OF SPECIFICATION

This specification covers requirements of Illumination system. List of major items shall include the following:

- Lighting fixtures
- Lighting distribution boards
- Lighting transformers
- Lighting panels
- Receptacle panels
- Receptacles
- Lighting mast (Winch operated)
- Lighting poles
- Switchboxes
- Junction boxes
- Conduits
- Wires

### 2.0.0 CODES AND STANDARDS

The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest version of the relevant Indian Standards, IEC publications and other standards as listed, except where modified and / or supplemented by this specification. The design and testing shall follow the following standards.

- a) IS: 1913 General and safety requirements for Luminaires.
- b) IS: 10322-5-5 Luminaires- Flood lights
- c) IS/IEC 60079 -1 Equipment Protection by Flameproof Enclosures "d"
- d) IS: 2149 Luminaires for street lighting.
- e) IS: 2206 Flame proof electric lighting fittings
- f) IS: 4013 Dust-light electric lighting fittings.
- g) IS: 8224 Electric Lighting fittings for Div. 2 areas.
- h) IS: 9583 Emergency lighting units.
- i) IS: 9974 High Pressure sodium vapour lamps.
- j) IS: 10322 Specification for Luminaires
- k) IS: 732 Electrical wiring installation (system voltage not exceeding 650 V).
- l) IS: 12640 Residual Circuit operated Circuit breakers.
- m) IS/IEC:60898-1 Miniature circuit breakers
- n) IEC: 60309-1 Plugs, socket-outlets and couplers for industrial purposes
- o) IS/IEC 60529 Degrees of protection provided by enclosures (IP code)



- p) IS: 694 PVC insulated cables for working voltages up to and including 1.1 kV.
- q) IS:9537 Conduits for electrical installation.
- r) IS:3480 Flexible steel conduits for electrical wiring.
- s) IS:1239 Mild steel tubes, tubulars and other wrought steel fittings. (for size above 63mm dia of rigid conduits)
- t) IS:14768 Fittings for rigid steel conduits for electrical wiring.
- u) IS:3837 Accessories for rigid steel conduits for electrical wiring.
- v) IS:14772 Boxes for enclosures of electrical accessories.

### 3.0.0 LIGHTING DESIGN

#### 3.1.0 The plant lighting system shall comprise following:

- Normal 230V AC Lighting System
- Emergency DC Lighting System

Normal AC lighting shall be provided by lighting distribution boards and lighting panel distributed throughout the plant. Supply to these lights shall be ON as long as the station AC supply is available. AC lighting fixtures shall be fed from respective area lighting panels. If fault level at lighting panel is more than 10kA, lighting distribution boards shall be fed through 415/433V ratio lighting transformers.

Emergency D.C lighting is envisaged in control rooms and in critical operating area. In case of failure of AC system DC lights shall remain energised from the station DC supply (220V DC). DC operated LED lamps can remain continuously ON along with AC lighting system.

For buildings, Emergency lighting units with integral batteries shall be used. It shall be provided by self-contained emergency lighting fixtures. Each emergency fixture shall provide emergency light for 3-4 hours when the normal power source is lost. Each emergency light fixture shall be provided with Ni-cd battery, battery charger and two CFL lamps.

#### 3.2.0 Lighting shall be provided in all the areas. Lux level proposed are given below:

S.No.	Area	Lux level
1.	Switch gear /MCC rooms, Battery room	200
2.	Control room	500
3.	Office area	300
4.	Main Road	20
5.	Secondary Roads	10
6.	Cable galleries	100
7.	Stair cases, Passages, Toilets	100



3.3.0 For **indoor** Areas, average lumen method shall be adopted to calculate luminance. Lighting level design shall include a Maintenance factor as follows to account for lamp lumen depreciation, luminaries' surface dirt and room surface dirt, etc.

- Air-conditioned clean interiors such as office rooms, Control and Switchgear room : 0.8
- Clean interiors such as office rooms, laboratories : 0.75
- Industrial areas with normal interiors such as workshops: 0.70
- Industrial areas with dusty interiors : 0.60
- Industrial areas with very dusty interiors : 0.50

3.4.0 Lighting **level** design shall also include the coefficient of utilization factor as calculated from table of reflectance provided by manufacturer for respective type of fixture.

3.5.0 For Outdoor **flood** lighting design, 'point by Point' method shall be adopted based on computer aided design package of the Contractor software. Uniformity in horizontal illuminance  $E_{min}/E_{avg}$  should be greater than 0.25.

#### 4.0.0 LIGHTING CONTROL

4.1.0 Switch control shall be provided for controlling lighting fixtures located indoor.

4.2.0 Electric power to light fixtures located outdoors shall be switched with photoelectric controllers and timers. Provision shall be made to bypass the photoelectric controller and timer. For Road lighting, alternative lighting fixtures shall be fed from different phases.

4.3.0 Load on each lighting circuit and single phase receptacle circuit shall be limited to about 1500 W and the number of luminaries connected to lighting circuit shall be limited to about fifteen (15).

4.4.0 At least one 6/16 ampere, 230 volt AC universal socket outlet with switch shall be provided in offices, cabins, etc. Receptacles with decorative cover plates shall be used in office / Control rooms.

4.5.0 20A, 230V, Single phase convenience receptacle with switch shall be provided in plant area. The convenience outlets shall be spaced to provide access to any point in the interior industrial areas with a 25 meter extension cord.

4.6.0 63A, 415V, 3 phase welding receptacle with switch shall be provided in plant area.

4.7.0 Each lighting panel shall be provided with one earth leakage circuit breaker rated 100mA.

4.8.0 Each receptacle panel shall be provided with one earth leakage circuit breaker rated 300mA.

4.9.0 In areas with hazardous atmospheres having coal dust, lighting and convenience outlets shall be flame proof type.



## 5.0.0 EQUIPMENT DESCRIPTION

### 5.1.0 LIGHTING FIXTURES

5.1.1 LED light fittings shall be of following types for the installations having room height of up to 5 metre:

- Industrial trough type/Industrial General purpose Rail type for all industrial areas
- Corrosion proof type for battery room and chemical areas, etc.,
- Anti-glare mirror optic type for Control rooms housing VDUs.
- Recessed mounted type for Control rooms.

5.1.2 In false ceiling areas, type of light fixtures shall suit the type of false ceiling provided.

5.1.3 LED light fittings with IP55 degree of protection shall be provided for the installations having room height of above 5 metre:

5.1.4 LED light fittings shall be of following types for outdoor installations:

- Road lighting Luminaire
- Flood lighting Luminaire

5.1.5 Road lighting / Flood lighting poles shall be of galvanised steel pole. Each Street lighting pole/Flood lighting pole shall be provided with MCB protection.

5.1.6 For DC lighting LED lights shall be used.

5.1.7 AC lighting fixtures and accessories shall be suitable for operation on 240 V, AC, 50 Hz supply with supply voltage variation of  $\pm 10\%$ , frequency variation of  $\pm 5\%$  and combined voltage and frequency variation of absolute sum of 10%. DC lighting fixtures and accessories shall be suitable for operation on 220 V, DC with variation between 190 V & 240 V.

5.1.8 Power factor of fluorescent lamp fixtures shall be not less than 0.90 and that of High Pressure Sodium Vapour and Mercury Vapour (HPSV & HPMV) lamp fixtures shall not be less than 0.85. Suitable power factor improving capacitors shall be provided for this purpose. Capacitors shall be hermetically sealed in aluminium enclosures to prevent seepage of impregnate & ingress of moisture.

5.1.9 Luminaires shall meet atleast Electrical safety class-I as per relevant IEC.

5.1.10 The lighting fixtures shall be designed for minimum glare. The finish of the fixtures shall be such that no bright spots are produced either by direct light source or by reflection.

5.1.11 High bay fixtures shall be suitable for pendant mounting and provided with safety chains.

5.1.12 Recommended luminaries at various places are listed below :



Sl.No.	Area	Type of Luminaries
1	Switch gear /MCC rooms	LED industrial fixture
2	UPS, Battery charger room, Ni-cd / SMF battery room	LED industrial fixture
3	Battery Room	Corrosion proof LED fixture
4	Cable galleries	LED well glass fixture
5	Stair cases, Passages, Toilets	LED rail type fixture/Mini lights
6	Office	Mirror optics, decorative LED fixture
7	Control rooms with PCs/VDUs	Mirror optics non-glare type LED fixture
8	Coal dust concentrated locations	Flameproof luminaries
9	Emergency 220V DC Lighting	DC LED Lamps
1	Outdoor Area	LED flood lighting fixtures on steel poles
2	Roads	LED street light fixtures on galvanized Steel poles

#### 5.2.0 Lighting distribution board

Lighting distribution board shall comprise, TPN MCCB as incomer and required no.of TPN MCCB feeders as outgoing feeders to feed lighting panels and receptacle panels. Construction of lighting DB shall be similar to ACDB and is detailed in LV switchgear section.

#### 5.3.0 Lighting Transformer

Lighting transformer shall be provided, where required. The transformer shall be dry type, 415/433V rated, AN cooled, Dyn11 type. Windings shall be fully uniformly insulated. Core shall be CRGO steel. The high voltage and the low voltage coils shall be wound with high conductivity copper conductors and the insulation shall be done by Vacuum pressure impregnation process. Insulation shall be class -H and temperature limited to class F. Transformer shall be housed in sheet steel enclosure. The enclosure shall be suitable for indoor use and designed to provide adequate ventilation for the transformer. Protection of enclosure shall be atleast IP 33.

#### 5.4.0 Lighting Panels & Receptacle Panel

5.4.1 The panels shall be rated for 415 V, 3 phase, 4 wire, AC with neutral bus and suitable for either wall/column mounting. Indoor panels shall have degree of protection of IP 54 and outdoor type shall have degree of protection of IP 55 and shall have a sloping canopy. Panels shall be constructed from Polycarbonate sheet. Sheet thickness shall be 10 mm.

5.4.2 Miniature circuit breakers (MCB) shall have thermal elements for overload protection and an instantaneous magnetic trip to protect against severe faults. All MCBs provided shall be suitable for breaking capacity of 10 kA (minimum) at 240 V AC.



- 5.4.3** Contactors shall be of the air break type fitted with arc shields. Time switch shall be suitable for automatic switching ON and OFF of street lighting / flood lighting circuits. Time switch has 00 - 24 hours clock base. Time switch shall indicate actual time and shall permit accurate time setting. Time switch shall be provided with Ni-Cd battery.
- 5.4.4** Lighting panel shall be provided with 415V AC, 63A, TPN MCB with ELCB as incomer, required nos. of 20 A, 240V AC, single pole MCBs for outgoing circuits, Separate neutral at terminal block for each outgoing circuit.
- 5.4.5** DC lighting panel shall be provided with 220V DC , 63A, DP MCB isolator as incomer, required nos.of 20 A, 220V DC, double pole MCBs for outgoing circuits.
- 5.4.6** Street lighting panel shall be provided with 415V AC, 63A, TPN MCB isolator as incomer, 63A Three pole AC Contactor, 00 - 24 hours timer and a photo-electric switch for automatic switching of contactor, a by-pass switch for timer/photo switch, 6 Nos. 20 A, 415V AC, TPN MCBs for outgoing circuits, Separate neutral at terminal block for each outgoing circuit. One number light sensor in weather proof enclosure having IP: 55 degree of protection shall be installed separately with necessary interconnecting cable for each street lighting panel.
- 5.4.7** Receptacle panel shall be provided with 415V AC, 63A, TPN MCB with ELCB as incomer, 6Nos. 20A, 240V AC, single pole MCBs for outgoing circuits, Separate neutral at terminal block for each outgoing circuit.

#### **5.5.0 Three Phase Industrial Receptacles**

The welding receptacle shall be of 63 A, industrial heavy duty insulated type with 5pin (with earth connection) suitable for 415 V, 3 phase, 50 Hz supply. The receptacle with MCB shall be housed in a FRP enclosure. The enclosure shall conform to the degree of protection IP-55 class. Socket shall be provided with safety cover. Robust mechanical interlock shall be provided so that the switch can only be turned on when the plug is fully engaged and the plug can only be withdrawn when the switch is off. Terminal blocks of adequate rating shall be provided for incoming/loop-in-loop out connection.

#### **5.6.0 Three Phase Flame proof Industrial Receptacles**

The welding receptacle shall be of 63 A, industrial heavy duty insulated type with 5pin (with earth connection) suitable for 415 V, 3 phase, 50 Hz supply. The receptacle with MCB shall be housed in a metallic enclosure. The enclosure shall conform to the degree of protection IP-55 class. Socket shall be provided with safety cover. Robust mechanical interlock shall be provided so that the switch can only be turned on when the plug is fully engaged and the plug can only be withdrawn when the switch is off. Terminal blocks of adequate rating shall be provided for incoming/loop-in-loop out connection.

#### **5.7.0 Single Phase Industrial Receptacles**

The single phase industrial insulated receptacles shall be heavy duty type rated for 20A, 240V AC complete with switch housed in FRP enclosure having degree of protection of IP 55. These shall be of three pin type with the third terminal connected



to earth. MCB shall be provided for control. Supply plug and Socket shall be insulated. Socket shall be provided with safety cover. Robust mechanical interlock shall be provided so that the switch can only be turned on when the plug is fully engaged and the plug can only be withdrawn when the switch is off. Terminal blocks of adequate rating shall be provided for incoming/loop-in-loop out connection.

#### 5.8.0 Single Phase Flame proof Industrial Receptacles

The single phase industrial receptacles shall be heavy duty type rated for 20A, 240V AC complete with switch housed in metallic enclosure having degree of protection of IP 55. These shall be of three pin type with the third terminal connected to earth. Switch shall be provided for control. Socket shall be provided with safety cover. Robust mechanical interlock shall be provided so that the switch can only be turned on when the plug is fully engaged and the plug can only be withdrawn when the switch is off. Terminal blocks of adequate rating shall be provided for incoming/loop-in-loop out connection.

#### 5.9.0 Flush type indoor receptacles

Flush type 3 pin, 6/16A, 240 V AC sockets shall be provided for office rooms and control rooms. The receptacle shall be complete with 16A Plate type switch & safety shutter. It shall be housed in suitable FRP enclosure. Inside the enclosure, terminals shall be provided for loop-in-loop out of 4 sq.mm copper conductor. Plugs shall be 2-pole, 3 wire, with a rating of 6 /16 ampere, 240 volt AC.

#### 5.10.0 Lighting mast

Each Lighting Mast shall be complete with the following accessories.

- High mast shaft in two/three section, hot dip galvanised
- Head frame, steel wire rope & double drum winch.
- Galvanised Lantern carriage arrangement suitable for 12 nos. luminaires & its control gear boxes and Lightning finial.
- Integral power tool installed inside base compartment for its operation.
- Foundation bolts manufactured from special steel along with nuts, washers, anchor plate and templates
- Suitable shallow foundation with M-15 concrete for the High mast considering safe soil bearing capacity at the site.
- LED floodlight luminaire
- Aviation obstruction light with 2 nos DC LED lamps.
- 4 nos. G.I pipe earthing station for High Mast (2 nos. for Mast and 1No. for Lightning and 1no. for power switch)
- Control panel housing suitable control circuit for the operation of the mast, precision timer for automatic On/Off control and required controls for the power tool motor.
- Power & control cables and cabling accessories required for the installation.
- Special tools & tackles

The High mast shall be of continuously tapered, polygonal cross section, at least 20 sided, presenting a good and pleasing appearance and shall be based on proven design to give an assured performance, and reliable service. The entire fabricated



mast shall be hot dip galvanized, internally and externally, having a uniform average thickness of atleast 85 microns.

An adequate door opening shall be provided at the base of the mast and the opening shall permit clear access to equipment like winches, cables, plug and socket, etc. and also facilitate easy removal of the winch.

A fabricated Lantern Carriage shall be provided for fixing and holding the flood light fittings and control gearboxes. The lantern carriage shall be of steel tube construction, the tubes acting as conduits for wires, with holes fully protected by grommets.

The winch shall be completely self-sustaining type, without the need for brake shoe, springs or clutches. Each driving spindle of the winch shall be positively locked when not in use, gravity activated PAWLS. Individual drum also shall be operated for fine adjustment of lantern carriage. The minimum-working load shall be not less than 750 kg. The winch shall be self-lubricating type by means of an oil bath and the oil shall be readily available grades of reputed producers.

The suspension system shall essentially be without any intermediate joint and to consist of only non-corrodible stainless steel of AISI 316 grade. The breaking load of each rope shall not be less than 2350 kg. Giving a factor of safety of over 5 for the system at full load. The thimbles shall be secured on ropes by compression splices.

A suitable, high-powered, electrically driven, internally mounted power tool with motor, with manual over ride shall be supplied for the raising and lowering of the lantern carriage for maintenance purposes. The power tool shall be of single speed, provided with a motor of the required rating. The power tool shall be supplied complete with suitable control.

#### 5.11.0 Lighting poles

Lighting pole shall be octagonal type, galvanized steel, supplied with base plate, foundation bolts, and necessary fixing-bracket for fixing the luminaire. Street lighting pole shall have integral junction box. All poles shall be provided with heavy square nuts on the anchor bolts under the pole base plate and hex nuts on the top. GI conduits shall be embedded in muff for incoming and outgoing cables. Height of poles shall be about 10M. Junction box shall be integral to the pole, supplied along with MCB and neutral link.

#### 5.12.0 PVC Wires

PVC wires shall be suitable for continuous conductor temperature of 70° C and short circuit conductor temperature of 160° C. PVC Wires shall have multi stranded copper conductor. PVC Wires shall be of 1.5 sq.mm/2.5 sq.mm/4 sq.mm size. The insulation material shall be resistant to flame, oil, acid and alkali and shall be tough enough to withstand mechanical stresses during handling. PVC wires shall have following colors.

- Red for R phase
- Yellow for Y phase
- Blue for B phase



- Black for Neutral
- Yellow-Green for Earth wire
- Grey & white for positive and negative connections respectively.

#### 5.13.0 Rigid Conduits and Fittings

Rigid conduits shall conform to the requirements of IS: 9537 (Part I & Part II). However conduits above 63mm diameter shall conform to the requirements of IS: 1239. All conduits and pipes shall be of medium duty. The rigid conduits shall be hot dip galvanized inside and outside. Weight of zinc shall be as per IS:4759. Conduits shall be thoroughly cleaned and pretreated, conforming to IS: 6005.

Conduit fittings shall be made out of tube or cast to the shape as to match with corresponding conduit sizes. All fittings shall be screwed type and hot dip galvanized inside and outside.

In corrosive areas, epoxy coated conduits shall be provided.

#### 5.14.0 Flexible Metallic Conduits and Fittings

Flexible metallic conduits shall conform to the requirements of IS:3480. Flexible conduits shall be made of strip steel which shall be of cold rolled mild steel. The strip shall be of uniform width and thickness throughout. The strip shall be electro galvanized to a minimum thickness of 25 microns. The surface of the strip shall be thoroughly cleaned before application of protective coating. Pretreatment, before galvanization, shall conform to IS:6005. Flexible conduits shall be supplied with suitable end coupler nipple and check nut.

5.14.1 GI pipes shall be of medium duty as per IS: 1239

5.14.2 Hume pipes shall be of reinforced concrete conforming to class NP3 for road crossings as per IS: 458.

#### 5.15.0 Switch Boxes

The switch boxes shall be of surface/flush mounting type with steel construction. Switch boxes shall have conduit knock out on the sides. The switches shall be of quick make and quick break type and shall be of plate type. Where specified, 6A, 3 pin 240V type receptacles shall be provided with safety shutter and 6A plate switch in the switch box. The switch box shall be flush mounted in places such as control rooms and office rooms.

Switches furnished shall be 6 or 16 Amps, 240 Volt totally enclosed plate type with side connected screw type terminals, phenolic compound housing and operating levers, and single mounting yoke design.

Switches used for switching direct current shall be 10 amperes, 240Volt T-rated AC/DC switches.

#### 5.16.0 Lighting Junction Box

The junction boxes shall be of FRP weather proof type. 650V grade multiday terminal blocks complete with screws, nuts, washers and marking strips shall be furnished for



connection of incoming/outgoing wires in the junction boxes. The Junction box shall be suitable for mounting on wall/column/poles/masts.

#### 5.17.0 Fans

Ceiling fans shall be of reputed make, BIS approved, 1200 mm sweep complete with copper wound, class E insulated motor, three nos. balanced blades, suspension rod, canopy and other accessories conforming to applicable IS. Ceiling fans shall be supplied with a wall mounted controller to turn the fan on and off and to vary the fan speed from 0 to 100%. Controller shall be Electronic type free from humming noise.

Pedestal fans shall be of reputed make, BIS approved, 500mm sweep, complete with aluminium blades, cast iron base, copper wound, class E insulated motor, support column, control switch and other accessories conforming to applicable IS.

### 6.0.0 INSTALLATION

6.1.0 The bottom of wiring devices shall be mounted the following distances above the finished floor.

Wiring Devices	Location	Distance above Floor (minimum)
Receptacles	Offices and finished areas	500 mm
Receptacles	All other locations	900 mm
Switches	All locations	1500 mm
Ceiling fan control	All locations	1500 mm
Ceiling fans	All locations	2500 to 3000 mm

6.2.0 The location of the light fittings, receptacles, switches, etc. shall be such as to avoid interference with piping / ventilation ducts / busduct or other equipment and to avoid objectionable shadows and glare.

6.3.0 In false ceiling areas the switchboards and the conduits shall be recess mounted.

6.4.0 In industrial buildings, wiring installation shall be carried out on surface conduits. In office building and other non industrial buildings, concealed conduit wiring shall be adopted.

6.5.0 Wooden plugs in walls and ceilings for fixing of lighting fixtures and accessories are not acceptable. Nylon rawl plug shall be offered.

6.6.0 In the rooms where false ceilings are provided, the lighting fixtures shall be supported separately by false ceiling grid over false ceiling if it is of steel structural or from ceiling or from cable trough / channel and not by the false ceiling board. The arrangement shall be to the approval of Owner.

6.7.0 A four (4) way terminal junction box shall be provided near each lighting fixture, for loop-in, loop-out and off connection of lighting wires or as required.



- 6.8.0 Conduit in finished areas, such as office and control areas, shall be concealed. Conduit shall be routed at least 150mm from the insulated surfaces of hot water, steam pipes and other hot surfaces. Where conduit must be routed parallel to hot surfaces, special high temperature cable shall be used.
- 6.9.0 Conduits supports shall be provided at an interval of 750 mm for horizontal runs and 1000 mm vertical runs.
- 6.10.0 Conduit shall be clamped on to approved type spacer plates or brackets by saddles or U-bolts. The spacer plates or brackets in turn, shall be securely fixed to the building steel by welding and to concrete or brick work by grouting or by nylon rawl plugs.
- 6.11.0 Wiring for indoor Lighting installation shall be carried with PVC insulated wire following sizes laid in Galvanised steel conduit of
- Lighting Panel to lighting Fixtures : 2.5 sq.mm copper
  - Lighting Panel to Switch box : 2.5 sq.mm copper
  - Switch box to lighting Fixtures : 1.5 sq.mm copper
  - Lighting Panel to Sockets : 4 sq.mm copper
- 6.12.0 Voltage drop in the cable shall be limited as follows,
- Lighting panel to lighting fixtures :3%
  - Switchbox to lighting fixtures :1.5%
  - Lighting panel to socket :3%
  - Lighting panel to switch box :1.5%
- 6.13.0 For outdoor lighting & road lighting, XLPE insulated, PVC inner sheathed, armoured, FRLS PVC outer sheathed cables shall be provided.
- 6.14.0 Wiring for lighting circuits of Normal AC system and DC system shall run in separate conduits.
- 6.15.0 Wiring for lighting fixtures and receptacle units shall be fed from different circuits and shall run in separate conduits. Two different phase circuits shall not be laid in the same conduit.
- 6.16.0 All conduits shall be surface mounted in general. In Office rooms & Control rooms conduit shall be concealed type.
- 6.17.0 Ceiling fans with variable speed electronic regulators shall be installed in the non-air-conditioned areas as specified. Ceiling Fans & pedestal fans for of required size and quantity to be provided in individual rooms / areas like Workshop, Stores, Office building / areas, Service building, etc.
- 6.18.0 Receptacles and lighting circuits shall be fed from different circuits. The switch controlling these circuits shall be on the live side (phase wire) of the circuits.
- 6.19.0 Wiring shall be spliced only at junction boxes. Maximum two wires shall be connected at each terminal.



6.20.0 Lighting branch circuits, telephone circuits, and intercommunication circuits shall be routed in conduit. Lighting circuits shall be routed in electrical metallic tubing ( EMT) for indoor areas, rigid conduit for hazardous and outdoor areas.

6.21.0 All conduit system shall be sized considering fill criteria specified in IS:732.

6.22.0 Each lighting poles and lighting / lightning mast junction box shall be earthed by 25 x 3 mm GS flat bonded to one (1) 20 mm dia MS earth electrode of 3 meter length driven vertically in the ground.



## SECTION - 3.5 CABLES

### 1.0.0 INTENT OF SPECIFICATION

This section covers the requirements of HT cables, LT cables and Control cables.

### 2.0.0 CODES AND STANDARDS

The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest edition (including amendments) of the following Indian Standards (IS), IEC publications and other codes except where modified and / or supplemented by this specification.

- a) IS: 3975 Mild steel wires formed wires and tapes for armouring of cables.
- b) IS: 4905 Methods for random sampling.
- c) IS: 5831 PVC insulation and sheath of electric cables.
- d) IS: 7098 Part-I Cross-linked polyethylene insulated PVC sheathed cables (LV)
- e) IS: 7098 Part-II Cross-linked polyethylene insulated PVC sheathed cables (HV)
- f) IS: 8130 Conductors for insulated electric cables and flexible cords.
- g) IS: 10418 Drums for electric cables.
- h) IS: 10810 Methods of tests for cables.
- i) IS: 3961 Recommended current ratings for cables
- j) ASTM-D-2843 Standard test method for density of smoke from the burning or decomposition of plastics
- k) ASTM-D-2863 Standard method for measuring the minimum oxygen concentration to support candle like combustion of plastics
- l) IEC-754 (Part-I) -Test on gases evolved during combustion of electric cables.
- m) IEC-332 - Tests on Electric cables under fire conditions Part-3 : Tests on bunched wires or cables (category -B)
- n) IEEE-383 - Standard for type test of Class IE Electric Cables.
- o) SS-4241475 class F3 - Swedish Chimney test

### 3.0.0 TECHNICAL REQUIREMENTS

#### 3.1.0 Power cables shall be sized to satisfy the following Criteria:

- Short circuit withstand capacity for applicable fault current and duration.
- Full load current carrying capacity under installation conditions considering Site ambient temperature & site installation (Grouping) conditions based on Manufacturer's recommendation.
- Permissible voltage drop limits under steady state/transient state as applicable.

3.2.0 For breaker operated feeders, Short circuit withstand duration for conductors shall be not less than 160 m.sec for motor / transformer feeders, 500 m.sec for tie feeders and 1 sec for incomers in general. For HT cables, screen/armour shall be sized to withstand 300 A for 3 sec.



- 3.3.0 To maintain voltage at motor terminals /equipment end with in desirable limit, it is proposed to limit the voltage drop in the cables within 3% during normal running condition and 10% during starting of Motor.
- 3.4.0 Cables can be armoured type only.
- 3.5.0 Power cables shall be XLPE insulated. Control cables shall be HRPVC insulated.
- 3.6.0 HRPVC insulation shall be suitable for continuous conductor temperature of 85°C and short circuit conductor temperature of 160°C. XLPE insulation shall be suitable for continuous conductor temperature of 90°C and short circuit conductor temperature of 250°C.
- 3.7.0 Cables for 11kV system shall be rated for unearthed grade. Cables for 415/230 V AC and 220V DC shall be rated for 1.1 kV grade.
- 3.8.0 To minimize the damage that can be caused by a fire, cables installed in electrical cable tray systems shall have sheaths which have low smoke, non-propagating, and self-extinguishing characteristics. Outer sheath shall be of HRPVC black in colour. These cables shall meet the following test requirements.
- Oxygen index of minimum 29 when tested as per IS 10810 Part-58 / ASTMD-2863/1977
  - Temperature index of minimum 250°C when tested as per IS 10810 Part-64// ASTMD-2863/1977
  - Acid gas emission of maximum 20% when tested as per IS 10810 Part-59 / IEC-754-I
  - Average light transmission of 40% minimum when tested as per IS 10810 Part-63 // ASTMD-2843/1977.(average smoke density is maximum 60%)
  - Flame test requirements as per IS 10810 Parts-53 and 62, IEEE-383-1974, IEC-332-1 & SS-4241475, Class-F3
  - Flame retardant test requirements as per IS 10810 Part-61
- 3.9.0 For power cables, copper conductor shall be used for current rating of up to 10A. For higher current rating, conductor can be aluminium/copper. Minimum size of copper conductor shall be 2.5 sq.mm and aluminium conductor shall be 6 sq.mm.
- 3.10.0 Conductor of control cables shall have plain annealed copper. The minimum size of control cable shall be of 1.5 Sq.mm. For CT circuits minimum size shall be 2.5 sq.mm copper.
- 3.11.0 Power cables shall carry the full load current of the circuit continuously under site conditions considering the various derating factors like thermal resistivity of soil, ambient air/ground temperature, grouping, method of laying, etc.
- 3.12.0 Design ambient air temperature and ground temperature shall be considered at 50°C and 40°C respectively for cable sizing.
- 3.13.0 Power cables shall be sized to withstand the fault current of the circuit for the fault clearing time indicated below:
- HT motor feeders and transformer feeders: 0.16 second.
  - LT ACB operated motor feeders & outgoing feeders: 0.16 second.
  - Tie between two 415V switchboards: 0.5 second.
  - Incomers: 1.0 second.
- 3.14.0 Voltage drop from transformer secondary to motor terminals during starting of motors shall be limited to the following values:
- For HT motors: 15% of the rated voltage.



- For LV motors: 15% of the rated voltage.

3.15.0 The voltage drop in feeder cables between PMCC/MCC to motor terminals shall be limited to 3% during full load running condition. However, the voltage drop from transformer secondary to motor terminals during full load running of motors shall be limited to 5 % of rated voltage.

3.16.0 Method of curing for HT XLPE insulation shall be Triple Extrusion Dry Cure (CCV) process using nitrogen gas.

3.17.0 Conductor screen and insulation screen shall both be of extruded semi-conducting compound and shall be applied with XLPE insulation in one operation through triple extrusion.

3.18.0 For armoured cables, armouring shall be of aluminium for single core cables. For multicore armoured cables, armouring shall be of galvanised steel.

3.19.0 All the cables shall be protected against rodent and termite attack. Necessary chemicals shall be added into the PVC compound of the outer sheath. The sheath shall be resistant to water, UV radiation, fungus, etc.

3.20.0 Multi-core cable color coding shall be as follows:

- Red, yellow, blue, black and gray for five core cables
- Outer sheath shall be of black in colour.
- For more than 5 cores, core identification shall be by alpha numerical numbering system at an interval of one meter.

3.21.0 Three core HT unearthing grade cables shall constitute the following as per IS-7098-Part-2:

- Circular stranded and compacted aluminium conductor
- Extruded semi conducting compound as conductor screen
- Extruded XLPE insulation
- Extruded semi conducting compound as insulation screen
- Copper tape as metallic screen for each core
- Extruded HRPVC inner sheath
- Galvanised steel formed wire/strip
- Extruded FRLS HRPVC outer sheath

3.22.0 Single core HT unearthing grade cables shall constitute the following:

- Circular stranded and compacted aluminium conductor
- Extruded Semi conducting compound as conductor screen
- Extruded XLPE insulation
- Extruded Semi conducting compound as insulation screen
- Extruded HRPVC inner sheath
- Hard drawn aluminium wire armour
- Extruded FRLS HRPVC outer sheath

No separate metallic screen for insulation is required, in case of single core armoured cable, as armour constitute the metallic screen.

3.23.0 Multicore 1.1 kV earthed grade cables shall constitute the following as per IS-7098-Part-1:

- Circular / shaped, stranded aluminium conductor (compacted for >10 sq.mm)
- Extruded XLPE insulation
- Extruded HRPVC inner sheath
- Galvanised steel formed wire/strip



- Extruded FRLS HRPVC outer sheath

3.24.0 Single core 1.1 kV earthed grade cables shall constitute the following:

- Circular stranded and compacted aluminium conductor
- Extruded XLPE insulation
- Hard drawn aluminium wire armour
- Extruded FRLS PVC outer sheath

3.25.0 Multicore 1.1 kV earthed grade control cables shall constitute the following as per IS:1554-1:

- Multi stranded annealed copper conductor
- Extruded HRPVC insulation
- Extruded HRPVC inner sheath
- Galvanised steel formed wire/strip
- Extruded FRLS HRPVC outer sheath

3.26.0 Multi pair 1.1 kV earthed grade, overall screened signal cables shall constitute the following as per BS EN 50288-7:

- Multi stranded annealed copper conductor
- Extruded PVC insulation
- Twisted pair
- Overall polyester taped, Al-mylar screened with ATC drain wire
- Extruded PVC inner sheath
- Galvanised steel formed wire/strip
- Extruded FRLS PVC outer sheath

3.27.0 Multi pair 1.1 kV earthed grade, individual and overall screened signal cables shall constitute the following as per BS EN 50288-7:

- Multi stranded annealed copper conductor
- Extruded PVC insulation
- Twisted pair
- Individual polyester taped, Al-mylar screened with ATC drain wire
- Overall polyester taped, Al-mylar screened with ATC drain wire
- Extruded PVC inner sheath
- Galvanised steel formed wire/strip
- Extruded FRLS PVC outer sheath

### 3.28.0 Cable drums

Cables shall be supplied in non-returnable steel drums of heavy construction. All ferrous parts shall be treated with suitable rust protective finish or coating to avoid rusting during transit and storage. The surface of the drum and the outer most cable layer shall be covered with waterproof layer. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/rubber caps, secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS 10418.

Each drum shall contain minimum 500 metres single length of cable. Allowable tolerance on individual drum length is +5%.

Cable identification shall be provided by embossing on every meter on the outer sheath the following:



- a. RRVUNL
- b. Manufacturer's name or trademark
- c. Voltage grade
- d. Year of manufacture
- e. Type of insulation and sheath, e.g. XLPE /HRPVC FRLS as applicable.
- f. Type of improved fire performance, e.g.FRLS
- g. No. of core and size of cables.
- h. Reference Standard
- i. ISI Mark
- j. Sequential length marking at an interval of 1m throughout the length of the cable.

### 3.29.0 Packing

Cable shall be wound and packed on drums in such a manner that it will be properly sealed and firmly secured to the drum. The ends of each length shall be sealed before shipment. Heat shrinkable cable seals shall be used for this purpose.

A label shall be securely attached to each end of the reel indicating the details mentioned below. A tag containing the same information shall be attached to the leading end of the cable inside. Drum numbers are to be indicated on cable drums.

The cable drums should carry the following details in printed form (non returnable):

- a) RRVUNL & Manufacturer's name or trade make
- b) Type of cable & voltage grade
- c) Year of manufacture
- d) Type of insulation / sheath e.g. XLPE /HRPVC FRLS as applicable.
- e) No. of core and size of cables
- f) Cable code
- g) Length of cable on drum
- h) ISI Mark
- i) Direction of rotation, by arrow
- j) Approx. gross mass.
- k) IS/IEC number

### 3.30.0 Tests

Cables offered shall be type tested and proven type.

All tests, i.e. routine, acceptance & type tests including special FRLS type & acceptance test shall be witnessed by Owner and/or Owner's representative. The Contractor shall give at least fifteen (15) days advance notice of the date on which the tests are to be carried out.

Acceptance tests shall be carried out on 1 drum out of every 10 or less number of drums selected on random basis from each lot for each type & size of cable.

Type tests shall be carried out on 1 drum per each lot selected on random basis for each type & size of cable.

Type & size shall mean voltage grade, type of insulation, and no. of cores read in conjunction with area of cross section of conductor.



## SECTION-3.6: CABLE TRAYS, SUPPORTS & ACCESSORIES

### 1.0.0 INTENT OF SPECIFICATION

This section covers the requirements of Cable trays & accessories. List of items shall include the following:

- Ladder type Cable trays
- Perforated type Cable trays
- Cable troughs
- Cable Tray bends, Tees, Cross, Coupler plates, etc.
- Cable tray covers
- Bolted (Unistrut type) cable tray support system
- Erection hardwares

### 2.0.0 CODES AND STANDARDS

The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest version of the following Indian Standards, except where modified and /or supplemented by this specification.

- a) IS: 1079 Specification for hot rolled carbon steel sheet and strip.
- b) IS: 1730 Dimensions for steel plates, sheet strips and flats for general engineering purposes.
- c) IS: 1363 Hexagon head bolts, screws and nuts.
- d) IS: 6005 Code of practice for phosphating iron & steel.
- e) IS: 2629 Recommended practice for hot dip galvanising on iron and steel.
- f) IS: 2633 Methods for testing uniformity of coating on zinc coated articles.
- g) IS: 6745 Methods for determination of mass of zinc coating on zinc coated iron and steel articles.
- h) IS: 816 Code of practice for use of metal arc welding for general construction of mild steel.
- i) IS:4759 Specification for hot-dip zinc coatings on structural steel and allied products

### 3.0.0 TECHNICAL REQUIREMENTS

#### 3.1.0 Cable Trays

3.1.1 Cable trays shall be ladder type for power and electrical control cables and perforated type for signal cables, prefabricated, made out of hot / cold rolled mild steel sheets, complete with matching fittings, accessories and hardware as required.. Cable trays shall be with standard width of 150mm, 300mm, 450mm, 600mm and 750mm and standard lengths of 2.5m or more. Minimum thickness of mild steel sheets used for fabrication of cable trays and fittings shall be 2mm. For ladder trays, rung spacing shall be 250mm maximum. The thickness of side coupler plates shall be minimum 2.5mm and of tray covers shall be minimum 1.6mm.

3.1.2 Separate cable trays shall be provided for the following cables:

- HT Cables



- LT power cables
- Electrical Control cables
- Signal cables
- Fiber optic cables

Cable trays shall be designed to cater to a load of minimum 75kg/m.

- 3.1.3** Cable trays shall be complete with matching fittings and accessories (like elbows, bends, reducers, tees, crosses, side coupler plates, etc.) and hardware (like bolts, nuts, washers, etc.) as required. At both the ends of cable trays, four holes shall be provided for fixing side coupler plates. All the slots and coupler holes shall be machine punched.
- 3.1.4** Cable trays, fittings and accessories shall be hot dip galvanized. Thickness of galvanizing shall be not less than 610grams/sq.m. Fasteners like bolts, nuts, screws washers etc. shall also be hot dip galvanized.
- 3.1.5** For branch cabling routes involving fewer cables, sheet steel galvanised cable trough of size 50/75/100mm shall be provided.
- 3.1.6** Cable tray covers shall be provided for outdoor trays on top most tray. It shall be prefabricated made out of hot/cold rolled mild steel sheets, complete with hardware as required. Tray cover shall be hut type. Special clamps shall be provided for fixing tray covers without drilling holes on trays. Tray covers shall be hot dip galvanized. Thickness of galvanizing shall be not less than 610grams/sq.m.

**3.2.0 Load Test for Cable trays shall be carried out as follows:**

A 2.5 metre straight section of each type of cable tray shall be simply supported at the two ends. A uniformly distributed load of 100 kg per meter shall be applied along the length of tray. The maximum deflection at mid span shall not exceed 7 mm.

**4.0.0 CABLE TRAY SUPPORT SYSTEM**

- 4.1.0** Cable tray supports shall be of prefabricated preformed sections of sheet steel, bolted type and shall be hot dip galvanized.
- 4.2.0** Cable tray support system shall be similar or equivalent to "Unistrut make". Support system for cable trays shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall be of following two types:
- Single channel strut support for supporting cable trays on one side
  - Double channel strut support for supporting cable trays on one side
- 4.3.0** Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor plates, all hardware such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc.



- 4.4.0 The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardware fittings and accessories shall be prefabricated factory galvanised.
- 4.5.0 The main support and cantilever arms shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hardware etc of the components shall not be allowed.
- 4.6.0 All steel components, accessories, fittings and hardware shall be hot dip galvanised after completing welding, cutting, drilling and other machining operation.
- 4.7.0 The typical arrangement of flexible support system shall comprise the following:
- The main support channel and cantilever arms shall be fabricated out of minimum 2.5 thick rolled steel sheet conforming to IS.
  - Cantilever arms of required length to match cable tray width shall be as shown in the enclosed drawing. The arm portion shall be suitable for assembling the complete arm assembly on to component constructed of standard channel section. The back plate shall allow sufficient clearance for fixing bolt to be tightened with tray in position.
  - The size of structural steel members or thickness of sheet steel of main support channel and cantilever arms and other accessories as indicated above or in the enclosed drawings are indicative only.
  - Main support channels may be supplied in any suitable lengths to minimize the wastage. Nevertheless, the support system shall be designed by the bidder to fully meet the requirements of type tests as specified.
- 4.8.0 Thickness of galvanizing on steel sections shall be not less than 610gm/sq.m on all steel sections.
- 4.9.0 Horizontally running cable trays shall be clamped by bolting to cantilever arms at an interval of 2000 mm. Vertically running cable trays shall be bolted to main support channel by suitable bracket/clamps on both top and bottom side rails at an interval of 2000 mm. For vertical cable risers/shafts cable trays shall be supported at an interval of 1000mm.
- 4.10.0 The cantilever arms shall be positioned on the main support channel with a minimum vertical spacing of 300 mm.



## SECTION – 3.7 CABLING ACCESSORIES

### 1.0.0 INTENT OF SPECIFICATION

This section covers the requirements of cabling accessories. List of major items shall include the following:

- Cable joints & terminations
- Cable glands
- Cable lugs
- Camps
- Tags
- Conduits & Pipes
- Junction boxes

### 2.0.0 CODES AND STANDARDS

The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest version of the following Standards except where modified and /or supplemented by this specification.

- a) VDE 0278 : Joints and Terminations
- b) IS: 13573 : Joints and Terminations for polymeric cables for working voltages from 6.6 kV up to and including 33 kV-Performance requirements and type tests.
- c) BS:6121 : Mechanical cable glands (Part 1 -Specification for metallic glands)
- d) IS: 12943 : Brass Glands for PVC Cables
- e) IS:8309 : Specification for compression type tubular terminal ends for aluminium conductors of insulated cables.

### 3.0.0 TECHNICAL REQUIREMENTS

#### 3.1.0 Joints & terminations

- 3.1.1 Termination and jointing kits shall be of proven design and make which have already been extensively used and fully type tested. Kits shall be complete with all accessories and consumables required for complete termination or jointing. Copper cable lugs & jointing ferrules for straight through joints shall form part of the kit.
- 3.1.2 Termination and jointing kits shall be suitable for the following types of cables as per IS.
  - 11 kV unearthing grade cable
  - 1.1 kV grade power cables
- 3.1.3 Termination kits shall be ‘elastimold’ or ‘Push on type’ or ‘heat shrinkable type’. Jointing kits shall be ‘Tapex type’ or ‘heat shrinkable type’.



**3.1.4** Straight through joint and termination shall be capable of withstanding the fault level of 40 kA for HT Cables.

**3.1.5** Straight through joints shall be protected against mechanical damage, rodent and termite attack. It shall be suitable for directly buried cables.

### **3.2.0 Cable glands**

Cables shall be terminated using cable glands suitable for the voltage grade of cables. Cable glands shall be heavy duty brass machine finished and tinned. Cable glands shall be supplied with neoprene seal and earth lugs suitable for the fault capacity of the armour of the installed cables. Cable glands shall be double compression type for armoured cables. For flame proof equipment cable glands shall be of flame proof type.

### **3.3.0 Cable lugs**

**3.3.1** Cable lugs shall be of aluminium for aluminium cables and tinned copper for copper cables. Thickness of tinning shall be not less than 10 microns Type of end connection shall be solderless crimping type.

**3.3.2** Cable lugs for conductors of power cables shall be "heavy duty" type. The type & size of cable lugs for power cables shall be selected according to the number and sizes of strands of the cable.

**3.3.3** Solder less crimping of terminals shall be done by using corrosion inhibiting compound. Cable lugs for control cable termination shall be insulated. These lugs shall be pin type/flat type/ ring type/U Type to suit the terminals provided in the panels.

**3.3.4** Type of cable lugs shall be as follows:

- Power cables with aluminium conductor : Aluminium crimping type.
- Power cables with copper conductor : Copper crimping type.
- Control Cables : Copper pin type /Copper screw type
- Special cables : pin type / maxi-termi type

### **3.4.0 Trefoil Cable Clamps**

- Clamps required for single core cables carrying alternating current shall be suitable for holding three cables together in delta formation. Clamps shall be of FRP material.
- Clamps shall be of suitable sizes to firmly hold the cables of various outer diameters including tolerance in OD.
- Clamps should have been type tested for Short Circuit Withstand Test .
- For Trefoil clamps run spacing shall be 2000 mm and Axial spacing shall be Double the diameter of larger adjacent trefoils cable or 150 mm whichever is less. Supports shall also be provided at each bend



### 3.5.0 Omega Cable clamps

- Omega clamps shall be of galvanized mild steel and shall be used to fasten the individual multi-core cables.
- Clamps shall be of simple construction, made of 2mm thick, 25mm wide strip of omega shape and suitable for clamping on the rungs / perforated sheet of tray with the help of two bolts.
- Clamps shall be of different sizes for different outer diameters of cables. Omega cable clamps shall be used for individual cables above 35mm outer diameter.
- Steel clamps shall be hot dip galvanized. Weight of zinc not less than 610 gms. per sq. metre
- For cables of above 35 mm OD, cables shall be individually clamped at 5000 mm interval for Horizontal runs and shall be individually clamped at 1000 mm interval for Vertical runs. Supports shall also be provided at each bend.
- For cables of up to 35 mm OD, cables shall be collectively clamped at 5000 mm interval for Horizontal runs and shall be collectively clamped at 1000 mm interval for Vertical runs. Supports shall also be provided at each bend.
- For cables supported along structures/ceiling, clamp spacing shall be 750 mm. Supports shall also be provided at each bend.

### 3.6.0 Strip Cable Clamps

- Strip clamps shall be of galvanized mild steel and shall be used to fasten the group of multi-core cables up to 35mm diameter only on a full or part of the tray width.
- Clamps shall be of simple construction, made of 3mm thick Steel, 25mm wide strip to cover the entire width up to 300mm wide tray and part of the tray for more than 300mm wide trays. Strip shall have two right angle bends at each end for fixing on to the rung/ perforated sheet of tray with the help of two bolts.
- Clamps shall be of different sizes for different sizes of tray width. However, the maximum size of clamp shall be 300mm and for cable trays of greater width, two clamps shall be used.
- Clamps shall be hot dip galvanized. Weight of zinc not less than 610 gms. per sq. metre

### 3.7.0 Self-locking Clamps

- Clamps shall be of FRP material. Clamps shall have self-locking feature when the cord is looped. Clamps shall be provided with manual lock release.
- Clamp cord shall not move in the backward position once it has been locked, unless the lock release is applied.
- Type test certificates to ascertain the strength of clamps shall be submitted for Owner's approval.
- Not more than four (4) cables shall be clamped together, wherever collective clamping is permitted.
- Clamp length shall be selected such that not more than 80% of lockable length is utilised for clamping.
- Nylon self-locking tie strips for collective clamping (up to 35mm OD max. group of 4 cables) shall be 4 mm having Tensile strength 30 kg.



- Nylon self-locking tie strips for Individual multicore clamping (above 35mm OD up to 55mm OD ) shall be 4 mm having Tensile strength 20 kg.
- Nylon self-locking tie strips for Individual multicore clamping (above 55mm OD ) shall be 7 mm having Tensile strength 60 kg.

### 3.8.0 Tags

- Cables shall be provided with cable number tags for identification.
- Cable tags shall be of aluminium.
- Cable numbers shall be engraved type
- Tags shall be of durable quality of size 60mm x 12mm with a tie hole at each end.
- Samples of tags shall be approved by the Owner before delivery.
- Tags shall be provided with non-corrosive wire of sufficient strength for tagging.

### 3.9.0 Junction Boxes

- 3.9.1 Junction box with IP 55 degree of protection, shall comprise of a case with hinged door constructed from FRP material. The junction box shall be provided with canopy. The boxes shall include brackets, bolts, nuts, screws, glands, lugs, M8 earthing stud etc.
- 3.9.2 Terminal blocks shall be of 650V grade, rated for 10A and in one piece moulding. It shall be complete with insulating barriers, clip-on-type terminal numbering on wiring diagrams. Terminal block shall be suitable for terminating 2Cx2.5mm<sup>2</sup> cable on both sides and arranged to facilitate easy termination. Cable entry shall be from bottom.
- 3.9.3 The boxes shall have provision for wall, column, pole or structure mounting and shall be provided with cable / conduit entry knockouts and terminals.



## SECTION – 3.8: FIRE STOP SYSTEM

### 1.0.0 INTENT OF SPECIFICATION

This section covers the requirements of Fire stop system for cable penetrations.

### 2.0.0 CODES AND STANDARDS

All the equipment and accessories covered under this specification shall be designed, manufactured and tested in accordance with the latest revision of the specified / applicable Standards. The fire proof cable penetration system shall confirm to the requirement of latest editions including amendments of the following standards:

- |                           |   |
|---------------------------|---|
| a) BS: 476 Part- 20 to 23 | Fire tests on building materials and structures                             |
| b) IS: 3809               | Fire resistance test for structures   |
| c) IS: 12458              | Method of test for fire resistance test of fire stops.                      |
| d) ASTME - 119            | Standard test methods for fire tests of building construction and materials |
| e) ASTME - 814            | Standard test methods for fire tests of Through Penetration fire stops      |
| f) UL:1479-1983           | Fire tests of Through Penetration fire stops                                |

### 3.0.0 TECHNICAL REQUIREMENTS

3.1.0 Fire proof cable penetration seals shall be provided for the following:

- All floor openings and wall openings (cable penetrations) in the switchgear rooms/ cable vaults

3.2.0 Fire barriers shall be provided for all fire rated wall and floor penetrations and for all direct cable entries into electrical equipment. Fire barriers shall be UL listed and Factory Mutual approved to provide a fire endurance rating at least equal to the fire wall or floor the raceway penetrates.

3.3.0 Sleeves and openings for the passage of electrical cable or raceway shall be sealed with fire stops having a fire rating not less than that of the wall or floor being penetrated, or 2 hours, whichever is greater.

3.4.0 All fire stops shall be installed in accordance with the manufacturer's recommendations including installation by trained personnel when so recommended by the manufacturer. All fire stop materials, fire stop testing, and installation methods shall be approved by the Owner prior to installation.

3.5.0 The fire proof cable penetration sealing system shall prevent spreading of fire in cable beyond the seal system in case of fire and shall have minimum two hour fire resistance rating



- 3.6.0 The fire proof cable penetration sealing system shall comprise either of the following methods:
- a) Panel sealing method complete with
    - Encasing Panels
    - Cavity fill material
    - Sealant
  - b) Mortar sealing method shall basically include Mortar based fire seal compound. The process shall include
    - Surface preparation like dusting / removal of any oil substance
    - Mixing Mortar with water
    - Damming / Shuttering
    - Filling
    - Curing with water
- 3.7.0 The fire proof cable penetration sealing system offered should have been tested and evaluated at CBRI, Roorke for compliance for the following tests. The following tests should have been carried out one after the other on the same sample in the specified sequence without any touching up/repair/modifications. A copy of test report shall be furnished along with the Bid.(but not more than 5 Years old).
- Accelerated ageing test
  - Water absorption test
  - Vibration test
  - Fire rating test
  - Hose Stream test
  - Anti Rodent test
  - Temperature rise test for cables in fire stops
- 3.8.0 The fire proof cable penetration sealing system shall be suitable for site condition at 50°C ambient temperature and relative humidity of 60%. Contractor shall co-ordinate, plan and use the material within stipulated self-life of material.
- 3.9.0 The fire proof cable penetration sealing system of each wall / floor crossing shall be adequately designed / sized such that 20% addition of cables is possible at any later date without disturbance / wastage of material in the penetration system.
- 3.10.0 The fire proof cable penetration sealing system shall be physically, chemically, thermally stable and shall be mechanically secured to the masonry / concrete / structural members. The system shall be mechanically robust and capable of giving satisfactory performance under vibrations encountered in power stations.
- 3.11.0 The encasing panel (support frame) shall be of single panel of uniform density. Paper laminated gypsum boards shall not be used.
- 3.12.0 Sealing putty shall not be based on chlorinated rubber.
- 3.13.0 Under normal load, short circuit & fire conditions cables may be subjected to movement and vibration. The fire proof cable penetration sealing system shall be designed to withstand & perform satisfactorily under these conditions. The fire proof cable penetration sealing system shall have life expectancy of 40 years.



3.14.0 The fire proof cable penetration sealing system should not affect the current carrying capacity of cables passing through it.

3.15.0 Asbestos shall not be used in the construction of fire penetration seal system.



## SECTION – 3.9 EARTHING & LIGHTNING PROTECTION SYSTEM

### 1.0.0 INTENT OF SPECIFICATION

This section covers the requirements of Earthing & Lightning protection system. The scope shall include the following:

- Buried earth mat for the CT MCC & CW Treatment System
- Embedded earth mat in the concrete floor of buildings.
- Equipment enclosure earthing for all electrical equipment
- Earthing of all metallic structures including cable racks
- Electronic earthing for all PLC/electronic equipment
- Lightning protection for the CT MCC & CW Treatment System

### 2.0.0 CODES AND STANDARDS

The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest version of the following Standards except where modified and /or supplemented by this specification.

- a) IS: 3043 Code of Practice for Earthing practice
- b) IS: 2062 Structural Steel (Standard Quality)
- c) IS: 1079 Specification for hot rolled carbon steel sheet and strips
- d) IS: 1730 Dimensions for steel plates, sheet, and strip for structural and general engineering purposes
- e) IS: 280 Specification for mild steel wire for general engineering purposes
- f) IS: 2629 Recommended practice for hot dip galvanizing on iron & steel
- g) IS: 816 Code of practice for use of metal arc welding for general construction of mild steel.
- h) IS: 4826 Specification for hot-dipped galvanized coatings on round steel wires.
- i) IS: 4759 Specification for hot-dip zinc coatings on structural steel and , allied products
- j) IS: 6745 Methods for determination of weight of zinc-coating on zinc coated articles.
- k) IEEE 80 IEEE Guide for safety in AC substation grounding
- l) IEC 62305 Protection of building and allied structures against lightning
- m) IEEE 142 Grounding of industrial & commercial power system.
- n) Indian Electricity Rules

### 3.0.0 TECHNICAL REQUIREMENTS

#### 3.1.0 Earthing System

- 3.1.1 Bidder shall provide earth mat of spacing 5 m x 5m below switchgear/MCC room/Switchyard and transformers. Suitable number of earth electrodes shall be provided. Perimeter earthing shall be provided around the building. The above grade earthing works including connection of equipments shall also be in bidder's scope. Earthing conductor for ground mat shall be minimum of 40 mm dia. M.S rod.



3.1.2 The earthing system shall meet the following requirements:

- Ensure adequate earth fault current for operation of earth fault protection
- Earthing conductors and connections shall withstand earth fault current for the duration of the fault

3.1.3 The mild steel earth grid shall be designed to withstand 25 years of corrosion. Corrosion rate shall be arrived at as per soil resistivity report.

3.1.4 Buried earthing conductors shall have at least 1000mm of earth cover unless stated otherwise.

3.1.5 Wherever earthing conductor crosses cable trenches, underground service ducts, pipes, tunnels, railway tracks etc., it shall be laid minimum 300mm below them and shall be circumvented in case it fouls with equipment / structure foundations.

3.1.6 Earthing conductors or leads along their run on cable trench, ladder, walls etc. shall be supported by suitable welding / cleating at intervals of 750mm. Wherever it passes through walls, floors etc., galvanized iron sleeves shall be provided for the passage of the conductor and both ends of the sleeve shall be sealed to prevent the passage of water through the sleeves.

3.1.7 Earthing conductor around the building shall be buried in earth at a minimum distance of 1500mm from the outer boundary of the building. In case high temperature is encountered at some location, the earthing conductor shall be laid minimum 1500mm away from such location.

3.1.8 Earthing conductors crossing the road shall be laid 300mm below road or at greater depth to suit site conditions.

3.1.9 Earthing pads shall be provided for the apparatus / equipment at accessible position. The connection between earthing pads and the earthing grid shall be made by two short earthing leads (one direct and another through the support structure) free from kinks and splices.

3.1.10 Steel / RCC structures & columns, metallic stairs etc. shall be connected to the nearby earthing grid conductor by two earthing leads. Electrical continuity shall be ensured by bonding different sections of handrails and metallic stairs.

3.1.11 Metallic pipes, conduits and cable tray sections for cable installation shall be bonded to ensure electrical continuity and connected to earthing conductors at regular interval. Apart from intermediate connections, beginning points shall also be connected to earthing system.

3.1.12 Metallic conduits shall not be used as earth continuity conductor.

3.1.13 Wherever earthing conductor crosses or runs along metallic structures such as gas, water, steam conduits, etc. and steel reinforcement in concrete it shall be bonded to the same.

3.1.14 Flexible earthing connectors shall be provided for moving parts.



- 3.1.15 A continuous earth conductor of 16 SWG GS wire shall be run all along each conduit run. The conductor shall be connected to each panel earth bus. All junction boxes, receptacles, switches, lighting fixtures etc. shall be connected to this 16 SWG earth conductor.
- 3.1.16 50mm x 6mm galvanized steel flat shall run on the top tier and all along the cable trenches and the same shall be welded to each of the racks. Further, this flat shall be earthed at both ends and at an interval of 30m.
- 3.1.17 Earthing connections with equipment earthing pads shall be bolted type. Contact surfaces shall be free from scale, paint, enamel, grease, rust or dirt. Two bolts shall be provided for making earth connection. Equipment bolted connections, after being checked and tested, shall be painted with anti-corrosive paint / compound.
- 3.1.18 Connection between equipment earthing lead and main earthing conductors and between main earthing conductors shall be welded type. For rust protection, the welds shall be treated with red lead and afterwards coated with two layers bitumen compound to prevent corrosion.
- 3.1.19 Steel to copper connections shall be brazed type and shall be treated to prevent moisture ingressions.
- 3.1.20 Resistance of the joint shall not be more than the resistance of the equivalent length of the conductor.
- 3.1.21 All ground connections shall be made by electric arc welding. All welded joints shall be allowed to cool down gradually to atmospheric temperature before putting any load on it. Artificial cooling shall not be allowed.
- 3.1.22 Metallic sheaths and armour of all multi-core power cables shall be earthed at both equipment and switchgear end. Sheath and armour of single core power cables shall be earthed at switchgear end only.
- 3.1.23 Earthing terminal of each lightning arrester and capacitor voltage transformer shall be directly connected to rod earth electrode which in turn, shall be connected to station earthing grid.
- 3.1.24 For electronic equipment such as PLC, chemical earthing pit shall be provided. The earth pit shall be tested and proven type and shall be guaranteed for service life of 25 years. The chemical earth pit shall comprise pipe electrode, crystalline conductive mixture, bentonite etc. constructed in a pit of not less than 3500mm depth. The pit shall be effective in all weather conditions and offer low resistance.
- 3.1.25 Size of the earthing conductor shall be as follows:

Sl.No.	Equipment	Size/type of Earthing material
1.	Main earthing conductor	Mild steel rod of 40mm dia size
2.	Earth risers	Mild steel rod 40 mm dia
3.	Rod earth electrode	Mild steel rod 40 mm dia
4.	Earth conductor embedded in concrete	50X6 mm MS flat



Sl.No.	Equipment	Size/type of Earthing material
5.	Treated earth pit	Minimum 65 mm dia galvanized steel pipe electrode as per IS:3043
6.	Electronic earthing	Chemical earth pit
7.	LT transformers (enclosure and neutral)	75X8mm GS flat
8.	HT Switchboards, HT motors, HT busducts	50X6mm GS flat
9.	LT Switchboards (PMCC & MCC), LT busduct	75X8mm GS flat
10.	All distribution boards	50X6mm GS flat
11.	LT motors of 75kW and above	50X6mm GS flat
12.	LT motors of 30kW to <75kW	32X5mm GS flat
13.	LT motors of 9.3kW to <30kW	25X3mm GS flat
14.	LT motors of 5.5, 7.5kW	4SWG GS wire
15.	LT motors of <5 kW	6 SWG GS wire
16.	Charger / UPS	50X6mm GS flat
17.	Lighting panels	25X6mm GS flat
18.	Cable trays	50X6mm GS flat

- 3.1.26 All earth electrodes shall preferably be driven to a sufficient depth to reach permanently moist soil. Electrodes shall preferably be situated in a soil which has a fine texture and which is packed by watering and ramming as tightly as possible. The electrodes shall have a clean surface, not covered by paint, enamel, grease or other materials of poor conductivity.
- 3.1.27 Earth pits shall be located avoiding interference with road, building foundation, column, equipment foundation etc. The disconnect facility shall be provided for individual earth pits to check their earth resistance periodically. Proper symmetry and distance between earth pits shall be maintained as per applicable standards and procedures. Treated earth pits shall conform to relevant standard.
- 3.1.28 Construction of trench for earthing conductor shall include excavation, laying of conductor, back filling and compacting. Back filling material to be placed over buried conductors shall be free from stones and harmful mixtures. Back filling shall be placed in layers of 150mm. Minimum earth coverage of 300mm shall be provided between earth conductor and the bottom of trench / foundation / underground pipes at crossings.
- 3.1.29 On completion of installation, continuity of earth conductors and efficiency of all bonds and joints shall be checked. Earth resistance at earth terminations shall be measured in presence of Owner's representatives. Equipment required for testing shall be furnished by Contractor.
- 3.1.30 Electronic panels and equipment shall be grounded utilising an insulated copper ground wire terminated at separate earth electrode.



- 3.1.31 Metallic frame of all electrical equipment shall be earthed by two separate and distinct connections to earthing system, each of 100% capacity. Steel RCC columns, metallic stairs, hand rails etc. of the building housing electrical equipment shall be connected to the nearby earthing grid conductor by one earthing.
- 3.1.32 Metallic sheaths, screens, and armour of all multi core cables shall be earthed at both ends. Sheaths and armour of single core cables shall be earthed at switchgear end only unless otherwise instructed by Owner.
- 3.1.33 Railway tracks within the plant area shall be bonded across fish plates and connected to earthing grid at several locations.
- 3.1.34 For prefabricated cable trays, a separate ground conductor shall run along the entire length of cable tray and shall be suitably clamped on each cable tray at periodic intervals. Each continuous laid out lengths of cable tray shall be earthed at minimum two places by G.S. flats to main earthing system, the distance between earthing points shall not exceed 30 metre. Wherever earth mat is not available Contractor shall do the necessary connections by driving an earth electrode in the ground.
- 3.1.35 The LV neutral of LT Service transformer shall be directly connected to earth and also connected to neutral of LT switchgear. Each earthing lead from the neutral of the Transformers/NGR shall be directly connected to two electrodes in treated earth pits which in turn shall be connected to station earthing grid.
- 3.1.36 Neutral connections and metallic conduits/pipes shall not be used for the equipment earthing. Lightning protection system down conductors shall not be connected to other earthing conductors above the ground level.
- 3.1.37 All ground conductor connections shall be made by electric arc welding and all equipment earth connections shall be made by bolting with the earthing pads through flexible insulated cable leads. Ground connections shall be made from nearest available station ground grid risers. Suitable earth risers approved by Owner shall be provided above finished floor/ground level, if the equipment is not available at the time of laying of main earth conductor.
- 3.1.38 Resistance of the joint shall not be more than the resistance of the equivalent length of conductor. For rust protection the welds should be treated with red lead compound and afterwards thickly coated with bitumen compound.
- 3.1.39 Earthing conductors buried in ground shall be laid minimum 600 mm below grade level unless otherwise indicated in the drawing. Earthing conductors crossings the road shall be installed at 1000 mm depth and where adequate earth coverage is not provided it shall be installed in hume pipes. Earthing conductors embedded in the concrete floor of the building shall have approximately 50mm concrete cover.
- 3.1.40 A minimum earth coverage of 300mm shall be provided between earth conductor and the bottom of trench/foundation/underground pipes at crossings. Wherever earthing conductor crosses or runs at less than 300mm distance along metallic structures such as gas, water, steam pipe lines, steel reinforcement in concrete, it shall be bonded to the same.



3.1.41 Earthing conductors along their run on columns, walls, etc. shall be supported by suitable welding/cleating at interval of 1000mm.

3.1.42 Earth pit shall be constructed as per approved drawing. Electrodes shall be embedded below permanent moisture level. Minimum spacing between electrodes shall be 6000mm. Earth pits shall be treated with salt and charcoal. Earthing conductor around the building shall be buried in earth at a minimum distance of 1200mm from the outer boundary of the building.

### 3.1.43 Earthing of cabling system

- Armour of the HT cables and LT single core cables shall be earthed only at one end of cable.
- Armour of other cables shall be earthed at both ends of cable.
- Screen of HT power cables shall be earthed at one end only.
- Screen of C&I screened control cables shall be earthed at one end.
- Screen of electronic earthing system cables shall be earthed as per the requirements to be furnished to the Contractor during contract stage.

3.1.44 Installation of earth conductors in outdoor areas, buried in ground, shall include excavation of earth up to 600mm deep and 450mm wide, laying of conductor at 600mm depth, brazing / welding / cad welding, if required, of main grid conductor, joints as well as risers of length 500mm above ground at required locations and then backfilling. Backfilling material to be placed over buried conductor shall be free from stones and other harmful mixtures. Backfill shall be placed in layers of 150mm, uniformly spread along the ditch, and tampered utilizing pneumatic tampers or other approved means. If the excavated soil is found unsuitable for backfilling, the Contractor shall arrange for suitable soil from outside.

3.1.45 Installation of earth pit shall include excavation, construction of the earth pits including all materials required for construction of earth pits, placing the rod and fixing test links on pipe / rod / plate electrodes in test pits and connecting to main earth grid conductors.

3.1.46 Each lighting poles and lighting / lighting mast junction box shall be earthed by 25 x 3mm GS flat bonded to one (1) 20mm diameter MS earth electrode of 3m length driven vertically in the ground. The flat and electrode shall be supplied by the Contractor and price of these shall be included in the erection price of individual pole / mast. 14 SWG GI wire shall be taken from fixture to JB.

3.1.47 After completion of grounding system installation, the measurement of ground resistance shall be performed by the Contractor. Before measurement, the overhead ground wires shall be disconnected from the Switchyard. The method of measurement shall be as per relevant standards / codes. .

## 4.0.0 LIGHTNING PROTECTION SYSTEM

4.1.0 All areas of the CT MCC & CW Treatment System shall be provided with lightning protection as per IEC 62305. The lightning protection system for buildings shall consist of Galvanised Steel horizontal air terminations, copper cladded steel rod vertical air terminations, down conductors, test link and earth electrodes.



4.2.0 Air termination network consisting of vertical or horizontal conductors or combination of both shall be provided for the building. Down conductors shall follow the most direct path possible between the air terminal network and the earth termination network. Each down conductor shall be provided with a test link for testing. An earth electrode shall be connected to each down conductor.

4.3.0 For Lightning protection, material & sizes shall be as follows:

- Vertical air termination : 20mm dia Galvanised MS Rod 1000mm long
- Horizontal air termination : 25X6 mm Galvanised MS Strip
- Down conductor : 25X6 mm Galvanised MS Strip
- Test link : 150x50x6mm Galvanised MS Strip with Box
- Earth Electrodes : Treated earth pit with pipe electrode as per IS:3043

4.4.0 The lightning protection system shall not come in direct contact with other equipment/systems such as cables, conduits, electrical equipment, underground metallic ducts etc. All metallic structures within 200 mm. vicinity shall be bonded to the lightning protection system.

4.5.0 All welded/brazed joints shall be coated with anti- corrosive paint for rust protection.

4.6.0 Lightning conductor when used above ground level and shall be connected through test link with earth electrode/earthing system. Down conductors shall be as short and straight as practicable and shall follow a direct path to earth. Down conductor shall not be connected to other earthing conductors above ground level.

4.7.0 Each down conductor shall be provided with a test link at 1500 mm above ground level for testing but it shall be in accessible to interference. No connections other than the one direct to an earth electrode shall be made below a test point. All joints in the down conductors shall be of welded type.

4.8.0 Down conductors shall be cleated on outer side of building wall/ welded to outside building columns at 1000mm interval.

4.9.0 Lightning conductor on roof shall not be directly cleated on surface of roof. Supporting blocks of PMCC/insulating compound shall be used for conductor fixing at an interval of 1500mm.

4.10.0 Thickness of galvanising shall be atleast 610gm/sq.m for all galvanised steel conductors.

4.11.0 Installation of lightning conductors on the roofs of buildings shall include construction of support, laying, anchoring, fastening and cleating of horizontal conductors, grouting of vertical rods wherever necessary, laying, fastening / cleating / welding of the downcomers on the walls / columns of the building and connection to the test links to be provided above ground level.



4.12.0 On completion of installation, continuity of earth conductors and efficiency of all bonds and joints shall be checked. Earth resistance at earth terminations shall be measured in presence of Owner's representatives. Resistance of individual earth electrode shall be measured after disconnecting it from the grid. Tests shall be carried out as per IS : 3043 for earthing installation including the following:

- a) Earth continuity checks
- b) Earth resistance of the complete system, sub-system and earth pits



## SECTION-3.10: INSTALLATION

### 1.0.0 INTENT OF SPECIFICATION

This section covers the requirements of Electrical installation. This shall also cover supply and installation of following items:

- Rubber mats for switchboards
- Caution boards
- Sand buckets
- First aid box
- Sheet steel cover for the exposed electrical equipment/cable shaft/trench etc.
- Cable route markers & Cable joint markers
- Shock hazard chart
- Erection hardware

### 2.0.0 CODES AND STANDARDS

Installation of cabling work shall comply with the latest edition of following Indian standards, rules, regulations and acts.

- IS: 1255 : Code of practice for installation and maintenance of power cables up to and including 33 kV rating.
- IS: 732 : Electrical wiring installation (system voltage not exceeding 650 V).
- IS 10028 : Code of Practice for selection, Installation & maintenance of transformers.
- IS 10118 : Code of practice for selection, installation & maintenance of Switchgear & Control gear.
- IS: 5216 : Guide for safety procedures and practices in electrical works.
- IS 2551 : Danger notice plates
- IS 8923 : Warning Symbol for dangerous voltages.
- Indian Electricity Act.
- Indian Electricity Rules.
- Fire insurance regulations.
- Regulations laid down by the Chief Electrical Inspector of the State.
- Regulations laid down by the Factory Inspector of the State.

### 3.0.0 GENERAL REQUIREMENTS

- 3.1.0 The work shall be carried out in the best workman like manner in conformity with the latest editions / amendments of relevant specifications / codes / standards / regulations.
- 3.2.0 Manufacturer's drawings, instructions and recommendations shall be correctly followed in handling, erecting, testing and commissioning of all items / equipment and care shall be exercised in handling to avoid distortion to stationary structures, marring to finish, or damaging of delicate instruments or other electrical parts.



- 3.3.0 All the equipment covered under this specification shall be installed in neat, professional manner such that the structures and equipment are level, plumb, squat, properly aligned and oriented. Clearance around electrical panels / equipment shall be as per relevant standards.
- 3.4.0 The Contractor shall be fully and finally responsible for proper erection and safe and satisfactory operation of the equipment under his scope of work to the complete satisfaction of the Owner. Equipment and material, which are wrongly installed, shall be removed and re-installed to comply with the design requirement at the Contractor's expense, to the satisfaction of the Owner.
- 3.5.0 The installation shall be carried out in such a manner as to provide access to other equipment installed. The Contractor shall restore floor / wall chipping, road cuttings and other such works done including replacement of equipment removed back to its place and make good damages done to original.
- 3.6.0 The Contractor shall effectively protect his work, equipment and materials under his custody from theft, damage or tampering. Finished work where required shall be suitably covered to keep it clean and free from defacement or injury. Contractor shall be held responsible for any loss or damage to equipment and material issued to him until the same is taken over by the Owner according to Contract.
- 3.7.0 All safety rules and codes as applicable to work shall be followed without exception. All safety appliance and protective devices including belts, hand gloves, aprons, helmets, shields, goggles, safety shoes etc. shall be provided by the Contractor for his personnel.
- 3.8.0 The Contractor shall provide guards and prominently display caution notices if access to any equipment / area is considered unsafe and hazardous. In order to avoid hazards to personnel moving around the equipment such as switchgear etc. which is kept charged after installation, before commissioning, such equipment shall be suitably cordoned off to prevent anyone accidentally going near it.
- 3.9.0 The Contractor shall have a separate cleaning gang to clean all equipment under erection as well as the work area and the project site at regular intervals to the satisfaction of Owner. In case this is not done, the Owner will have the right to carry out the cleaning operation and any expenditure incurred in this regard will be to the Contractor account.
- 3.10.0 The Contractor shall ensure that instruments and gauges to be used for testing and inspection have valid calibration and the accuracy can be traced to National Standards.
- 3.11.0 It shall be the Contractor's responsibility to obtain approval from local statutory authorities including Electrical Inspector / CEA, wherever applicable, for carrying out any work or for installation carried out which comes under the purview of such authorities. All such documents and certificates shall be handed over to Owner which then shall be property of the Owner.
- 3.12.0 The installation shall be carried out only by electrical Contractor, holding a valid license, issued by relevant authorities for carrying out installation work of the voltage classes involved, under the direct supervision of a person holding valid certificates of



competency for the same voltage classes, issued or recognized by the state Government.

- 3.13.0 The installation shall have to be approved by statutory government authorities like Electrical Inspector, Factory Inspector, Insurance Officials etc. It shall be the responsibilities of Contractor to prepare and submit all necessary drawings, calculations and test certificates to electrical inspectorate and obtain approval prior to installation and commissioning work and also arrange inspection by them after installation. After inspection, any modification in the equipment of installation that may be demanded by them shall have to be carried out by the Contractor at no extra cost to the Owner. The Contractor shall take all necessary steps to enable the Owner to get the installation approved by the above authorities and shall render all necessary assistance to the Owner in the matter.
- 3.14.0 Handling of equipment shall be done strictly as per manufacturer's / supplier's instructions / instruction manual. Handling equipment, sling ropes etc. shall be tested periodically before erection for strength. The slings shall be of sufficient length to avoid any damage to insulator due to excessive swing, scratching by sling ropes etc.
- 3.15.0 All boards shall be made completely vermin-proof.
- 3.16.0 Contractor shall take utmost care in holding instruments, relays and other delicate mechanisms wherever these are supplied separately. They shall be installed only after the associated panels have been erected and aligned. The packing materials employed for safe transit of these shall be removed after ensuring that panel have been completely installed and no further movement of the same are necessary. Any damage shall be immediately reported to Owner.
- 3.17.0 Equipment furnished with finished coats of paint shall be touched up by Contractor if their surface is scratched or marred while handling.
- 3.18.0 After installation of panels, power and control wiring and connections, Contractor shall perform operational tests on all switchboards, to verify proper operation of switchboards / panels and correctness of all equipment in each and every respect.
- 3.19.0 The cable opening and cables entries for cables terminating to the panels shall be sealed with approved fire sealing materials.
- 3.20.0 All doors of all substation cubicles, operating cabinets, terminal boxes etc. shall be provided with locking facility. Three sets of keys shall be handed over to the Owner after installation.
- 3.21.0 The Contractor shall make his own arrangement for moving/lifting all the equipment/items into the respective buildings/erection sites. No part of the structure shall be utilized to lift or erect any equipment without prior permission of the Owner.
- 3.22.0 The installation shall be carried out in such a manner as to provide access to other equipment installed. The Contractor shall restore floor / wall chipping, road cuttings & other such works done including replacement of equipment.
- 3.23.0 Cable installation shall be properly coordinated at site with other services and wherever necessary suitable adjustment shall be made in the cable routings with a



view to avoid interference with any part of the building, structures, equipment, utilities and services Any such adjustment shall be done with the approval of Owner.

#### 4.0.0 CABLING CONCEPT

- 4.1.0 In the plant building, switchgear rooms, control rooms etc., power and control cables shall be laid on cable trays installed in concrete trenches, Overhead trays, cable vaults, cable shafts or along building and structures as the case may be. Short cable runs in auxiliary plant areas local to equipment shall be laid in floor slits up to near the equipment.
- 4.2.0 In cable trenches, pipe racks/ cable racks, overhead routes, cable shafts and cable vaults, cables shall be laid in cable trays only. Fewer cables installed along buildings, structures, ceilings, walls, etc., which are required to be protected against mechanical damage, shall be taken in GI conduits.
- 4.3.0 GI Conduits shall also be used for flameproof installations, wherever required, with sealing at both ends.
- 4.4.0 Entry of cables from trenches into buildings shall be by means of GI Pipes. Trenches / duct banks/ embedded conduits shall enter buildings as per approved layout drawings. All such entries shall be sealed against water ingress after completion of cable laying. The method of sealing shall not be deleterious to the cables and shall be to the approval of Owner. During cabling work, all such pits as are meant for cabling shall be kept in dry condition by use of means such as portable sump pumps specially during rainy season. Suitable numbers of such pumps shall be deployed to ensure no water collection/ retention in cable pits / indoor trenches etc
- 4.5.0 Cables laid exposed in racks/trays and routed from trenches etc to individual drive / control devices etc shall be taken in embedded/exposed/surface-grouted rigid GI conduits / rigid PVC Conduits and / or flexible conduits as specified in the drawings, unless directly terminated to the equipment in the panels located above trenches, tunnels or basement.
- 4.6.0 All cables routed along walls or in equipment rooms shall be protected by means of laying them through G.I. pipes.
- 4.7.0 Where direct heat radiation from equipment/pipes exists, heat isolating barriers for cabling system shall be adopted.
- 4.8.0 Wherever cables are to be laid below roads and railway tracks, the same shall be taken through ducts buried at a suitable depth. Provisions of IS:1225 shall be followed for cables buried directly in ground
- 4.9.0 At certain places where hazardous fumes/gases may cause fire to the cables, cable trenches after installation of cables may be sand-filled.
- 4.10.0 In corrosive atmosphere, PVC conduits shall be used for cables. Metallic pipes / conduits shall not be used in corrosive areas



- 4.11.0 Single core cables, when pulled individually, shall be taken through PVC pipes only. No single core cable shall pass through a GI conduit / pipe or duct singly except DC single core cables. AC single core cables shall pass through GI conduit/ pipe in trefoil formation only, or through PVC pipes
- 4.11.0 Cable routes shall be segregated unit wise, to the extent possible. Similarly, cables for the standby drives shall preferably be taken through the alternative route. Separate routes shall also be preferred for duplicate control supply cables, first and second channel protection cables, and cables to common station service of two or more units.
- 4.12.0 Cables shall be avoided below oil pipes and in the vicinity of steam pipes.
- 4.13.0 Cable trays shall be laid in vertical formation in boiler, mill and ESP areas to avoid accumulation of coal-dust / ash on cables and cable-trays.
- 4.14.0 Complete cable tray support structure after installation shall be inspected for straightness, accuracy, use of proper sizes & compliance to drawings.
- 4.15.0 Complete cable tray & accessory installation work shall be inspected/tested for proper alignment, levelling (by use of plumb lines), use of proper accessories, provision of proper bending radius at bend for site fabricated accessories and high quality workmanship .
- 4.16.0 Cable trays shall be ladder type for power and electrical control cables, while perforated type cable trays shall be used for instrumentation and control cables. However, in vertical cable tray risers, all trays shall be ladder type.
- 4.17.0 Screened control cables of small cross sectional area, shall be terminated by means of Maxi- Termi termination system.
- 4.18.0 Individual cores of control cables shall have ferrules for identification. Ferrule numbers shall be provided as per the control schemes and other related documents.
- 4.19.0 Termination and jointing of HT cables shall be done with approved type termination/jointing kits of proven design & type tested as per IS: 13573.
- 4.20.0 Flexible conduits shall be used between fixed conduits and equipment terminal boxes, where vibration is anticipated.
- 4.21.0 Junction boxes shall be installed so that they are level, plumb & properly aligned and present a pleasing appearance. Boxes shall be adequately supported by means of proper supporting arrangement to Owners approval. The Contractor shall perform all drilling, cutting, welding & bolting required for attachment of supports.
- 4.22.0 The Contractor shall seal off all the floor and wall openings after installation of conduits/pipes/trays for cabling/earthing materials.
- 4.23.0 All welding work shall be carried out by electric arc welding method only with appropriate size of welding electrodes to ensure sufficient welding strength.



- 4.24.0 Flexible conduits shall be used for the final connection between rigid conduits & motors, only for vibrating equipment or equipment requiring regular removal.
- 4.25.0 Wherever it is possible for water or liquids to enter conduits, sloping of conduit runs and drainage of liquids accumulated shall be ensured.
- 4.26.0 The entire metallic conduit system, whether embedded or exposed, shall be electrically continuous and grounded, preferably with grounding bushings or grounding clamps.
- 4.27.0 Minimum bending radius for conduits shall be 10 times the external diameter of the conduit.
- 4.28.0 All conduits shall be permanently identified at each end with the conduit number assigned to it as per the applicable drawings.
- 4.29.0 Pull boxes shall be installed between termination points wherever required to facilitate cable out at a maximum interval of 30metres.
- 4.30.0 Conduits shall be firmly fastened within 900mm of each junction box, cabinet or fitting. Conduits shall be supported at least every 2000mm.

## 5.0.0 CABLE TRAY AND SUPPORT SYSTEM INSTALLATION

- 5.1.0 Cable trays shall be bolted to tray mounting supports with a minimum clearance of 250mm between cable tray tiers / as shown in the drawings.
- 5.2.0 Cable trays shall be supported at an interval of 1500mm for all horizontal runs. For vertical cable risers/shafts cables will be supported at every 1000 mm interval.
- 5.3.0 Support system shall be so designed that it is able to withstand weight of the cable trays, Weight of the cables (75 Kg/metre run of each cable tray), Concentrated load of 75 Kg between every support span without any permanent deflection. Factors of safety of atleast 1.5 shall be considered.
- 5.4.0 Cable tray supports shall be of 'Unistrut' type, which shall be installed at site by bolts. Fixing of tray supports by welding is not allowed. Cable tray supports structure shall be bolted to the steel structure by clamping and to concrete structures using anchor fasteners.
- 5.5.0 All cable way sections shall have identification, designations as per cable way layout drawings and painted/stenciled at each end of cable way and where there is a branch connection to another cable way. Minimum height of letter shall be not less than 60mm. For long lengths of trays, the identification shall be painted at every 10 meter. Risers shall additionally be painted / stenciled with identification numbers at every floor.
- 5.6.0 Tray covers shall be provided for overhead cable trays on top most tier. The cable risers or vertical raceways shall also be covered by cable tray covers up to 1.5 metres from respective floor for mechanical protection. The sheet cover shall be of removable type.



- 5.7.0 Atleast 250 mm spacing shall be maintained between top of the trays and beams/piping etc. Solid covers shall be provided for outdoor trays, top tray of horizontal tray runs located under grating floor or insulated piping, and for all trays routed in areas where oil might enter or accumulate.
- 5.8.0 Contractor shall install galvanized MS sheet covers over cable shafts. The width of the covers shall be same as that of cable trays. Bolting shall be done to fasten covers to the cable trays, elbows, reducers, tees, crosses etc.

#### 6.0.0 CONDUITS/PIPES/DUCTS INSTALLATION

- 6.1.0 Rigid steel conduits shall be used indoors in non-hazardous areas. PVC conduit shall be used for duct banks and for some below grade concrete encased conduit. Liquid tight flexible metallic conduit shall be used for connections to solenoid valves, limit switches; pressure switches etc., for connection to motors or other vibrating equipment and across areas where expansion or movement of the conduit is required.
- 6.2.0 Exposed conduits shall be routed parallel or perpendicular to dominant surfaces with right angle turns made of symmetrical conduit bends or fittings. Conduits shall be securely supported within 900 mm of connections to boxes and cabinet.
- 6.3.0 Embedded conduits shall have a minimum concrete cover of 50mm. Positioning and ensuring proper alignment during concreting by other agencies shall be the responsibility of the Contractor. All conduits to be embedded in concrete shall be inspected to ensure continuity and accuracy of placement before concrete is poured. All embedded pipes/conduits, sleeves, long radii bends etc. shall have at least 50mm long extension beyond the embedded part, for extension of the same or for providing end plugs. If any embedded conduit is not required it shall be plugged/sealed. All accessories/fittings required for making the installation complete, shall include tees, elbows, check nuts brass or galvanized steel end caps, PVC/brass bell mouths for water proof sealing, pull boxes, saddles, spacers and required steel supporting work.
- 6.4.0 Flexible conduit shall be terminated using suitable end coupler and check nut at both ends.
- 6.5.0 All conduits installed outdoor shall be sloped towards pull boxes, hand holes/manholes for drainage. Low points of conduits not terminating in pull boxes, hand holes/manholes shall be provided with weep holes for drainage. Care shall be taken to see that no rough edge is left around the weep holes. Where no provision for drainage can be made, both end of conduits shall be sealed after cable is laid through. Minimum slopes of 1 in 400 shall be provided.
- 6.6.0 Exposed conduit shall be adequately supported by racks, clamps, straps or by other approved means. Conduits supports shall be erected square and true to line and grade. For bending of conduits, bending machine shall be arranged at site by the Contractor to facilitate cold bending. The bends formed shall be smooth.



6.7.0 When two lengths of conduits are joined together through a coupling, running thread equal to twice the length of coupling shall be provided on any one length to facilitate easy dismantling. The Contractor shall have at site die for threading pipe or conduit. After threading of conduits anti corrosive paint shall be provided.V

6.8.0 Occupancy of conduits shall not be greater than 40%.

## 7.0.0 CABLE INSTALLATION

7.1.0 Cable installation shall be carried out as per IS: 1255 and other applicable standards.

7.2.0 Power and control cables shall be laid on separate tiers. The laying of different voltage grade cables shall be on different tiers according to the voltage grade of the cables. Generally H.T. cables shall be laid on bottom most tier and cables of subsequent lower voltage grades on upper tiers of trays. Separate cable trays shall be used for the following:

- HT Power Cables
- LT Power Cables
- Control Cables
- Instrumentation/communication cables

7.3.0 Single core cable in trefoil formation shall be laid with a spacing equal to the diameter of the Trefoils and clamped at every two metre. All multicore cables shall be laid in touching formation. Power and control cables shall be securely fixed to trays /supports with self-locking type nylon cable strap with de-interlocking facility at every 5 meter interval for horizontal run and cables laid in vertical run of trays shall be securely fixed to trays/supports by galvanised steel clamps at every one metre interval. All power cables should be clamped individually. In general power and control cables shall be laid in ladder type trays & instrumentation cables shall be laid on perforated type trays.

7.4.0 Bending radii for cables shall be as per manufacturer's recommendations.

7.5.0 Where cables cross roads/rail tracks, the cables shall be laid in hume pipes embedded in ground with a minimum cover of 1 metre or with RCC covering for lower depth.

7.6.0 In each cable run some extra length shall be kept at suitable point to enable one straight through joints to be made, should the cable develop fault at a later stage. Control cable termination inside equipment enclosure shall have sufficient lengths so that shifting of termination in terminal blocks can be done without requiring any splicing.

7.7.0 For Directly Buried cables, construction of cable trench for cables shall include excavation, preparation of sieved sand bedding, riddled soil cover, supply and installation of brick or concrete protective covers, back filling and compacting, supply and installation of route markers and joint markers. Before the cables are placed, the excavated portion shall be filled with a layer of sand. This sand layer shall be leveled and the cables laid over it. The cables shall then be covered with 150 mm sand on top of the largest diameter cable and sand shall be lightly pressed.



A protective covering with 70 mm thick bricks shall then be provided on top. The remaining portion of the excavated trench shall then be back filled with soil, rammed and leveled.

- 7.8.0 RCC cable route and RCC joint markers shall be provided wherever required. The voltage grade of the higher voltage cables in route shall be engraved on the marker. Location of underground cable joints shall be indicated with cable marker with an additional inscription "Cable Joint". The marker shall project 75mm above ground and shall be spaced at an interval of 30 meters and at every change in direction. They shall be located on both sides of road crossings and drain crossings. Top of cable marker/joint marker shall be sloped to avoid accumulation of water/dust on marker.
- 7.9.0 Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry, and at every 30 meters in cable tray/trench runs. Cable tags shall also be provided inside the switchgear, motor control centers, control and relay panels etc. where a number of cables enter together through a gland plate. Cable tag shall be of rectangular shape for power cables and control cables. Cable tag shall be of 2mm thick aluminium with number punched on it and securely attached to the cable GI wire.
- 7.10.0 Where a cable route crosses a permanent road/railway line cables shall be drawn through hume pipes or G.I. pipes. Pipes should be laid in a straight configuration. Filling criteria in any pipe shall not be more than 40%.
- 7.11.0 Conduits shall be used for routing of cables (power / control) from cable trays to equipment/ junction boxes. Pipe sleeves shall be used for routing of cables between floors, road crossing, entry/exit from outside of building etc. All conduits/pipes shall have their ends closed by caps till the cables are pulled. After the cables are pulled, the ends shall be sealed by suitable sealing compound having fire withstand capability.
- 7.12.0 Each cable and cable tray shall be tagged with numbers. Cables and conduits shall be tagged at their entrance, at every 30 m and exit from any equipment, junction box. The tags shall be of aluminium or other approved means with the number punched on it and securely attached to the cable. The location of cable joints, if any, shall be clearly indicated with cable marker with an additional inscriptions "Cable-Joint" and "Cable Number".
- 7.13.0 Cable Termination and Jointing**
- 7.13.1 All cable entries in the equipment shall be sealed by cable glands.
- 7.13.2 Adequate length of cables shall be pulled inside the switchboards, control panels, terminal boxes etc so as to permit neat termination of each core / conductor.
- 7.13.3 Power cable terminations shall be carried out in a manner such as to avoid strain on the terminals by providing suitable clamps near the terminals.



- 7.13.4 Control cable cores entering switchboard or control panels shall be neatly bunched and strapped with PVC perforated tapes / nylon ties and suitably supported to keep them in position at the terminal block. All spare cores shall be connected to spare terminals, wherever possible. If spare terminals are not available, spare cores shall be neatly dressed and suitably taped at both ends.
- 7.13.5 Screened control cables of small cross sectional area, e.g. 0.5mm<sup>2</sup>, shall be terminated by means of maxi-termi termination system. Contractor shall ensure the availability of all tools, tackles and accessories such as maxi-termi guns, clips, wire etc. required for the termination of small cross section screened control cables by this method. Compressed air supply for maxi-termi guns shall also be the responsibility of Contractor.
- 7.13.6 Individual cores of control cables shall have ferrules for identification. Ferrule numbers shall be provided as per control schemes and other related documents.
- 7.13.7 Fiber optic termination and splicing equipment shall be used for cutting, finishing and joining fiber optic cables. An optical fiber tool shall be used to slice into the cable's outer coating and unpack the fibers without damaging them. Fiber optic cleaners, cleaning chemicals or solvents and cleaner dispensers shall be used for preparation of the cut and polished joint or splice. Fiber optic cables shall be terminated by using connectors to couple the cable to network devices. Fiber optic connectors shall be specifically designed to limit light loss and provide a secure connection to a device. The fiber optic termination connectors shall have a bayonet mount and a cylindrical ferrule to hold the fiber in place.

## 8.0.0 TESTING AND COMMISSIONING

- 8.1.0 The Contractor shall take full responsibility of testing at erection, pre-commissioning and commissioning stages of all the equipment / system being installed by him. The Contractor shall submit to the Owner a checklist for testing and commissioning and the activities shall be carried out in accordance with the checklist. The Contractor shall carry out the commissioning tests and checks after erection at site as per applicable standards and also as recommended by manufacturers.
- 8.2.0 On completion of erection work, the Contractor shall request the Owner for inspection and test. The Owner shall arrange for joint inspection of the installation for completeness and correctness of the work. Any defect pointed out during such inspection shall be promptly rectified by the Contractor. The installation shall be then tested and commissioned in the presence of the Owner and put on trial run for stipulated contract period.
- 8.3.0 The Contractor shall arrange for inspection of his installation work by Electrical Inspector and shall obtain necessary approval certificate for his installation work and charging. Any modification work required by Electrical Inspector must be undertaken by the Contractor at his own cost. All rectification, repair or adjustment work found necessary during inspection, testing, commissioning and trial run shall be carried out by the Contractor without any extra cost.
- 8.4.0 Following successful inspection and testing, all the equipment shall be commissioned and put on trial run in a manner mutually agreed upon based on the commissioning schedule.



- 8.5.0 The Contractor shall have to bring all testing equipment and instruments in sufficient numbers to carry out the job simultaneously in more than one area. Tests shall be conducted by qualified and experienced personnel. Valid calibration certificates for the testing equipment shall be produced.
- 8.6.0 All documents / records regarding test data and all other measured values shall be submitted to Owner for approval and subsequent record and reference. The results of all tests shall conform to the specification requirements as well as any specific performance data guaranteed during finalization of Contract.
- 8.7.0 All checks and tests as per manufacturer's drawings / manuals, relevant codes of installation and commissioning checklists for various electrical equipment such as transformers, breakers, motors, switchgear, relays, meters etc. shall be carried out.
- 8.8.0 The Contractor shall perform operating tests on all switchgear and panels to verify operation of switchgear / panels and correctness of the interconnections between various items of the equipment. This shall be done by applying normal AC or DC voltage to the circuits and operating the equipment for functional checking of all control circuits, e.g. closing, tripping, control interlock, supervision circuits, alarm circuits etc. All connections in the switchgear shall be tested from point to point for possible earth or phase faults.
- 8.9.0 Contractor shall submit specified copies of site testing procedures, test formats along with details of site test instruments proposed to be deployed at site along with respective valid calibration certificates, six weeks prior to commencement of site testing, for approval by Owner. Only procedures and test formats approved by Owner shall be used for site testing. After completion of commissioning of all equipment and prior to handing over, six sets of such signed test data in the agreed / approved formats shall be furnished prior to issue of provisional acceptance of the equipment / installation.
- 8.10.0 The testing of all electrical equipment as well as the system as a whole shall be carried out at site to ensure that the equipment and its components are in satisfactory condition and will successfully perform its functional operation. The inspection of the equipment shall be carried out to ensure that all materials, workmanship and installation conform to the accepted design, engineering and construction standards as well as accepted codes of practice.
- 8.11.0 All tests shall be carried out by the Contractor using his own instruments, testing equipment as well as qualified testing personnel.
- 8.12.0 The results of all tests shall conform to the specification requirements as well as any specific performance data guaranteed during finalization of the Contract.
- 8.13.0 At site, all equipment shall be energized only after certification by the personnel performing the test that the equipment is ready for energizing and with concurrence of the Owner.
- 8.14.0 The various commissioning checks / tests to be carried out on the various equipment shall be in accordance with applicable standards and equipment supplier's recommendation.



## 9.0.0 SAFETY REQUIREMENTS

- 9.1.0 Provisions of Indian Electricity Rules in respect of various safety requirements (especially as provided at Rule 29, 35, 36, 42, 43, 44, 64, 74 to 80, 87 & 92) shall be complied with.
- 9.2.0 The minimum safety working clearances shall be maintained for the bare conductors or live parts of any apparatus in outdoor substations as per IE rule 64 (2) a ii).
- 9.3.0 All practical steps shall be taken to prevent operating the earth moving, lifting and housing machinery in dangerous proximity to a live overhead power line.
- 9.4.0 Barricades or barriers shall be installed to prevent accidental contact with energized lines or equipment. Where appropriate, signs indicating the hazard shall be pasted near the barricade or barrier.
- 9.5.0 Rubber gloves and insulated shoes shall invariably be worn in all cases while operating gang operating switches controlling high tension lines and equipment where accidental contact of operating personnel with live parts are likely. While working near live lines and equipment and working on live low-tension lines and equipment, gloves shall be worn.
- 9.6.0 Safety belts shall invariably be used in all cases while working on overhead systems like lines, bus bars, substation equipment etc.
- 9.7.0 Tested rubber mats shall be kept in front of operating panels / switches etc. They shall be checked for condition periodically and replaced as necessary.
- 9.8.0 First aid box shall be maintained. These shall be checked periodically and refilled or items replaced as necessary.
- 9.9.0 Chart for providing relief and treatment of person electrocuted shall be displayed prominently at suitable places in the substation. These shall be checked for condition periodically and replaced as and when necessary.
- 9.10.0 Fire fighting equipment such as fire buckets filled with sand and fire extinguishers for both electrical and oil fires shall be maintained and kept at easily accessible place in substation
- 9.11.0 The Contractor shall supply and install all danger plates as per IS 2551. The danger plates shall be written in Hindi, local language and English and shall be provided as required for all electrical equipment.
- 9.12.0 All safety appliances and protective devices including belts, hand gloves, aprons, helmets, shields, goggles, safety shoes etc. shall be provided by the Contractor for his personnel.



# **RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD**

## **Cooling Water System Package for Kota Super Thermal Power Station Unit # 5 (1 x 210 MW) Kota, Rajasthan, India**

[DOC. No. FCE-1117155-ME-DOC-SPC-3000-033]

### **VOLUME II SECTION 4 DETAILED TECHNICAL SPECIFICATION – CONTROL & INSTRUMENTATION**

**FICHTNER Consulting Engineers (India) Private Limited**  
Chennai, Bengaluru, India



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## VOLUME – II

### SECTION – 4

#### DETAILED TECHNICAL SPECIFICATION FOR CONTROL & INSTRUMENTATION

##### 1.0.0 INTENT OF SPECIFICATION

- 1.1.0 This section covers technical requirements of the Control and Instrumentation (C&I) for the safe, reliable, continuous and satisfactory operation of CW and ACW pumps & Cooling Tower, CW treatment system & CT Make-up Pumps in all regimes of operation envisaged for this project. The work shall be consistent with modern based power plant practices and shall be in compliance with all applicable codes, standards, guidelines and safety requirements in force on the date of award of the contract.
- 1.2.0 It is not the intent to specify completely herein, all details of design and construction of the equipment. However the equipment will confirm, in all respects, to high standards of engineering, design and workmanship and be capable of performing in continuous commercial operations up to vendor's guarantee in a manner acceptable to Owner who will interpret the meaning of drawing and specifications and will have the power to reject any work or materials which in his judgment, are not in full accordance herewith.
- 1.3.0 It is not the intent or purpose of this specification to specify all individual system/ components since the bidder has full responsibility for engineering and furnishing of complete system.
- 1.4.0 All local gauges as well as transmitters, sensors and switches for parameters like pressure, temperature, level, flow etc as required for the safe and efficient operation and maintenance as well as for operator and management information (including all computation) of equipment under the scope of specification shall be provided on as required basis within the quoted lump sum price. For bidding purpose, tentative minimum instruments have been indicated in the P & IDs. However bidder shall supply any additional local gauges/switches/transmitters/sensors for reasons mentioned above without any additional cost to the Owner.
- 1.5.0 In the event of conflict between requirements of any two clauses or specification documents, the more stringent requirements shall apply unless confirmed otherwise by the Owner in writing before the award of this contract based on a written request from the Bidder for such clarification.
- 1.6.0 Any deviation or variation from the scope, requirement, and/or intent of this specification shall be clearly brought out under Schedule of Technical Deviations, irrespective of the fact that such deviation/variation may be the standard practice or a possible interpretation of the specification by the Bidder. Except for those deviations covered under Schedule, which are accepted by the Owner before award of contract, it shall be the responsibility of the Bidder to fully meet the intent and requirements of this specification within the quoted lump sum price. No other departure from this specification, except for the declared deviations



submitted by the Bidder with his proposal under Schedule of Technical Deviations shall be considered and bids not complying with this requirement are likely to be treated as non-responsive. The interpretation of the Owner in respect of the scope, details and services to be performed by the Bidder shall be binding, unless specifically clarified otherwise by the Owner in writing during the bidding period.

**1.7.0 Proven Product :**

All equipment's, systems and accessories including PLC furnished under the specifications shall be from the latest proven product range at the time of supply and of a qualified/reputed manufacturer (as per approved vendor list by the Owner) whose successful performance has been established by a considerable record of satisfactory operation in coal fired power stations which are in successful operation for a period of not less than one year as on the date of techno commercial bid opening. The equipment/ devices offered shall be suitable for satisfactory performance for their respective application. The Owner reserves the right to reject any work or material in which in his judgment is not in full accordance therewith.

- 1.8.0 The Bidder shall furnish as per data requirements schedules and other applicable sections, full details regarding all equipment and systems including complete Bill of Materials, Design basis reports (DBR), drawings, data, information, technical literature and other details required to fully establish the capability and performance of the equipment and systems offered by the bidder. Any bid not containing sufficient details to fully describe the equipment and systems offered or sufficient details regarding past experience for meeting the qualifying requirements may be treated as non-responsive and hence rejected.
- 1.9.0 The drawings enclosed with the specification are indicating the minimum requirement, which shall be binding on bidders. Any further improvement required during detailed engineering and execution shall also be implemented by bidder. Bidder shall confirm that the type, make, model of all bought out items supplied by the bidder under the specification shall be subject to the approval of the Owner during detailed engineering stage.
- 1.10.0 The scope of work pertaining to system for C&I shall include design, detailed engineering, documents generation, manufacturing, shop inspection and testing, supply, packing, forwarding, unloading, storage & handling at site, erection, field calibration, testing and commissioning at site, trial operation, performance testing at shop and site, submission of all drawings/documents, O&M manuals, obtaining statutory approvals from government and other agencies required during manufacture and commissioning, training of Owner's personnel, etc., and finally handing over a fully functional system / equipment to Owner along with the supply of all consumables, tools and tackles, testing instruments covering all the Instrumentation & control(C&I) equipment /services specified in this specification. It is not the intent to specify herein all details of materials/ equipment to be supplied. Any item related to this work not covered in this specification but necessary to complete the system will be deemed to have been included in the scope of the work.



- 1.11.0 Any wrong supply shall be replaced and any wrong erection shall be re-erected promptly to comply with the design requirements to the satisfaction of Owner.

## 2.0.0 BASIC SCOPE OF SUPPLY

Bidder shall refer to General Technical specification for scope of supply and services.

### 2.1.0 Other Services

- i. The Bidder shall provide all other services necessary for meeting the intent and requirements of this specification. These shall include, but shall not be limited to, the following services for all equipment/ systems furnished as per this specification
- ii. System engineering and design for all equipment/systems specified on system basis to ensure that the intent and requirements of this specification are fully met.
- iii. Preparation and furnishing of all drawings, data sheets, cable schedules, and information as stated hereinafter in multiple copies to the Owner. This will include all drawings/documents, technical literature identified under this specification and shall be adequate for:-
  - a) Ensuring proper review by Owner to ensure full compliance with specification requirements and proper interface with other related system.
  - b) Quality assurance checks during various stages of design, manufacture, installation, testing, system integration and commissioning; performance guarantee tests.
  - c) Post commissioning operation and maintenance of the equipment and systems.
  - d) The above drawings/documents shall be prepared by the Bidder and furnished to the Owner generally as per Distribution Schedule.
  - e) As commissioned/built drawings and documents.
- iv. Participation of Bidder's senior personnel and experts in discussions with Owners and other equipment bidders during various stages of contract implementation as required by the Owner.
- v. Facilities for detailed engineering, system integration, inspection and witnessing of shop and site tests by representative of Owner and carry out performance guarantee test.
- vi. The Bidder shall conduct all shop and site tests as per the requirements of this specification and Owner approved 'Quality Assurance Program'. All approval/ Inspection are to be carried out by Owner or Owner appointed agency only.



- vii. Familiarization / Acquaintance of Owner's engineers in all aspects including system design, engineering, installation, system integration, testing, commissioning, operation and maintenance at Bidder's manufacturing works either in India or abroad.
- viii. Recommendations and proposal covering spare parts required for 3 years trouble-free operation.
- ix. Guarantee for all equipment and system furnished under this specification.
- x. Provision of post commissioning support on as required basis beyond Guarantee period on terms to be discussed and finalized later.
- xi. Provision of spare parts for full service life of the plant.
- xii. The Bidder shall arrange skilled / semiskilled / unskilled manpower from local source(s) as far as available in this country. He shall also arrange supervisory staff for quality execution of all works in his scope.

## 2.2.0 Interface With Owner Furnished Equipment/Systems

The Bidder shall furnish necessary interface equipment required for satisfactory operation of equipment furnished by the Bidder with own system and Owner furnished equipment/ Systems. This will include the following:-

Interfacing requirements including cables / co-axial cables / gate ways/all type of hardware / interposing relays / software for exchange of signals for information & controls.

Interface with main plant DCS through OFC for monitoring the Cooling Tower and CW Treatment system from CCR also lies with the Bidder. OPC- OPC connectivity with existing DCS system shall be in the scope of bidder including OPC license, any required additional hardware and service of DCS OEM (ABB Symphony S+ DCS).

The Bidder shall fully meet all the interface requirements with switchgear, motor control centers etc.

## 2.3.0 Drains

For all drains required on his system e.g. transmitter, transmitter enclosures etc., the bidder shall discharge from each rack / Enclosure to suitably sized header.

## 2.4.0 Process Connections

Typical hook-up drawings for instruments installation enclosed.

For pressure, differential pressure, level and flow measurements root valve shall be Socket Welded globe valve of sizes 1/2", 3/4", 1".



Weldable stubs (M33x2) for thermowells of various sizes for temperature elements.

Separate stubs and take-off points with thermo well & root valves shall be provided for performance guarantee test.

For control actuators in others scope, but controlled from bidder furnished systems/instruments, the terminal point is the final drive's input signal port and instrument air supply ports.

Hookup diagrams shall also be referred for installation of field instruments enclosed as Annexure - 7

## 2.5.0 System Particulars

System particulars are as follows:-

### Tropicalisation

All equipment supplied against this specification shall be given tropical & fungicidal treatment in view of the severe climatic conditions prevailing at site as described under project data.

Tropical protection shall conform to IS: 3202 entitled "Climate Proofing of Electrical Equipment" or BI: CP-1014:1963 entitled "Protection of Electrical Power Equipment against Climatic condition"

Gases and fumes:

Sulphur dioxide and/or trioxide fumes mildly present. Climate is Tropical conductive to fungus growth.

Dust particles:

Heavily dusty with abrasive dust and coal particles of size 5 to 100 microns present in the atmosphere in large quantity

## 3.0.0 DESIGN REQUIREMENTS

### 3.1.0 General

3.1.1 The offered I&C system shall be based on State of the art practices prevailing in the field of Control & Instrumentation for Thermal Power Stations, designed to have a fully automated plant control.

3.1.2 The Instrumentation and Control equipment system called for in this specification consists of a fully coordinated and integrated PLC based system for carrying out the functions of measurement system, control system, protection and interlock system and operating system and communication system. The system shall be complete with hardware and software along with the Human Machine Interface (HMI) capable of operating together as an integrated system. The system shall include but not be limited to panels, cables, control desk, cabinets, field



instruments and erection hardware, control elements and devices to perform the various functions of the above systems as specified. The system shall be upgradable, evolutionary in both hardware and software.

- 3.1.3 The design, material selection, constructional features, manufacture, inspection, testing and performance of all Instrumentation & Control equipment shall comply with all currently applicable statutory regulations and safety codes in the locality where the equipment are to be installed.
- 3.1.4 The general engineering and calculations shall be made as per prevailing Indian, International standards acceptable to Owner. Wherever such standards are not available, they shall be as per the best practice in India and abroad.
- 3.1.5 The I&C equipment design shall be suitable for continuous operation under the environmental conditions specified under Project information.
- 3.1.6 The Units of measurement shall be SI units.
- 3.1.7 All the electronic circuitry shall be built-up with plug in modules providing maximum flexibility and easy servicing.
- 3.1.8 On failure of power supply or PLC / microprocessor fault, output shall be automatically switched over to fail safe mode - either locking in place or driving to open / closed position as required.
- 3.1.9 All signal schemes shall be audio-visual. When one fault is being announced, the system shall be capable of receiving the second fault. The audio signal shall be automatically silenced after a pre-selected time. The fault shall be always available in the alarm page of operator work station, until the fault is cleared and acknowledged.
- 3.1.10 SS Legend plates shall be provided on the cabinet front and back, desk face, local panels, junction boxes, transmitter racks, instruments, Control valves etc., for all items supplied to identify the equipment.
- 3.1.11 Overall dimensions of the nameplates shall be decided by the text of legend, maintaining overall consistency and clarity and avoiding size variations.
- 3.1.12 The outside color of all instrumentation cabinets, control desks, consoles, local cabinets, marshalling cabinets, system cabinets, junction boxes, transmitter racks, etc. shall be of **RAL 7032**. The interior color of all these cabinets shall be **Brilliant White**. This shall hold good for instrumentation cabinets of all auxiliary units also. Color coding shall be uniform throughout the plant and shall be subjected to Owner's approval.
- 3.1.13 All panels, cubicles and enclosures shall be furnished complete with integral piping, internal wiring, convenience outlets, internal lighting, grounding, ventilation, space heating, vibration isolating pads and other accessories.
- 3.1.14 Unless otherwise specified cable entry for panels / desks / cabinets shall be through bottom via glanding plate. Fireproof seal shall be used to seal the bottom to prevent entry of dust.



- 3.1.15 Equipment inside the cabinets shall be so located that their terminals and adjustments are readily accessible for inspection and maintenance.
- 3.1.16 Screened cables shall be of twisted pair type and shield shall be earthed at one end only inside the control room.
- 3.1.17 All the equipment fed from electrical system and installations shall meet the statutory requirements of relevant Indian Electricity Rules.
- 3.1.18 Conduits, junction boxes, and pull boxes shall be properly grounded.
- 3.1.19 All the cores of the cables shall be marked with ferrules. Identification no. of the cores shall be incorporated at regular short intervals. Metals tags shall be provided at both the ends of the cables for identification.
- 3.1.20 After completion of cable laying work, all cable bushings on the cabinets & desk shall be filled with fire resistant sealing compound against the floor and pipe. The instrumentation earthing system wherever necessary must run to a common pit as per standard. All the cables entering the main control room shall be properly filled and sealed with fire resistant sealing compound against the floor and pipe.
- 3.1.21 All electronic/electrical instruments, junction box and control panel shall be suitable for area classification as per IEC/NEC codes. Certified intrinsically safe / explosion proof equipment shall be used, in general, in hazardous area.
- 3.1.22 The transmitters and other instruments shall be grouped together and mounted:  
(a) Local instrument enclosures in open and dust prone areas.  
(b) Local instrument racks in covered areas.
- No more than six instruments shall be grouped in single Rack / Enclosure.
- Enclosure outer shall be constructed from at least 3 mm thick steel plate and epoxy Painted to shade gray. Base frame shall be made of ISMC 100 and black color finish.
- 3.2.0 PLC based Instrumentation and Control system shall consist of Measurement system, Control System, Interlock, Protection and Sequential Control System, Annunciation system and Data Bus System for Control and Communication with the process which are detailed in further clauses.
- 3.3.0 Programmable Logic Controller (PLC) based control system shall be designed with 1:1 hot redundant configuration. CPUs shall have word length of 32 / 64 bits minimum.
- 3.4.0 Following components shall be redundant as well: communication processors, memory modules, rack power supply units, bulk IO power supply units, IO communication modules, data highway, Serial link interface module for connecting I/O modules and high speed data network connecting the operator stations.



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- 3.5.0 All electronic modules shall have gold plated connector fingers and further all input and output modules shall be short circuit proof. These shall also be tropicalized & components shall be of industrial grade or better
  - 3.6.0 Measurement system shall be complete with processor, signal conditioning, monitoring cards and function cards. The system shall also be capable of transmitting the data to the HMI display unit for display to operator.
  - 3.7.0 Closed loop control system (CLCS) shall be complete with processor, signal conditioning and monitoring cards and function cards to perform control system functions. The system shall also be capable of executing commands from HMI through keyboards / from operational hardware located on the local control panels besides transmitting the data to the HMI display units and printers.
  - 3.8.0 Interlock, Protection and Sequential control system - Open Loop Control System (OLCS) shall be complete with processor, signal conditioning and monitoring cards and function cards to perform the sequential and combinational logic functions. The system shall also be capable of executing commands from HMI through keyboards / from operational hardware located on the local control panels besides transmitting the data to the peripherals.
  - 3.9.0 The drive control philosophy for various drives shall be as per the project specific Drive Control Philosophy Document of main plant equipment and bidder shall follow the same without any commercial implications to the owner.
  - 3.10.0 Operator cum engineering stations (OES) shall be freely assignable and functionally Interchangeable between themselves. Printers shall be network compatible and shall be freely assignable.
  - 3.11.0 The control system shall be provided with a high degree of automation to minimize operator intervention. The controls shall be configured in a hierarchical structure including Group control, Sub Group Control, Sub Loop Control and Individual Drive Control. All the required hardware and software to implement the above hierarchical structure shall be included in the scope of work.
  - 3.12.0 Trending and logging facilities shall be provided for all those parameters whose trends are necessary for safe and efficient operation of the system and measurement of performance.
  - 3.13.0 For binary and analog inputs required in major equipment's of system protection, triple-sensing devices shall be provided. Binary and analog inputs, which are, required for protection of more than one equipment as well as protection signals for HT Drives etc., triple sensing devices shall be provided. All protection signals shall be in 2 out of 3 configurations.
  - 3.14.0 Critical interlocks and all HT motor interlocks shall be 2 out of 3 configuration. All other interlocks shall be 1 out of 2 configurations.
  - 3.15.0 Alarm and Indications shall be single or 1 out of 2 configuration depending on criticality.



- 3.16.0 Temperature elements RTD & TC shall be connected directly to PLC without transmitters. Use of process actuated switches is shall be limited and subjected to owner approval.
- 3.17.0 All RTD and TC supplied for this project shall be duplex element type.
- 3.18.0 Bidder shall include all the measurements necessary for the safe, efficient, reliable and fully automatic operation of the entire plant including all fail-safe requirements and recommendations of each equipment manufacturer.
- 3.19.0 Actuators shall be sized in such a way that the valves operate properly even when the upstream pressure exceeds 10% of maximum value. Actuators shall be provided with air failure lock to obtain the required fail safe condition, control contacts as warranted, adjustable minimum / maximum stops, local position indication and two (2) wire electronic position transmitters with solenoid valves wherever necessary and air filter regulator. Fail safe action of the final actuator shall be as follows:
- i. Modulating control - stayput or move to safe-end-position
  - ii. ON/OFF control - move to safe-end-position
- 3.20.0 All actuators shall be provided with hand wheel for local operation and all motor operated valves (MOV) shall be of Integral starter type.
- 3.21.0 The control valves shall be capable of handling at least 130 percent of required maximum flow at full open condition. Control valves shall be provided with manual isolating and bypass valves for facilitating maintenance wherever alternative flow paths are not available. SMART type positioners with HART compatibility shall be used for all regulating services and limit switches shall be provided on the valve wherever required depending upon the system requirement.
- 3.22.0 Separate moisture separator in the instrument airline for all required equipment.
- 3.23.0 All I&C cables including twisted & shielded , FRLS PVC insulated ,compensating cable, special cable, Fiber Optic cable shall be shielded and armoured .The to DDCMIS serial link cables/Bus cables shall, be through conduits. Direct cables between cabinets (whichever is not routed through conduits) shall be treated with Anti-Rodent treatment.
- 3.24.0 Control rooms shall be air-conditioned and control room shall be provided with fire detection system and portable fire extinguishers.
- 3.25.0 Process connection & piping including LIE / LIR, all impulse piping, pneumatic piping/tubing, valves, valve manifolds, fittings and all other accessories shall be provided on as required basis for proper installation & completeness of impulse piping system and air supply system, as stipulated elsewhere in the specification.
- 3.26.0 Bidder shall follow KKS Tagging philosophy.



- 3.27.0 Bidders to confirm to the Hazardous area classification requirements as applicable for I&C equipment. Bidders shall envisage intrinsic barriers / explosion proof enclosures etc., as required and mount them suitably as recommended in the statutory classification.
- 3.28.0 All statutory requirements including IBR, Pollution Control board etc., shall be met as required.
- 3.29.0 Makes shall be as per the list of approved makes of the Owner. If any preferred make of PLC is suggested by the Owner to maintain uniform inventory in the plant then the Bidder shall provide the same without any price implication.
- 3.30.0 All specified documentation shall be submitted in both soft and hard copies as per Owner's requirement and format.
- 3.31.0 The enclosed bid purpose flow diagrams are indicative only. The actual P&ID's of Bidder shall include all the specified requirements including those indicated in flow diagram, along with tag numbers, functional description of the signals, control loop references for OLCS and CLCS, legend etc. Also Bidder shall indicate all Field mounted, Local Panel mounted, PLC displayed measurements using standard symbols along with alarm, protection, interlock and control functions based on the Redundancy Philosophy mentioned in the specification.
- 3.32.0 The annunciation system shall be an integral system to PLC and shall be displayed in OWS etc. Annunciation shall be provided by bidder for each and every instrument, valves, limit switches, drive etc. All the field contact for this purpose shall be acquired through control system. The annunciation sequence/logic shall conform to ISA sequence ISA-2A.
- 3.33.0 The instrumentation to be provided for each of the plant auxiliary shall be as per the technical specification document / drawings wherever provided for the respective systems as a minimum requirement for bidding purpose. However, for completeness of each of the plant auxiliary and its associated equipment, Bidder shall also provide all the necessary instruments to the process requirement even if it is not specifically indicated in the given technical Specification document / drawings.
- 3.34.0 The instrumentation, operation and control philosophy proposed is specific to the plant design. Any improvement over the proposed typical Control & Instrumentation scheme shall be accepted so long as it does not deviate from the basic intent and general philosophy enumerated herein and elsewhere in this specification.
- 3.35.0 The PLC shall have digital data communication connectivity with DDCMIS. The control system for PLC shall have provision to interface with DDCMIS in the respective unit central control room and shall be as follows:
- Considering the high ambient noise and electromagnetic interference prevailing in power plant, it is recommended that all links between PLC and plant DDCMIS shall be based on Dual Optical Fiber Communication (OFC) medium. Necessary ports / converters shall be provided at both ends.



- ii. Communication media shall be optical fiber cable with MODBUS TCP-IP / RS 485 between DDCMIS and PLC as per requirements. Optical cable, PLC end Modem/Converter and DDCMIS end Modem/Converter shall be supplied by bidder. Optical cables shall be routed through GI conduit pipes. Communication protocol between the modems shall be RS485/MODBUS and the maximum communication time for receipt of signal at DDCMIS end should not exceed 2 seconds. PLC signals transferred to DDCMIS shall be along with time stamping, the time stamping shall be carried out at IO level.
- iii. In addition hardwired signal interfacing shall also be provided for any signal required for interlock, control & protection. Similarly cable for hardwired signal transfer between DDCMIS and PLC based system shall be supplied, laid terminated by the bidder including preparation of cable schedule. Quantum of hardwired signals for linking PLC based system and DDCMIS shall be decided during detailed engineering.

3.36.0 Whenever control system is PLC based, annunciation system shall be driven by PLC. For other local relay based control systems, solid-state annunciation system shall be provided in-built to the panel.

3.37.0 The PLC control system shall be supplied directly from manufacturer/vendors and shall be subjected to owner's approval. PLC system supplied /engineered by system houses shall not be acceptable.

3.38.0 All PLC, I/O cards, remote I/O cards shall be with required protection class and should withstand temperature up to 60 deg.C temperatures.

3.39.0 All cables shall be terminated in the terminal block. Ferruling shall be double cross ferruling (i.e.) source and destination addresses shall be marked on both sides of the tube ferruling.

3.40.0 Bidder shall provide local panel for local start/ stop monitoring of auxiliaries and equipment as per requirement. The requirement shall be decided during detailed engineering. All local panels shall be minimum IP 65 with canopy.

3.41.0 Bidder shall provide ammeters, voltmeters, pushbuttons indicating lamp, mimic, electrical scheme, indicators, recorders and HW annunciations on the local control panels as per process requirement and shall be decided during detailed engineering.

3.42.0 PLC supplier shall prepare graphic for the complete plant with proper tag nos. for drives, binary inputs, analogue inputs, status of drives etc for the hardwired and soft link signals interfaced with respective unit DDCMIS as per format of DDCMIS.

3.43.0 PLC system shall be time synchronized with master clock system. Main plant Master / Redundant clock system And required cable, Hardware and software shall be in Bidder's scope.



#### 4.0.0 DESIGN CRITERIA

##### 4.1.0 General Requirements

- 4.1.1 The design criteria given in this section supplements the requirements stated in other sections of this specification and the drawings enclosed herewith. These shall be fully met by all equipment/systems and accessories furnished as per this specification.
- 4.1.2 All equipment/systems and accessories furnished as per this specification shall be from the latest proven product range of a qualified manufacturer meeting the requirements given in this Specification. The Bidder shall furnish satisfactory evidence regarding successful operation and high reliability of the proposed equipment/systems in coal fired utility stations for similar applications.
- 4.1.3 The equipment and systems shall be designed and constructed to meet all specification requirements, and perform accurately and safely under the environmental and operating conditions described or implied in this specification without undue heating, vibration, wear, corrosion or other operating troubles. It will be the responsibility of the Bidder to fully acquaint himself with the functional requirements and operating conditions, for equipment systems and accessories offered for this project. Additional features shall be provided where required to meet the service conditions, functional or descriptive requirements stated in individual clauses for these equipment/systems.
- 4.1.4 The equipment, systems and accessories furnished as per this specification shall be designed and constructed to meet all specification requirements and performance specifications during the continuous service life of the plant. The equipment or components that cannot meet this life expectancy or specified design and operational requirements during the entire service life shall be identified and their expected failure rate shall be indicated by the Bidder in his proposal. When no such information is furnished the equipment shall be deemed to have been certified by bidder suitable for the above service life and requirements.
- 4.1.5 During execution of the project or at the time of dispatch, any latest product is launched or introduced then the same shall be supplied without any price implication.
- 4.1.6 All the hardware / software shall be latest and field proven as available in the market. Bidder shall offer latest system available with him at the time of supply / dispatch & for the PLC system / microprocessor based control system and software up to handing over of the project, whenever at later stage such up gradation takes place for the system offered by him or by his collaborator. Software / hardware lock shall be provided for all OWS/EWS for security reason.
- 4.1.7 Even after the guarantee period, the Bidder shall be responsible for providing spare parts and other required support at reasonable cost during the service life of the plant as indicated above. Any exception to these requirements shall be clearly indicated in the Schedule of Technical Deviations.



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- 4.1.8 Bidder shall also guarantee supply of spares for at least 15 (Fifteen) years after commissioning of the plant. In case of future upgradation of a product in terms of hardware, bidder shall remain committed to upgrade the supplied system
  - 4.1.9 When more than one device uses the same measurement or control signal, the transmitter and other components shall be fully equipped to provide all signal requirements. The system shall be arranged so that the failure of any recorder, indicator or control component shall not open the signal loop nor cause the loss of signal to other devices using the same basic signal. The design shall permit the removal from service of any indicating, recording or control devices without causing any disturbance or requiring re-adjustment in other measurement/ control loops using the same signal.
  - 4.1.10 All requirements of auxiliary equipment for Instrument and Control devices including thermocouples and thermowells, resistance elements and thermowells, transmitters, special wiring and piping accessories, air filter and pressure regulators, separation chambers, condensation pots and all other special devices required for installation in instrument piping and wiring system shall be furnished complete as required for each individual element, instrument or system unless specifically stated otherwise in this specification.
  - 4.1.11 Each pneumatic device requiring air supply and intended for field mounting shall include a filter regulator air set with gauge.
  - 4.1.12 Process fluids shall not be piped directly to instruments located in Local Control Room (LCR) and unless otherwise specified herein.
  - 4.1.13 All parts subject to high pressure, temperature or other severe duty shall be of materials and construction suitable for the service conditions and long operating life.
  - 4.1.14 Temperature measurements shall have fail safe protection feature against open circuits of sensors. Apart from fail safe protection against open circuit, temperature measurement shall have protection against rate of rise of temperature more than pre-defined value.
  - 4.1.15 Each communication network shall be industrial grade and shall be provided with 1 GBPS speed, industrial grade managed Ethernet switches, external surge protection system/devices and industrial firewall. Industrial grade managed type Ethernet switches shall be provided with inbuilt diagnostic features, 20% spare ports & redundant power supply.
  - 4.1.16 Design criteria for continuous online analytical measurements of important plant media such as water, steam and flue gas shall be based on microprocessor based instruments only.
  - 4.1.17 All process parameters (i.e. pressure, temperature & flow) shall be indicated in the P&IDs on all important process lines.
  - 4.1.18 All approval/Inspection are to be carried out by Owner or Owner appointed agency only.



- 4.1.19 Open and Close limit switch feedbacks of critical manual valves are to be connected to PLC for remote viewing and interlocks & protection which shall be decided during detailed engineering.
- 4.1.20 Incomer/outgoing feeders for any Distribution Board's rated upto 32A shall be with fast acting semiconductor fuse & MCB controlled, from 32A to 400A shall be MCCB Controlled; above 400A shall be breaker controlled. Each feeder shall be provided with LED indication.
- 4.1.21 Remote and local indications of all process parameters to the process requirement shall be provided which shall be decided during detailed engineering.
- 4.1.22 Alarm management standard as per ISA-18.2 shall be confirmed by bidder and shall be considered by bidder in their scope.
- 4.1.23 For DC application all electronic type DC MCB-2 Pole shall only be used, For AC application -AC MCB shall only be used.

#### 4.2.0 Environmental Conditions

Instruments for location in outdoor/indoor/air-conditioned areas shall be designed to suit the environmental conditions indicated below and shall be suitable for continuous operation in the operating environment of a coal fired utility station without any loss of function, or departure from the specification requirements covered under this specification.

1. All equipment/systems for air conditioned areas shall also be designed and constructed to operate indefinitely without loss of function, departure from specifications or damage during periods of air conditioning failure in summers such temperature may rise up to 55 deg. C even.
2. The period for which the equipment/system can function satisfactorily without A/C shall be mentioned by the bidder.
3. Outdoor Locations

SI.No.	Design Temp.	Pressure	Relative humidity	Atmosphere
1.	Maximum 55 °C	Atmospheric	100%	Air (dirty)
2.	Minimum 4 °C	-do-	5%	Air (dirty)

- i. Indoor Locations (Excluding the heat self-generated by equipment)

SI.No.	Design Temp.	Pressure	Relative humidity	Atmosphere
1.	Maximum 50 °C	Atmospheric	95%	Air
2.	Minimum 4 °C	-do-	5%	Air



ii. Air-Conditioned

SI.No.	Design Temp.	Pressure	Relative humidity	Particle size	Atmosphere
1.	Normal 24 °C + 5° * Maximum 50 °C	Atmospheric	50% + 10%	15 microns	Air
2.		do	95%	* 50 microns	Air

\* During air-conditioning failure for short duration's.

#### 4.3.0 Power Supply and Air Supply

##### 1. Power Supply

###### A UPS (Uninterrupted Power Supply System)

Redundant Feeders shall be supplied by Owner for bidder's requirement. Bidder to provide complete load list including UPS load list within one month from the date of order.

###### B Power Supply Monitoring Facility

- 1 The power supplies for all control panels are **to be monitored for under voltage/over voltage**. Necessary **alarms are to be initiated** for under voltage/over voltage.
- 2 Loss of single power source in case of redundant power supplies is to be alarmed in PLC for all control panels by providing voltage monitoring relays.

Each electronic cabinet shall be equipped with redundant power supply source & auto change over circuit with changeover time less than 10 msec in order to guarantee hold capacity of feeders for modules and I/O signals. 24V DC power supply system located inside the cabinet, shall furnish power supply to the equipment via. selector circuit mounted on DC output, made of block back-up diodes, with the aim of preventing energy exchange between power sources. A continuous monitoring apparatus watches the voltage and alarms power supply failures.

PLC shall be supplied with independent redundant UPS power supply, all system devices requiring 24V/48V DC power shall be arranged by bidder by providing 100% parallel redundant UPS system along with battery and ACDB with automatic change over 240V AC UPS to 24/48V DC converter. AC to DC convertor shall be SMPS based and shall have wide range of AC/DC input voltage (85-264 V AC & 90-350 VDC). It shall have the necessary diagnostic functions like indications for DC OK, automatic overload monitoring etc. The MTBF for the power supplies shall not be less than 500,000 hours (in Accordance with (IEC - 1709). UPS and battery bank for the system shall be separate and the same shall be in Bidders scope. Alarm for any disturbance in UPS system shall be in PLC system.



## 2. Air Supply

Clean, dry, oil free instrument Quality air of the following quality shall be provided by bidder from the pump house for various pneumatic instruments/control drives & accessories:-

Nominal pressure : 7Kg/cm<sup>2</sup> (g)

Range of pressure : 3.5 to 8.5 Kg/cm<sup>2</sup> (g)

Dew point : + 2°C at the above pressure.  
- 40 deg.C at NTP

Maximum particle size : 5 microns

Pneumatically operated equipment offered by the Bidder shall be designed to operate with the above air supply and adequately cater to their respective duty within the full range of pressure variation. Wherever required, moisture separator for vital instruments/actuator/ analyzer shall be provided in the airline by bidder.

The Bidder shall indicate system wise requirement of instrument air along with his proposal and same shall be included in the compressor capacity as supplied.

The instrument air supply system for various pneumatic Control & Instrumentation devices like pneumatic actuators, power cylinders, I/P converters, pneumatically operated valves etc. shall be complete in all respect with necessary air filter regulators, valves, piping/tubing etc. Each pneumatic instrument shall have an individual air shut off valve. The pressure-regulating valve shall be equipped with an internal filter, a 50 mm pressure gauge and a built in filter-housing blow down valve. Filter shall be of minimum 5-micron size & sintered bronze material.

On collection of water in the drains of instrument air lines, mechanical automatic drains and periodically solenoid operated drains (with electronic timer – 15min, 30min, 60min and 2 hours & timing adjustable) are to be provided.

### 4.4.0 Instrument Accuracy, Standard Scales and Ranges

#### Instrument Accuracy

All instruments/systems furnished as per this specification shall meet the accuracy requirements indicated in these specifications. The minimum requirements to be met by all equipment/systems are indicated below:-

All instruments shall be constructed to perform normally and meet all guarantees when subjected to the service conditions listed in the applicable sections.

All thermocouples and extension lead wire shall have limits of error that comply with special limits of error contained in ANSI MC96.1-1982, Class-A accuracy.

Resistance temperature detector elements shall have a resistance characteristic which is linear with respect to temperature within plus or minus one-half of one per cent of the top range value, Class-A accuracy.



Transmitters for pressure shall transmit a signal which is linear with respect to the measured pressure accuracy shall be within plus or minus 0.075% of the measured range span.

Flow meter transmitters shall produce transmitted signals within plus or minus one-tenth of one percent of the measured span range when operating between 25 and 100 percent of full scale flow value. The accuracy guarantee shall include the effect of errors in the differential head measuring device, square root converter and signal generator, but not the primary device.

Transmitters for level shall transmit a signal which is linear with respect to the measured level within plus or minus one-tenth of one percent of the metered level range span based on a specific gravity of 1.00.

Transmitter accuracy mentioned above shall be inclusive of the combined effects of hysteresis, repeatability and linearity etc. All transmitters shall have less than one-half of one percent shift in output with a 50° C change in ambient temperature.

Where temperature compensation networks are furnished, they shall produce corrections which are in accordance with theoretical requirements over the specified variations, over a flow range from 10 percent to 100 percent of maximum flow, subject to a plus or minus tolerance of one-half of one percent of the maximum flow.

Accuracy requirements of other instrument type are given in the appropriate specification paragraphs.

#### 4.5.0 Instrument Scales

Instrument scales will be black graduations in white dials and where practicable with scale divisions based on multiples of 10. The smallest division shall preferably be a whole number approximately 1% of the scale range if not otherwise impracticable.

All Instrument scales and charts shall be calibrated and printed in Metric units and shall have linear graduation. The ranges shall be selected to have the normal reading at 75% of full scale.

All scales and charts shall be calibrated and printed in Metric Units as follows:-

1. Temperature : Degree centigrade (deg. C)
2. Pressure : Kilograms per square centimeter (kg/cm<sup>2</sup>)
3. Draught : Millimeters of water column (mm wcl.)
4. Vacuum : Millimeters of mercury column (mm Hg)  
or water column (mm wcl)
5. Flow (All gases) : Tonnes/hour.
6. Flow (Steam) : Tonnes/ hour
7. Flow (liquid) : Tonnes/ hour



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8.	Flow base	:	Based - 760 mm Hg, 15 deg.C
9.	Density	:	Grams per cubic centimeter
10	Speed	:	RPM
11.	Frequency	:	Hz
12.	Differential Pressure	:	kg/cm <sup>2</sup>
13.	Level	:	mm
14.	Conductivity	:	micro S/cm
15.	Analytical parameter	:	ppm or ppb as specified in respective case.

Pressure instrument shall have the unit suffixed with 'a' or 'g' to indicate absolute or gauge pressure.

Scales and charts of all instruments shall have linear graduations and the Bidder shall offer devices for square root extraction or other functional operations required for this purpose. Local indicator scales may be non-linear if approved by the Owner.

All Instruments and Control devices provided on panels shall be of miniaturized design, suitable for modular flush mounting on panels with front draw out facility and flexible plug-in connection at rear.

#### **4.6.0      Instrument Ranges**

Instrument ranges will be selected to have the normal reading preferably at 60-75% of full scale. Deviation indicators shall have the null position at mid-scale.

#### **4.7.0      Choice of Hardware**

##### **General**

The primary objective for the design of Instrumentation and Control systems shall be to assist in the attainment of maximum unit availability.

Instrument sensing, transmission, measuring system shall be of latest microprocessor based/solid state electronic type with signal transmission in current mode with 4-20 mA level except for local instruments.

All Instruments and Control devices located on control panels shall be of miniaturized design, suitable for modular flush mounting on control panels with front draw out facility and flexible plug-in connections at the rear.

The interrogation voltage level for plant annunciation, interlock and protection systems shall be adequate to ensure high signal to noise ratio, but should not exceed 60V DC. The logic system shall be adequately protected from signal and power line borne noise and surge voltages and shall satisfy stipulations in specification.



All instrument contacts unless otherwise specified shall be rated for interrupting 5 amp at 240V AC, 50 Hz and 0.5 amp at 220V DC. Potential free contacts at output of interlock and protection system for interlocking with electrical switchgear & motor control centers shall be capable of interrupting at least 10 Amps at 240V, 50Hz and 0.5 amp at 220V DC.

#### 4.8.0 Proven Performance

Instruments and hardware furnished as per this specification shall be from the latest established range of a qualified manufacturer whose design, performance and high availability have been demonstrated by a considerable record of successful operation in coal fired utility stations.

#### 4.9.0 Operability & Maintainability

4.9.1 The design of the control systems and related equipment shall adhere to the principle of "fail safe" operation at all system level. "Fail Safe Operation" signifies that the loss of signal, loss of power or failure of any component will not cause a hazardous condition and at the same time prevent occurrence of false trips.

4.9.2 The types of failure which shall be taken into account for ensuring operability of the plant shall include but not limited to:-

1. Failures of sensors or transmitters producing high or low signal
2. Failure of controller & other modules during automatic operation.
3. Loss of motive power to final control element
4. Loss of control power.
5. Loss of Instrument Air.

4.9.3 The Bidder shall ensure proper operability of all Instrument and Control modules and also take into account protections to minimize accidental mal-operations, in the operator interfaces and configuration of panel boards offered.

4.9.4 The choice of hardware shall also take into account, sound maintainability principles and techniques. The same shall include but shall not be limited to:-

1. Standardization of parts
2. Minimum use of special tools
3. Modular replacement
4. Grouping of functions
5. Separate adjustability/ Interchange-ability
6. Malfunction identification facility
7. Easy removal, replacement and repair
8. Easy assembly and disassembly
9. Fool proof design providing proper identification and other features to preclude improper mounting and installation.



**4.9.5** Equipment devices which require maintenance shall be suitably located to ensure easy accessibility. Bidder shall supply all necessary furniture including ergonomically designed chairs & desks for use at the local control room and CCR desks for various operating and engineering programming stations, printers etc.

**4.9.6** All necessary furniture such as tables, desks, chairs etc shall also be furnished to set up and same shall be completely erected and commissioned by the bidder.

**4.10.0 Established Reliability**

**4.10.1** All components and systems offered by the Bidder shall be of established reliability. The minimum target reliability of each component shall be established by the Bidder, considering its failure rate & meantime between failures (MTBF) & meantime to repair (MTTR), such that the availability of the complete system is assured for 99.7%.

**4.10.2** Further the Bidder shall ensure that all equipment/parts of his system that are not listed under recommended spares shall have the normal life expectancy exceeding the expected plant life.

**4.10.3** In order to ensure the target reliability the bidder shall perform necessary availability tests and burn in tests for major systems. Surge protection for electronic control systems, annunciation system and other solid state systems conforming to SWC test per ANSI C 37.90a (IEEE standard 472) and selection of proper materials, manufacturing processes, quality controlled components and parts, adequate de-rating of electronic components and parts shall be ensured by the Bidder to meet the reliability and life expectancy goals.

**4.10.4** Continuous self-checking features shall be incorporated in system design with automatic transfer to healthy/redundant circuits to enhance the reliability of the complete system. In general, failure of equipment used for alarm purpose will cause switching to the alarm state.

**4.11.0 Proveness Criteria**

**Proveness of Supplier:** The various C&I equipment shall be from established sources i.e. The supplier for any particular type of equipment/system should have equipment /system manufactured by him and under successful operation in a Power Plant for not less than 2 years.

**Proveness of offered system:** Equipment, system, instrument being offered by the bidder comprising of instrumentation, PLC based control system, and their MMI system and other associated systems shall be as elaborated in Technical Specifications.

**4.12.0 Standardization and Uniformity of Hardware and Software**

To ensure smooth and optimal maintenance easy interchangeability and efficient spare parts management of various C&I instruments/equipment, uniformity shall be maintained in all 4-20mA electronic transmitters/ transducers, control hardware, control valves, actuators and other instruments/ local devices etc.



being furnished by the Bidder. The Bidder shall ensure that they are of the same make, series and family of hardware.

**4.13.0 Redundancy Criteria for Sensors**

- 4.13.1** Redundancy of components and systems shall be dictated by availability criteria described under PLC to ensure the system availability target as well as safety considerations in critical applications are fully met.
- 4.13.2** Triple redundancy or double redundancy for sensors and transmitters will be used for critical control / protection application & other control/interlock applications. Where correction/ compensation for the measured signal are involved, the computed signal shall be the one transferred for control purposes. The measured value indicated shall be the duly corrected/ compensated signal.
- 4.13.3** It is mandatory to use sensors with 2 out of 3 logic for critical control & protection (Analog & Binary) application/service and sensors with 1 out of 2 logic for all other control & interlock (Analog & Binary) application/service as explained below. Sensor utilization shall be decided during detail engineering.

**4.14.0 Triple measurement scheme**

- 4.14.1** Triple measurement scheme for analog inputs employing three independent transmitters connected to separate tapping points shall be employed for the most critical measurements. For protection of all the HT drives, 2 out of 3 logics shall be provided by the bidder accordingly.
- 4.14.2** For lube oil protection of all the HT drives, 2 out of 3 logics and necessary pressure transmitters for lube oil pressure shall be provided by bidder accordingly.
- 4.14.3** The three signals shall be auctioneered to determine the median/average value, which will be used for control purpose. In case one transmitter fails or shows excessive deviation with respect to others, it will be removed from computation of median/average value & the average of the other two redundant transmitter outputs shall be used for controls.
- 4.14.4** The output of the other two redundant transmitters shall be continuously monitored for excessive deviation. In case the deviation is within limits, the mean value shall be used for the control loop. If the deviation becomes high (with both transmitters remaining healthy), the loop will be automatically transferred to manual.
- 4.14.5** The control loop shall trip to manual when any two of the three transmitter signals fail. The operator shall be able to select any of the transmitters or the median/average value from OWS. The outputs of the transmitters shall be continuously monitored for excessive deviation which shall be displayed, logged & alarmed. In triple measurement scheme, the operator shall have the option to select any one of the three measurement transmitters for auto control besides median/average value, when three/two transmitters are available.



#### 4.15.0 Dual measurement scheme

- 4.15.1 For binary and analog inputs required for other modulating control, protection and interlock purpose of other equipment etc., min. dual sensors shall be provided.
- 4.15.2 Dual measurement scheme for analog inputs employing two independent transmitters, connected to separate tapping points/ temperature element shall be employed for the remaining measurements used for analog control functions.
- 4.15.3 The output of the redundant transmitters shall be continuously monitored for excessive deviation. In case the deviation is within limits, the mean value shall be used for the control loop. If the deviation becomes high (with both transmitters remaining healthy), the loop will be automatically transferred to manual, however, if one transmitter fails and the other transmitter remains healthy, then the output of the healthy transmitter shall be used for control. If the other transmitter also fails, loop shall trip to manual. The operator shall be able to select any of the transmitters or the mean value from the OWS. The outputs of the transmitters shall be continuously monitored for excessive operation which shall be displayed and logged and alarmed.
- 4.15.4 All the instruments/ sensors/transmitters/switches meant for redundant applications shall have completely separate and independent impulse pipes/ root valves etc. No redundant instrument shall share a single process tapping.

#### 4.16.0 Protection, Class of Cabinets / Panels, Enclosures etc.

1. All panels, desks cabinets, consoles & enclosures furnished at least comply with the requirements of protection classes as indicated below.
  1. In-door Air-conditioned (A.C.) areas - IP32 (min.)
  2. In-door Non A.C. areas:
    - (a) Ventilated enclosures - IP42
    - (b) Non Ventilated IP54
  3. Out-door IP65
2. Distribution boxes, junction boxes, cold junction compensation boxes, terminal boxes and all other field mounted equipment to be furnished as per this specification shall have weather protection conforming to IP 65.
3. The design of panels, cabinets, enclosures and packaging density of components mounted therein shall be such that the temperature rise does not exceed 10 deg. C above the ambient under the worst conditions.
4. The panels housing electronic hardware shall be provided with flame and smoke detectors by bidder and necessary annunciation shall be provided by bidder.
5. Enclosures for peripheral equipment like printers, etc. shall take care of noise and shall ensure minimum possible noise disturb to the working personnel.



#### 4.17.0 System Expandability

Modular System design shall be adopted to facilitate easy system expansion. The system shall have the capability and facility for expansion through the addition of controller modules, I/O cards, hand/auto stations, push button stations, peripherals like operator workstations (OWS), printers etc. while the existing system is fully operational. The system shall have the capability to add any new control loops, groups/subgroups, in control system while the existing system is fully operational.

#### 4.18.0 Online Maintenance

It shall be possible to remove/replace online various modules (like I/O module, interface module etc.) from its slot for maintenance purpose without switching off power supply to the corresponding rack. System design shall ensure that while doing so, undefined signaling and releases do not occur and controller operation in any way is not affected (including any control loop trip to manual, etc) except that information related to removed module is not available to controller. Further, it shall also be possible to remove/replace any of the redundant controller module without switching off the power to the corresponding rack and this will not result in system disturbance or loss of any controller functions for the other controller. The on-line removal/insertion of controller, I/O modules etc. shall in no way jeopardize safety of plant and personnel.

#### 4.19.0 Fault Diagnostics

The PLC shall include on-line self-surveillance, monitoring and diagnostic facility so that a failure/malfunction can be diagnosed automatically down to the level of individual channels of modules giving the details of the fault on the programmer station displays and printers. The faults to be reported shall include fault in main & standby power supplies, sensor fault, Controller fault, any channel fault in 2V3 channels, failure of links to PLCs, LAN etc. These faults and Controller faults shall be reported as colour change on system status display and messages on programmer /OWS as well as through local indication on the faulty channel/ module and on respective rack/ cubicle. The diagnostic system shall ensure that the faults are detected before any significant change in any controller output has taken place. Failure of any I/O modules, Controller etc. shall be suitably grouped and annunciated to Annunciation facia on OWS.

#### 4.20.0 Fault Tolerance & Controllability

- 4.20.1 The PLC shall provide safe operation under all plant disturbances and on component failure so that under no condition the safety of plant, personnel or equipment is jeopardized. Control System shall be designed to prevent abnormal swings due to loss of Control System power supply, failure of any Control System component, open circuits/short circuits, instrument air supply failure etc. On any of these failures the controlled equipment/parameter shall either remain in last position before failure or shall come to fully open/close or on/off state as required for the safety of plant/personnel/equipment and as finalized during detailed engineering. System shall be designed such that there will be no upset when Power is restored.



- 4.20.2 The system shall be designed to permit the operator to supplement but not inhibit the protective functions.
- 4.20.3 During transient conditions, causing deviations of a process variable, the control system furnished under this specification shall not permit deviations, which exceed those permitted by manufacturers of the main plant equipment.
- 4.20.4 The control system furnished under this specification shall not inhibit a greater capacity output than the rated capacity of the unit, if permitted by the main plant equipment and required by the Owner.
- 4.20.5 The controlled variable response rate & controllability shall be limited by the characteristics of main equipment, which is being controlled, and PLC shall not impose any limitations in the response rate or controllability. Controlled process variables shall return to normal values in a stable manner and without control loop interactions or cycling of generation when generation matches with load demand.
- 4.20.6 No single failure either of equipment or power source shall be capable of rendering any part/system/sub-system of PLC inoperative to any degree.

#### 4.21.0 Station Blackout

Availability of all equipment, drives, emergency power supplies, controls, logics required for the protection/safe operation/shutdown of the boiler/turbine and auxiliaries during emergency blackout shall be ensured by bidder. All the related drives, controls shall operate automatically on the occurrence of blackout. All such drives, controls required during emergency and black out shall be provided with continuous power supply source (each type of power supply depending upon requirements, sizing shall be done considering this requirements) to ensure availability and shall be designed for fail safe mode. All the required controls shall be available as the system is to be powered from UPS. The UPS sizing shall consider this requirement.

#### 4.22.0 Electrical Noise Control

- 4.22.1 The equipment furnished by the Bidder shall incorporate necessary techniques to eliminate measurement and control problems caused by electrical noise. Areas in Bidder's equipment which are vulnerable to electrical noise shall be hardened to eliminate possible problems. Any additional equipment, services required for effectively eliminating the noise problems shall be included in the proposal. The equipment shall be protected against ESD (Electrostatic Discharge) as per IEC-801- 2. Radio Frequency interference (RFI) and Electro Magnetic Interference (EMI) protection against hardware damage and control system mal-operations/errors shall be provided for all systems.
- 4.22.2 The Bidder shall be fully responsible for detailed recommendations on the type, size, shielding, input balancing, ripple amplitude and frequency, isolation and grounding for field inputs and for equipment furnished by the Bidder to achieve an installation with minimum noise from all sources.



- 4.22.3** The Bidder shall carefully review the electrical field construction and cabling specifications given in Section-9 of this volume. If the performance of the equipment furnished by the Bidder is likely to be adversely affected in any manner because of these cabling and electrical field construction practices, the Bidder shall bring this to the attention of the Owner along with his proposal.
- 4.22.4** Any additional equipment, services required for effectively eliminating the noise problems shall be identified by the Bidder and shall be included in his lump sum proposal.
- 4.22.5** The Bidder shall be fully responsible for satisfactory elimination of any noise problems that evidence themselves following the installation of the equipment. All expenses incurred in the elimination of noise problems shall be borne by the Bidder.
- 4.23.0** **Surge-protection design criteria for solid state / microprocessor based equipment / PLC and Remote IO panel etc.**
1. All solid-state equipment shall be able to withstand the noise and surges inherent in a powerhouse. The equipment shall be designed to successfully withstand without damage to components and/or wiring, application of surge withstand capability (SWC) wave whose shape and characteristics are defined in ANSI publication C37.90a – 1974 entitled “Guide for surge withstand capability (SWC) Tests”.
  2. All solid state equipment, power supply to electronic cards, power supply to controllers, PLC panels, SMPS power supply shall have external surge protection device with Pluggability and life indication as per IEC 61643-1:1998-02 and E DIN VDE 0675 part 6:1996-03/A2: 1996-10, to withstand max. 40 kA, 8/20 u Sec of Surge.
  3. Signal lines shall have surge protection devices with pluggability and testability as per IEC 61643-21:2000-09 and E VDE 0845 part 3-1:1999-07, to withstand max. 20 kA, 8/20 u Sec of surges.
  4. For data lines, communication lines, Ethernet/CAN networks/LAN, Coaxial lines modular surge protection device should be used as per IEC 61643-21:2000-09 to withstand a min of 2.5 kA, 8/20 u Sec of surges. The surge protection device should be used with the corresponding connector as being used for the lines i.e. RJ45, D-Sub, BNC, N-Type etc.
  5. “The Bus systems (like Profibus/ MODBUS etc) or the Serial Port Systems (like RS-232/ RS-485 etc) shall be protected with suitable surge protection devices, confirming to the latest IEC-61643-21 guidelines. The surge handling capacity of device shall at least be 10 KA, 8/20  $\mu$ Sec between core-core and 20 KA, 8/20 $\mu$ Sec between core-ground. The device shall be pluggable & on-site testable”.
  6. All electronic cards/modules shall also be protected from failure against accidental/inadvertent application of high voltage up to 500V DC (common mode) even though these modules may be designed to operate at lower voltage levels such as 24V/48V DC.



7. In the case of DC powered system/subsystem/instrument, the design shall ensure protection against reverse polarity.
8. The Bidder shall provide details of production tests being carried out to fully satisfy the Owner that the proposed equipment meets the above requirements and to assure that the products furnished shall be of the desired grade.

#### **4.24.0 General Tools and Tackles, Special Calibration Instruments:**

Bidder must offer general tools & tackles and special calibration instruments required during start-up, trial run, operation and maintenance of the plant.

#### **4.25.0 PG Test Points**

Pressure, temperature and flow test points shall be provided in line with latest performance test code requirements.

In addition, pressure and temperature test points shall be provided for the following services:

- (a) At the discharge of all pumps and fans
- (b) At the inlet and outlet of the heat exchangers for the fluid media involved

At the inlet and outlet of each control valve

Pressure test points shall be complete with root valves and shall terminate with a nipple.

Temperature test points shall be provided with thermowell with a cap and chain.

#### **5.0.0 CODES AND STANDARDS**

- 5.1.0 All equipment, system and service covered under this specification shall comply with the requirements of the latest statutes regulations and safety codes as applicable in the locality where the equipment/systems will be installed. The Bidder shall fully acquaint himself with these requirements and shall ensure compliance with them.
- 5.2.0 The equipment, systems and services furnished as per this specification shall confirm to the codes and standards as mentioned elsewhere in further clauses. However in the event of any conflict between the requirements of two standards or between the requirements of any standard and this specification, the more stringent requirements shall apply unless confirmed otherwise by the Owner in writing. The decision of the Owner shall be final and binding in all such cases.
- 5.3.0 The Bidder's scope of supply shall include some items such as thermowells, and other in-line devices falling under the purview of Indian Boiler Regulation (IBR) Act. It shall be the responsibility of the Bidder to obtain the necessary approval of the concerned Inspecting Authority/Chief Inspector of Boilers for the design and design calculations and manufacturing.



**5.4.0** The requirements of statutory authorities (e.g. MOEF, Inspectors of factories, TAC, BEE, CPCB/State Pollution Control Board etc.,) with regards to various plants areas like plant, Fire Fighting system, Emission Measurement etc. shall be complied even if not actually spelt out.

**5.5.0 Reference Codes and Standards**

The design, manufacture, inspection, testing, site calibration and installation of all equipment and systems covered under this specification shall conform to the latest editions of codes and standards mentioned below and all other applicable ANSI, ASME, IEEE, NEC, NEMA, ISA, DIN, VDE, NFPA and Indian Standards and their equivalents. Bidder to note that in no case, OEM/manufacturers own standards shall be accepted.

**5.5.1 Temperature Measurement**

1. Performance Test Code for temperature measurement ASME PTC 19.3 (1974 – R 1998)
2. Temperature measurement - Thermocouples ANSI-MC 96.1 - 1982, IEC 584
3. Temperature measurement by electrical resistance thermometers - IS-2806.
4. Thermometer-element-platinum resistance-IS-2848, IEC 751
5. RTD Design Code - DIN EN 60751:1996, BS EN 60751: 2008
6. Thermowell Design Code - ASME PTC 19.3 TW - 2010

**5.5.2 Pressure Measurement**

1. Performance Test Code for pressure measurement - ASME PTC 19.2 (2010)
2. Bourdon tube pressure and vacuum gauges-IS 3624, IS 3602, ASME B 40.1

**5.5.3 Electronic measuring Instruments & Control hardware**

1. Automatic null balancing electrical measuring instruments - ANSI C 39.4 (Rev. 1973)
2. Safety requirements for electrical and electronic measuring and controlling instrumentation - ANSI C 39.5 – 1974.
3. Compatibility of analog signals for electronic industrial process instruments - ISA-S 50.1:ANSI MC 12.1 - 1975.
4. Dynamic response testing of process control instrumentation - ANSI MC 4.1 (1975): ISA-S26 (1968).
5. Surge withstand capability (SWC) tests - ANSI C 37.90A (1974) IEEE Std. 472 (1974). IEC - 254.1.
6. Printed circuit boards - IPC TM-650, IEC 326 C
7. General requirements and tests for printed wiring boards - IS 7405 (Part-I) - 1973
8. Edge socket connectors - IEC 130-11.
9. Requirements and methods of testing of wire wrap terminations DIN 41611 Part-2.
10. Dimensions of attachment plugs & receptacles ANSI C73-1973.
11. Direct acting Electrical Indicating Instruments: IS-1248-1968.

**5.5.4 Instrument Switches and Contacts**

1. Contact rating - AC services NEMA ICS Part-2 125, A600
2. Contact rating - DC services NEMA ICS Part-2-125, N600.



#### 5.5.5 PLC & other Control System

1. Application of Safety Instrumented System - ANSI/ISA 84.01 1996
2. Functional Safety - Safety Instrumented System for Process Sector - IEC - 61151
3. IEEE Application Guide for Distributed Digital Control Monitoring for Power Plant – IEEE 1046
4. Fossil Fuel Power Plant Steam Turbine Bypass System - ANSI/ISA - 77.13.01
5. Human System Interface Design Review Guide lines - NUREG - 700
6. Annunciation Sequence and Specification - ANSI/ISA 18.1
7. “IEEE 1050, IEEE guide for Instrumentation & control system grounding in generating station”.

#### 5.5.6 Control Valves

1. Control Valve sizing - Incompressible fluids - ISA S39.2 - 1972.
2. Control valve sizing - Compressible fluids - ISA S39.3 - 1973, ISA S39.4 - 1974.
3. Face to face dimensions of control valves - ANSI B16.10
4. ISA Hand book of control valves - ISBN B1047-087664-234-2.
5. Valves - flanged, threaded and welding end: ANSI B 16.34(2009)
6. Casting: ASTM A 216 / A 351 (2008)
7. Welded end connection: As per ASME boiler and pressure vessel code / ANSI.B 16.34(2009), B16.25 (2009), B 16.11(2009).
8. Defect removal: ANSI B 16.34 2009.
9. Cleaning: ASTM A 380 2006.
10. CV test: As per ISA procedure S 75.02 (2008).

#### 5.5.7 Enclosures

1. Types of enclosures - NEMA Std. ICS-6-110.15 through 110.22 (Type 4 to 13).
2. Racks, panels, and associated equipment - EIA: RS-310-B (ANSI C83.9 - 1972)
3. Protection Class for Enclosure, Cabinets, Control Panels and Desks - IS-13947-1962.

#### 5.5.8 Apparatus, enclosures and installation practices in hazardous areas

1. Classification of hazardous area - NFPA Art. 500, Vol.70-1984.
2. Electrical Instruments in hazardous dust locations - ISA-RP 12.11
3. Intrinsically safe apparatus - NFPA Art.493 Vol.4.1978
4. Purged and pressurized enclosure for electrical equipment in hazardous location – NFPA Art. 496 1982.

#### 5.5.9 Sampling System

1. Stainless steel material of tubing and valves for sampling system – ASTM A269-82 Gr TP316.
2. Submerged helical coil heat exchangers for sample coolers ASTM D 11-98.
3. Standard methods of sampling system - ASTM D 1066-69.



#### 5.5.10 Announciators

1. Specifications and guides for the use of general purpose annunciators - ISA RP 19.1-1979.
2. Surge withstand capability tests - ANSI C.37.90a - 1974 and IEEE std. 472-1974.

#### 5.5.11 Interlocks, Protections

1. Relays and relay system associated with electric power apparatus - IEEE std.3.13.
2. Surge withstands capability tests - ANSI C.37.90a - 1974 and IEEE Std. 472 -1974.
3. General requirements & tests for switching devices for control and auxiliary circuits including contactor relays - IS-6875 (Part-I) 1973.
4. Turbine water damage prevention - ASME - TDP-1980.
5. Boiler safety interlocks - NFPA Section 85B, 85D, 85E, 85F, 85G.

#### 5.5.12 Process Connection and Piping:

1. Codes for pressure piping power piping ANSI B31.1
2. Seamless carbon steel pipe ASTM A-106.
3. Forged and Rolled Alloy steel pipe flanges, forged fittings, valves and parts - ASTM A-182.
4. Material for socket welded fittings - ASTM A-105.
5. Seamless ferrite alloy steel pipe - ASTM A-335.
6. Pipe fittings of wrought carbon steel and alloy steel - ASTM A-234.
7. Composition bronze or metal castings - ASTM B-62.
8. Seamless copper tube, bright annealed ASTM B-168.
9. Seamless copper tube - ASTM B-75.
10. Dimensions of fittings - ANSI B-16.11
11. Valves flanged and butt welding ends - ANSI B16.34.
12. Nomenclature for Instrument tube fittings ISA-RP-42.1 - 1982.

#### 5.5.13 Instrument Tubing

1. Seamless carbon steel pipe - ASTM - A106.
2. Material for socket weld fittings - ASTM - A105.
3. Dimensions of fittings - ANSI B16.11
4. Code for pressure piping, welding, hydrostatic testing - ANSI B31.1.

#### 5.5.14 Cables

1. Thermocouple extension wires/cables - ANSI C 96.1 - 1982.
2. Colour coding of single or multi-pair cables - VDE 0815
3. Guide for design and installation of cable systems in power generating stations (insulation, jacket materials) - IEEE Std. 422 - 1977.
4. Requirements of vertical tray flame test - IEEE 383 - 1974.
5. Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B-33 - 81.
6. Oxygen index and temperature index test - ASTM D-2863.
7. Smoke generation test - ASTMD-2843 and ASTME-662.
8. Acid gas generation test - IEC-754-1.



9. Swedish chimney test - SEN - 4241475 (F3)
10. Instrumentation cables and internal wiring IS-1554 (Part-I, 1976) and IS-5831(1984).
11. Standard for Control, Thermocouple Extension and Instrumentation cable - NEMA WC57-2004 ICEA S-73-532, Rev. 2, 2004)
12. PVC insulated (heavy duty) Electric cables for working voltages upto and including 1100V- IS:1554 (Part-I)
13. Conductors for insulated electric cables and flexible cords. - IS:8130
14. PVC insulation and sheath of electric cables - IS:5831
15. Mild steel wires, strips and tapes top armoring cables - IS:3975
16. Water Immersion Test - VDE 0815
17. Drums for electric cables - IS : 1048

#### 5.5.15 **Cable Trays, Conduits**

1. Guide for the design and installation of cable systems in power generating station (cable trays, support systems, conduits) – IEEE Std. 422, NEMA VE-1, NFPA-70-1984.
2. Guide for the design and installation of cable systems in power generating station (Cable trays, support systems, conduits) Test Standards, NEMA VE-1 – 1979.
3. Galvanising of Carbon steel cable trays - ASTM A-386-78.

#### 5.5.16 **Flow measurement**

1. ASME Performance Test Code PTC-19.5 (2004), ISA RP3.2
2. BS 1042
3. ISO 5167

#### 5.5.17 **Surge Protection System**

1. Surge withstand capability tests - ANSI C37.90a-1974. IEEE Std. 472 – 1974
2. IEC 61643-1:1998-02 and E DIN VDE 0675 part 6:1996-03/A2: 1996-10
3. IEC 61643-21:2000-09 and E VDE 0845 part 3-1:1999-07

#### 5.5.18 **Digital Video Recording & Management System (DVRMS)**

- i. ISO 9001 (2000)
- ii. ISO/IEC15504 Level 3 or higher (SPICE 2.0 Software Process Improvement and Capability Determination)
- iii. SEI/CMM Level 3 or higher (American Software Engineering Institute - Capability Maturity Model).

#### 5.5.19 **General**

- i. ANSI/ISA-RP77.60.05-2001 (R2007) - Fossil Fuel Power Plant Human-Machine Interface: Task Analysis
- ii. ANSI/ISA-RP77.60.02-2000 (R2005) - Fossil Fuel Power Plant Human-Machine Interface: Alarms
- iii. ANSI/ISA-77.70-1994 (R2005) - Fossil Fuel Power Plant Instrument Piping Installation
- iv. ANSI/ISA-TR77.60.04-1996 (R2004) - Fossil Fuel Power Plant Human-



- Machine Interface-Electronic Screen Displays.  
ISA-99/IEC 62433-2-1- Industrial Communication Networks - Network and System Security - Establishing an industrial automation and control system security program
- v. IEEE 1100-2005, IEEE recommended practice for Powering and Grounding Electronic Equipment.
  - vi. IEEE 1100-2005, IEEE recommended practice for Powering and Grounding Electronic Equipment
  - vii. Hydrogen Piping and Pipelines: piping in gaseous and liquid hydrogen service and pipelines in gaseous hydrogen service - ASME B31.12. Code of Practice for Installation and maintenance of Power cables – IS : 1255. IEEE 1185: IEEE Recommended Practice for Cable Installation in Generating Stations and Industrial Facility.
  - viii. NEMA VE 2 (2013) - Cable Tray Installation Guidelines.
  - ix. All supplied / equipments/ analyzers shall be according to latest guideline of RPCB/ CPCB.

**Where:**

- i) IEEE - Institute of Electrical and Electronics Engineers.
- ii) ISA - Instrument, Systems and Automation Society.
- iii) NEMA - National Electrical Manufacturers Association.
- iv) ANSI - American National Standards Institute
- v) NFPA - National Fire Protection Association.
- vi) ASME - American Society of Mechanical Engineers.
- vii) IS - Indian Standards.
- viii) IEC - International Electro-technical Commission
- ix) ASTM - American Society for Testing Materials.
- x) EIA - Electronic Industries Association
- xi) DIN - Deutsche Institute Normale.

## **6.0.0 PROGRAMMABLE LOGIC CONTROLLER (PLC) SYSTEM**

### **6.1.0 The PLC for system shall have the following features:**

1. The PLC system shall fulfill all demands emanating from the domains
  - Automation
  - Monitoring
  - Process control
  - Management
  - Engineering
2. Uniform operator machine interface
3. Reliable user guidance
4. Comprehensive redundancy concept
5. Modern object oriented software structure
6. Shall be able to communicate with external system and intelligent field equipment
7. Simple central project planning and configuration aids
8. Integrated documentation system
9. Integrated diagnosis and service
10. Commissioning support



**6.2.0** The Control System shall have on-line simulation & testing facility.

- 1 The system shall have the flexibility to easily reconfigure any controller at any time without requiring additional hardware or system wiring changes and without disabling other devices from their normal operation mode. Modifications shall not require switching off power to any part of the system.
- 2 Fault Diagnostics

Complete software for PLC based system including the communication software between systems; the software shall be also included for equipment performance test, life evaluation, equipment capability curve and alarm analysis, Management information system, etc.
- 3 Bidder to calculate the actual BOQ (No. of PLC panels, I/O Modules, CPU Modules, Fiber optic interface etc) of the offered PLC as per technical specification/system requirement, PLC spare philosophy, CPU loading etc for their entire system. Bidder to include the cost of PLC system based on actual requirement along with other C&I items in the quoted lump sum price.
- 4 Online calibration Facility for all the analyzers is required from the local control room.

**6.3.0** **Design Requirements**

1. The Instrumentation and Controls shall be designed for maximum availability, reliability, operability and maintainability.

All components shall function in a satisfactory manner within their rated capacity under the specified conditions for entire life of the plant.
2. All I&C equipment shall be designed for their specific application within the power plant and shall be furnished for required control, protection, alarm and remote monitoring. The application and selection of these C&I equipment including signal converters, interposing relays, microprocessors, etc. shall be the responsibility of bidder.
3. Separate interposing relay panels, dedicated marshalling / termination cabinets for termination and separate system cabinets for each control system
4. All C&I equipment furnished must have proven performance of working in the power plant, at least two sets of such equipment installed in a similar power plant have been running successfully for at least two years. No prototype components shall be used. The Bidder shall state the application, the performance of the equipment furnished, including accuracy, repeatability, drift due to time and temperature, etc. and give the equipment list and the examples and statements for their application in his proposal.
5. All like instrumentation, control hardware, control and protective system should be furnished by the same manufacturer in order to achieve the goal of consistent control philosophy and to minimize the diversity of I&C equipment.



6. PLC equipment shall employ modern microprocessor based technology, as required to comply with the project specification and the PLC system should not be more than 5 year old. A truly integrated PLC is envisaged with all the self-sustaining subsystems communicating with each other over the bus network and thus ensuring that the system has a truly global data base.
7. The fundamental functions of control, alarm, monitoring and protection shall be functionally and physically segregated to greatest practicable extent so that failure of a function does not result in the failure of other functions. Special attention should always be given to the independence of the protection function so that safety of plant personnel and equipment is preserved.
8. The active control system including the plant protection system is the heart of the PLC system and therefore most stringent safety, availability and reliability requirements have to be fulfilled by this subsystem. The bidder must bring out very clearly in his proposal how he intends to satisfy these requirements. In order to ensure that the control of the final control element is independent of the availability of the superimposed hardware, the active control system's interface to the modulating and ON/OFF drives should be a so-called intelligent drive control module. All drive control related functions should be executed independently by this self-sustaining drive control module. Wherever conventional operation modules are required to be provided, these will be directly interfaced to these drive control modules.
9. A functional group control hierarchy shall be devised for the plant equipment and their auxiliaries to allow operator to select a lower level of certain system or equipment.
10. In case of redundant Analogue and Binary Signals, these will be connected to different input modules.
11. Control system shall comply with following general failure criteria :
  - a. No single fault can cause the complete failure of the control system.
  - b. The grouping of control functions into system blocks shall be arranged such that failure of any one block will only partly degrade the control of the overall system. Such degradation shall always be manageable by operator intervention.
  - c. The control system shall be structured to reflect the redundancy provisions of the plant so that no single fault within the control system can cause the failure of the duty equipment or make the standby equipment unavailable. Start command or stop command/trip command towards safety of process or process equipment shall be hardwired parallel from the two different DO cards.
  - d. As a result of a control system fault, a plant item or control function shall always respond to its controls at the actuator level (i.e., remote manual



- control). That item or control function shall be required to be isolated from automatic control system.
- e. No single random fault in the entire automation and control system will cause a load loss, forced outage or unit trip.
  - f. No two simultaneous faults shall lead to or potentially cause damage to plant
  - g. Safety related Instrumentation and Control shall be designed with a fail-safe mode.
  - h. No single fault shall jeopardize the functioning of the entire system.
  - i. The control and automation system and the field instruments and actuators as well as its support systems, power supplies and data networks shall be immune to the electromagnetic interference and shall conform to the internationally accepted standards.
  - j. To meet the operational and safety requirements, the control system hardware and software shall conform to a modular, hierarchical architecture.
  - k. When more than one device utilizes the same measurement or control signal, the transmitter and other components shall be fully equipped to provide all signal requirements without overloading and with proper isolation. Transmitters required to serve multiple receivers shall be arranged so that disconnecting, shorting or grounding of one receiver device shall not have any perceptible influence on any other consumer point of the same signal nor shall change the transmitter calibration.
12. To meet the above failure criteria, the I&C system shall incorporate self-checking facilities so that internal faults can be detected within the system itself prior to any resulting disturbance to the process. In addition, the protection and safety systems shall incorporate channel redundancy or diversity of measurement as well as self-checking and adequate test facilities. For some important systems, "on line" test shall be employed with no effect to the proper functioning of the protection system.
13. To meet the stringent failure and self-checking requirements for C&I system, measurement redundancy shall be provided for all such parameters which can cause a direct system trip.
14. In order to make sure that the PLC is an extremely user friendly system a centralized engineering subsystem is envisaged. An integrated subsystem has to be provided which takes over the complete task of planning, I/O allocation, generation of function schemes and wiring documentation (in design stage) and finally the automatic linking and loading of the planned functions in the target hardware.
15. The complete engineering of all the automation and data acquisition functions should be possible from this central tool. This shall include all modulating and



sequence control functions as far as the automation is concerned, generation of plant graphics, logs and other MMI functions. In addition the central engineering system must support all service, maintenance and commissioning assistance functions.

16. The measurement for the functions of control, indication and protection may be appropriately combined, provided, the integrity of measurement is ensured by adequate channel redundancy. Where a signal is required for control purposes only or for both control and data indication, the signal shall be derived from the conditioned output of a number of detectors. Where a signal is required only for data indication, then it may be derived directly from a detector, if necessary via a suitable conditioner. For some critical parameters, three independent measurements shall be provided. Median signal shall be selected for control and direct wired indication. Alarm shall be provided for large deviation from the median signal.
17. For selected protection applications, multi-channel measurements shall be provided incorporating 2 out of 3 trip action. Facilities for the on-line testing of each independent channel shall be provided without loss of protection. Each measurement channel shall include discrete transmitters and instrument loops, i.e. multi-channel measurement of the same process variable shall not be derived from common instrument.
18. Both redundancy and diversity of trip criteria shall be considered to achieve sufficient guarantee against non-operability or unnecessary operation of the protection system. The principle of de energized to trip (Fail safe logic) shall be adopted.
19. Individual control elements shall be equipped with permissive to prevent the in- appropriate operation of the item and “active interlocks” to trip the item in case of dangerous operation conditions.
20. Each of the multifunction controller together with its I/O and drive level control modules is to be understood as a self-sustaining automation island, which executes the function allocated to it independently and is not affected by a disturbance in the adjacent island. For the purpose of lateral communication between the automation islands, a high speed bus (the so-called control bus) should be provided which should be solely responsible for the automation (control) signal exchanges.
21. Alarms shall be provided for all abnormal conditions over which the operator has control in the control room, plus those abnormal conditions which are of interest to the operator because they may affect plant operation or security.
22. The following colors shall be selected for equipment status indicating lights :
  - Red --- energized, running, valve open
  - Green --- de-energized, stopped, valve closed
  - Light yellow ----abnormal, discrepancy
  - White--- control power available



23. AC power from UPS supply for control cubicles of each control and monitoring system shall be derived from two independent sources shall be furnished to guard against the total loss of power supply. The arrangements of power supplies shall be such that no single fault could interrupt both supplies and no control system malfunction shall occur as a result of supply changeover.
24. The functions of PLC System are achieved through bus communication units, bus interfaces, process controllers, I/O modules and computers. The system shall be versatile and provide the user, the flexibility to freely choose configuration and redundancy. The system shall ensure very high reliability and safety through complete distribution and decentralization which goes right down to the individual I/O level.
25. Interposing relays with suitable contact rating shall be provided between PLC and MCC/Swgr in Interposing relay panels for giving command signals ON/OFF or OPEN/CLOSE. Interposing relays shall have minimum 2 NO and 2 NC contacts.
26. All parameters on which protection is achieved through pressure/ temperature/ flow switches; the measurement shall also be made available through transmitters. Provision of transmitter/remote sensor will be applicable for 70% protection signals which will be decided during detailed engineering”
27. Also the system shall have the flexibility to easily reconfigure any controller at any time, without requiring additional hardware or system wiring changes and without disabling the devices from their normal operating mode.
28. The system shall execute all control functions with the help of a set of pre-programmed functions resident in controllers. The offered system shall have provision for open system architecture to establish communication to any other system using open system standards such as UNIX, WINDOWS NT, WINDOW XP/7, TCP/IP, OSF, MOTIF, SQL Access etc.
29. The system shall be provided with extensive diagnostic features so that a system failure can be diagnosed down to the module level giving location and nature of fault. Ease of maintenance and trouble-shooting shall be a primary consideration in equipment selection.
30. The system shall provide inherent safe operation under all plant disturbances and component failures so that under no circumstance safety of the plant personnel or equipment is jeopardized.
31. All process input/output cards shall have built in galvanic/optical/electronic isolation for each input and output channel.
32. The failure of each controller module and each I/O module shall be indicated on control cubicles and all operator stations.
33. For all the trip signals (very high/very low), the alarms (High/Low) shall appear for correcting the process by the operators.



34. Bidder to submit the Logic for entire plant in SAMA format only (Any other format of Logic shall be based on owner acceptance).
35. Necessary software shall be supplied for uploading the data for chart less recorders.
36. External resistance shall be connected at field side equipment (Process switches, transmitters, JB, Limit switches, SOV JB etc.) by bidder for each Input and output to & from field side equipment for enabling short circuit and wire break detection feature of the PLC input & output modules.  
  
External resistance shall be connected by bidder at MCC end TBs for each Input and output signal to & from MCC for enabling short circuit and wire break detection feature of the PLC input & output modules.
37. All Operating Stations shall be provided with LED Monitors.

#### 6.4.0 Plant Automation System

It is proposed to automate the Units. The Bidder will be required to do the complete sequencing for start-up, raising the load to full load operations, emergency shut downs etc. under various conditions. The system shall be capable of three (3) modes of operation:

- i) System guided modes in which extensive operator guides will be provided by the system. The operator will start/stop the major sequences based on the operator guides. The major sequences will however, be programmed into the system.
- ii) Manual step by step mode in which the operator can directly intervene at the drive level. Detailed operator guides shall be provided by the system under such mode also.
- iii) On power operation  
The system shall perform scheduled load control operation.
- iv) Plant Failure  
On failure of any auxiliaries, the system shall automatically switch on the back-up auxiliary if any or decrease load to the required extent
- v) Plant Shut down  
The system shall be capable of orderly plant shut down as and when required. The operator guides and check listing will be displayed via. the operator OS on the Control Panel.
- vi) The automation scope covers the operation of on/off drives as well as closed loop outputs required to be ramped under a major sequence of operations.

#### 6.5.0 All operating stations connected on redundant data highway shall be interchangeable and operation of the plant shall be possible from Engg. Station after security check. All operator stations shall have full access to the entire plant



data base and shall have identical functionalities. The system shall have full data base redundancy. The data base shall be independent and shall reside separate from the operator stations.

**6.6.0** Modulating Controls (CLCS) and Discrete Open Loop Control (OLCS) shall be designed to eliminate the necessity of operator action except manual / auto selection, set point changes, biasing and similar actions during normal operation. Bumpless and balance less transfers between automatic and manual operation modes and vice-versa shall be provided automatically without need of operator action. Complete backup shall also be provided for safe shutdown operation of system.

**6.7.0** The system shall have built in redundancies for all system functions both at the processor and device level. No failure of any single device or processor shall lead to any system function being lost. It shall have redundant data highway on a "master less" principle.

**6.8.0** Redundant equipment wherever provided shall be powered from redundant power supply units in order to improve system availability and reliability.

**6.9.0** The system shall have the capability and facility for expansion through addition of station/drops, controllers, processors, process I/O cards etc., while the existing system is fully operational. The system shall have the capability to add any new control loop in CLCS and new group, sub group, drive functions in OLCS while existing system is fully operational. Intelligent I/O cards will be preferred.

**6.10.0** All the basic systems shall be connected through redundant data high way/bus system. The local bus system with associated bus couplers shall be provided for communication between different I/O modules and processors. The communication system shall be designed keeping in view the integrity & security aspects for the control system. In case the system employs master communication controllers, facility for 100% hot backup controllers with automatic switch over shall be provided and it shall be ensured that no loss of data takes place during failure of communication controller.

**6.11.0** The PLC shall be fully capable to operate plant in all regimes of plant operating conditions, including emergency operation/trip conditions, black out conditions etc. without resorting to manual control. The PLC shall be capable of bringing the plant to safety state automatically without operator interventions.

**6.12.0** The application programs for the functional controllers shall reside in EPROMS or in non-volatile RAM. The application program shall be alterable by access through programer's console. Parts replacement or parts removal shall not be required for accomplishing changes in application programs including control loop tuning. The CPUs shall not be loaded over 60% of the Individual capacity even under worst data loading conditions.

#### **6.13.0 Main Controller Characteristics**

Each controller envisaged for this project shall have following features as minimum:-



- i) Processing word length of 32/64 bit (Preferably 64 bits)
- ii) 16 Mbytes RAM
- iii) Redundant power supplies
- iv) Power fail/auto start feature
- v) Watch Dog timer
- vi) Memory protection
- vii) Direct Memory Access feature
- viii) Self-monitoring & diagnostic feature
- ix) Easy modification of control functions
- x) RISC/CISC based
- xi) Real time data controller, Computer/PC based soft controller are not acceptable.

#### **6.14.0 Controller Redundancy**

- 6.14.1** All functional controllers for sequence control, functional controllers for closed loop control and functional controller for DAS & monitoring shall be provided with hundred percent hot standby controllers. DAS function can also be integrated within CLCS/OLCS controller. All processors for modulating controls shall have self-tuning facility.
- 6.14.2** All the 100% hot back up controllers shall be identical in hardware and software to their corresponding main controllers. Further, each of the 100% hot backup controller shall be able to perform all the tasks of their corresponding main controller. The 100% hot backup controller shall continuously track/update its data corresponding to its main controller. There shall be an automatic and bump less switchover from the main controller to its corresponding back-up controller in case of main controller failure and vice versa. The changeover shall take place less 5 m sec. Engineered solution for redundancy in CPU are not acceptable. Dual redundant controllers shall be placed separately.
- 6.14.3** Any switchover from main controller to 100% hot backup controller and vice versa, whether automatic or manual shall not result in any process upset or any change in control status. The transfer from main controller to the back-up & vice-versa shall be indicated as alarm on all operator station (OS).
- 6.14.4** In case of switchover from main controller to backup controller, the backup controller shall be designated as the main controller.
- 6.14.5** All the input variables shall be available to the main controller as well as its 100% hot backup controller so that any failure within the main controller shall not degrade the input data being used by the 100% hot back-up controller and vice-versa.
- 6.14.6** The CPUs shall not be loaded over 60% of the Individual capacity even under worst data loading conditions. Each controller shall have battery backup or NVRAM for program memory.
- 6.14.7** Each of the corresponding communication controllers shall also have same spare capacity as that of controller.



- 6.14.8** For controller, the worst loading condition shall include the following tasks:
- (a) All process inputs scanning and processing is in progress and all the data is transmitted over the main data bus every one (1) second.
  - (b) All closed loop controls in operation
  - (c) All open loop controls in operation
  - (d) All output devices are in operation with rated performance/speed.
  - (e) Control/information request is initiated on all control Operating stations.
  - (f) In burst mode operation (in case of major equipment trip), 100 digital alarms are generated per second for a period of 10 seconds.

**6.15.0 Redundancy implementation**

- 6.15.1** No redundancy at I/O card level is required which are executing purely data acquisition/monitoring functions. No. of channels per I/O card indicated are maximum, which may also further reduced to meet the I/O cards features specified elsewhere in specification.
- 6.15.2** Bidder to note that all I/O cards shall be sourced from their original Principal's works.
- 6.15.3** Each of the triple /dual redundant binary & analog inputs shall be wired to separate input modules, so that even if one input module fails, the signal will be available from the other input module. These redundant modules shall be placed in different racks, which will have separately fused power supply distribution. Implementation of multiple measurement schemes of these inputs will be performed in the redundant hardware. Loss of one input module shall not affect the signal to other modules. Other channels of these modules can be used by other inputs of the same functional group.
- 6.15.4** In all OS, controller card, power supply module shall be redundant and OS shall be fault tolerant.
- 6.15.5** Redundant Data highway shall be provided.
- 6.15.6** Redundant Cooling fans with fire retarded filter for panels/cabinets

**6.16.0 Response Times**

The system shall have adequate speed of response through all regimes of system loadings. The minimum criteria to be ensured are as follows:-

1. Key board command to field equipment shall be executed and its confirmation shall be displayed on the screen within 1 second.
2. The response for operator requested display (time between pressing of last key and appearance of last character on screen) shall be of the order of one to two seconds under all loading conditions.
3. Dynamic parameters in the OS displays shall be updated in one second interval.



The cycle time for open loop and closed loop controls shall be as follows:-

- a) Critical closed loop controls shall be 50 ms.
- b) For non-critical closed loops it shall be max. 250 milli seconds (preferably 150 milli seconds).
- c) For all open loops, sequential interlocks & protection it shall be max. 100 milli seconds.  
(The loop cycle time is defined as the time taken from change at input module to change in output module for command).
4. All analog inputs to CLCS shall be acquired and data base updated within an interval of 50 milli seconds. Data for critical loops shall be acquired & data base updated at a faster rate to suit the requirements above.
5. The digital inputs for SOE shall be monitored at 1 milli- second resolution.
6. The system shall acquire & check all inputs at the input scan rate. If the input is in alarm state (i.e. the input is in an off normal condition) the alarm status shall be annunciated, printed out and displayed within 1 second after the input is scanned.

#### 6.17.0 PLC Configuration

- 6.17.1 The PLC configuration will have a hierarchy of industrial grade open system architecture for Management Information System (MIS) and closed system architecture for plant operation and control system
- 6.17.2 The specification of Peripherals for Operator Station, Engg Station & printers for PLC/microprocessor based system shall be as same as mentioned below.
- 6.17.3 The closed system architecture for plant operation and control system is secure and deterministic system for real time operations of the plant.
- 6.17.4 Industrial grade managed type Ethernet switches with in built diagnostic features, 20% spare ports & redundant 24 V DC power supply shall be provided with control system.
- 6.17.5 PLC Network shall also be provided with external surge protection system and firewall
- 6.17.6 The PLC shall be functionally and topographically distributed, (i.e. the control for 3 similar equipments for eg. Pump A, B and C should be in different set of controllers) highly modular and arranged to reflect the functional grouping of plant equipment and systems to be controlled. This functional group control strategy shall also form the basis for the partitioning of the controller to enhance the system reliability and flexibility. In case of redundant Analogue and Binary Signals, these will be connected to different input modules and different CPU. Similarly whenever inputs are more than one and needs temperature and pressure correction, the same shall be carried out in different CPU. Hence separate PLC hot redundant controllers shall be provided for each functional



system for this package as approved by Owner. Quantities of hot redundant controller shall be finalized accordingly and bidder shall consider minimum 3 sets ( 6 nos ) of hot redundant controllers in their offer.

**6.17.7** All the operator stations will be 'work stations' and are required to reside on the main redundant bus running on IEEE 802.4 or IEEE 802.5 to facilitate determinism.

**6.17.8** Redundant Time Synchronization:

Time synchronization signals shall be provided from redundant Master Clock System for PLC. Bidder to consider necessary provision and cables for the above requirement.

**6.17.9** MODBUS/ Interface Ports

The Bidder shall provide MODBUS TCP-IP / RS 485 Protocol as decided during detailed engineering to interface with other control systems like Plant DDCMIS, UPS system, Numerical relays and any other interface required. The Bidder shall include in his scope the relevant software & hardware for communication with the equipment/systems. Above quantities is minimum & guaranteed by bidder, which shall be finalized as per requirements during detailed engineering. Applications for redundancy & bidirectional shall be decided during Detailed Engineering. In addition HW signal interfacing shall also be provided for any signal required for interlock, control & protection.

The interfacing between two systems shall be effectively immune to the types of electrostatic and electromagnetic interference that can be expected in the power plants. To end this, If the control system is located in different building then the communication link cable shall be through fiber optic cable with necessary EI-Optical converter and de-converter units at both the ends and this special cable are in the scope of the bidder.

**6.18.0** **Technical Specification for PLC**

**6.18.1** PLC should be sourced from original manufacturers; PLC from system house shall not be acceptable. PLC system shall be complete with hot standby redundant CPU of word length of 32 / 64 bits minimum, Input / Output modules, dual serial link interface module for connecting Input / Output Modules, dual Communication Processors, dual Memory modules and redundant Power supply units. Power supply unit shall be redundant for each CPU & I/O rack.

**6.18.2** Redundant CPUs in hot standby mode shall operate on fault tolerant mode with continuous self and cross monitoring facility. Failure of the active CPU shall not adversely affect the operation of the plant in any perceptible way. Failure of the active CPU will lead to transfer of the tasks being performed to the other healthy CPU within fastest possible transfer time (i.e. < 5 msec.) without causing any output to drop during the Transfer period. In the Event of the both the CPU failure, the system shall revert to the Fail-safe mode. The CPUs shall not be loaded over 60% of the Individual capacity even under worst data loading conditions. It shall be possible to switch from the active to the back-up CPU and vice versa from operating station as well from the CPU front panel. (The worst



data condition of PLC means all modules in active mode, printer in operation, OLCS&CLCS logics active and process in running condition). Engineered solutions for redundancy in CPU & I/O cards are not acceptable.

- 6.18.3** The system shall be of modular construction and expandable by adding hardware modules and incorporating them in the address register.
- 6.18.4** The memory unit of the CPU shall be field expandable. The memory capacity shall be sufficient (min. 16 MB) for complete system operation and shall have the capability for future expansion at least to the tune of 40%. The application program / sequence logic etc. shall be stored in non-volatile memory (EPROM). However all the dynamic memories shall be provided with battery backup with at least for 360 hours. Lithium or Ni-cd battery shall be used.
- 6.18.5** The max number of Input / Output points per card shall be as follows:

Analog Input module	: 08
RTD / Thermocouple Analog Input	: 08
Analog output module	: 08
Digital Input module	: 16
Digital output module	: 16

Individual input channels shall have galvanic isolation. Output points shall also have optical / galvanic isolation. Merely fusing of individual or a group of channels is not acceptable. The I/O cards shall be rack or DIN rail mounted. Failure of Analogue I/O cards, binary cards / modules shall also be displayed on the Engineering cum diagnostic station. All electronic modules shall have gold plated connector fingers and further all input and output modules shall be short circuit proof. These shall also be tropicalized & components shall be of industrial grade or better.

- 6.18.6** The data communication system of the PLC including that of its redundant system bus with hot backup and other allied buses such us I/O bus, local bus etc., shall fulfill the following minimum features. The bidder shall furnish all the calculation details of CPU utilization and Bus loading. Bidder shall also furnish communication protocol used for the offered PLC.
- 6.18.7** Communication links between CPU and Input & Output (I/O) modules and between CPU and workstation shall be dual redundant. In no case failure of a link shall affect the control of the plant.
- The communication system design shall ensure that any single point failure on the system bus / media shall not disrupt not more than single message and disrupted message shall be automatically retransmitted after the standby communication link takes over control.
  - Failure or physical removal of any station / modules connected on the system bus shall not lead to any loss of communication.
  - Diagnostics display both at operating workstation and module front end shall be provided for easy fault detection.



- d. Bus change over from active bus to standby bus, during failure of active bus shall be performed automatically and bumpless. Such event shall be suitably logged or alarmed.
  - e. The system communication between PLC module / stations and the operator stations shall be conducted at high speed 100 MBPS with Ethernet based open protocol with no collision feature to avoid data jamming / overloading of the system. The communication bus, serial link etc. shall have adequate protection against electrical noise and mechanical damage.
  - f. System should have open bus structure and should allow further extension facility and connection with any third party system.
  - g. Network shall also be provided with external surge protection system and industrial firewall.
- 6.18.8** Man Machine Interface (MMI) shall be industrially ruggedized Operator's station based on latest window based market available software along with its peripherals like LED monitor, printer, mouse. Engineering functions shall normally be carried out from dedicated workstation. The engineering station EWS shall also be worked as operating station through password / Hardware lock. The monitor refresh time i.e. latency time should be  $\leq$  2 second.
- 6.18.9** The Operator's station shall perform the following minimum requirements. Selection of Auto / Manual, Open / Close operation, sequence auto, start / stop operation etc.
- a. Dynamic mimic display detecting the entire process for control monitoring purpose.
  - b. Alarm monitoring, report generation, logs, calculations and printing of logs, reports, trends etc.
  - c. Online / historical trending, historical storage and retrieval of data.
- 6.18.10** Software provided shall be latest, modular, upgradable and industrially proven. It shall have capability for multi-tasking, multi programming, multi user operation in real time environment and support for third party system. Bidder shall provide the following minimum requirements:
- a. Required software for fulfilling the complete implementation of the control logics, operation displays, logs, data storage, and retrieval, diagnostic and other functional requirements as indicated in this specification.
  - b. Detail documentation on all programming software's and this shall be part of the O & M manual.
  - c. Supply of Licensed version of all software both in edit and run mode with multi – user license. All the third party software should be latest and market available.
  - d. Bidder shall provide and connect suitable communication hardware / software/ cables and other accessories required for connecting all numerical relays as per IEC - 61850 of auxiliary in PLC / SCADA.



e. Bidder shall provide firewall (hardware) in various layers to protect PLC from other network as per ISA - SP - 99.

**6.18.11** PLC shall specifically meet the following requirements:

1. PLC shall have extensive self-diagnostic capability. Self-diagnostics shall include both module level diagnostics as well as channel level diagnostics
2. PLC shall have redundant processors/controllers. This shall mean the fulfillment of the following requirements:
  - i. Automatic synchronization of primary processor/controller of PLC with secondary processor/controller
  - ii. Bumpless switchover to secondary processor/controller of PLC when the primary fails.
  - iii. Automatic program and data equalization in the event of any on-line program / edit executed in the primary processor/controller of PLC.
  - iv. Automatic "Forcing Bit" update in the secondary processor/ controller of PLC when any "Forcing is applied in the primary processor/controller of PLC.

**6.18.12** The Bidder shall have to furnish all technical details including circuit diagrams, specifications of components, etc., in respect of each and every electronic card/module as employed on the various solid state as well as microprocessor based systems and equipment including conventional instruments, peripherals etc. It is mandatory for the Bidder to identify clearly the custom built ICs used in the package. The Bidder shall also furnish the details of any equivalents of the same.

**6.19.0** **Spare requirements**

**6.19.1** The PLC shall be provided with the capacity and capability to handle either 10% additional modules for each type of modules or 10% over and above the specified number of modules connected to the system bus without any additional hardware or software requirements. These additions shall not result in decrease in system response time (i.e. control response time, display response time, SOE resolutions etc.).

**6.19.2** 20% spare relays of each type and rating, mounted and wired in relays cabinets. All contacts of relays shall be terminated in terminal blocks of relay cabinets, additionally in each of the relay cabinets, 20% spare terminal blocks shall be provided so that additional relays can be mounted and wired. In case bidder's system employs marshalling cabinet for all inputs, the spare terminals, fully wired up to marshalling cabinets are also to be provided.

**6.19.3** Wired-in "usable" space for 20% modules in each of the system cabinets for mounting electronic modules shall be provided by the bidder. Empty slots between individual modules/group of modules, kept for ease in maintenance or for heat dissipation requirement as per standard practice of Bidder shall not be



considered as wired-in "usable" space for I/O modules. Field Terminal assemblies, PCB/ Connectors (if any in the offered system), corresponding to the I/O modules shall be provided for above-mentioned 20 % blank space.

- 6.19.4** In addition to this 10% or minimum one no. extra assigned complete spare cards (whichever is more) fully wired mounted in the cabinets for each type of I/O modules shall also to be provided. The spare channel and cards shall be fully wired up to termination cabinets.
- 6.19.5** The spare capacity as specified above shall be uniformly distributed throughout all controller systems. The system design shall ensure that above-mentioned additions shall not require any additional controller/processor/Peripheral drivers in the system delivered at site. Further, these additions shall not deteriorate the system response time/ duty cycle, etc. from those stipulated under this specification and shall meet other redundancy / functional requirement. Above criteria shall be applicable for PLC & any other microprocessor based control system

**6.20.0 System Requirement & Specification**

- 6.20.1** The system shall have high MTBF and shall be hot maintainable. The system hardware shall be designed to be fault avoidant by selecting high grade components of proven quality and properly thermally de-rated design. The system shall have extensive fault monitoring, self- surveillance & on-line self-diagnostic capability so that failure up to module / card level is immediately detected. Each of the modules shall have its self-diagnostic system. The operator station located at the control room shall be used for fault data presentation and monitoring purpose.
- 6.20.2** The system shall have capability to automatically check & correct gain & drift for ADCs on-line.
- 6.20.3** All data exchanged in a bus shall be fully monitored & checked for validity.
- 6.20.4** Following operations will be performed on I/Os, as required:
- a. Square root extraction
  - b. Pressure & Temperature compensation
  - c. Responsibility check of all inputs (analog specially), validate and quality tagging like good, bad, suspects etc
  - d. Channel wise engineering unit conversion.
  - e. Contact bounce filtering with adjustable time constant.
- 6.20.5** All controllers shall be freely configurable with respect to requisite control algorithms. An extensive library of macros shall be included for the purpose adequate software capability shall be provided to implement closed loop control functions as follows:
- a. P, PI, PD and PID control and their variations.



- b. Open loop (On- Off, sequence control)
- c. Cascade control
- d. Ratio control

**6.20.6** For open Loop Controls, the system shall have, as a minimum, the following features:

- a. Logic functions like AND/OR/NOT gates, timers (on-delay, off-delay), shift registers, counters, latches, flip-flops, mono - shots, tantalizers etc.
- b. The automatic sequence control to ensure sequential start up and shut down of auxiliaries / equipment. Sequence control shall be performed in groups initiated by command from operator's console. A sequence shall be made of steps executed in predetermined order according to logic criteria. For each step there shall be a provision for 'waiting time' and 'monitoring time', and it shall output an action on the process. System shall have the capability to bypass one step if desired by the operating personnel by forcing an input or output from the operator's station. Such action however will be registered as an exception or alarm.
- c. Increase the reliability and availability of the plant as a whole, for example, by timely and correct switchover to standby drives etc.
- d. Basic interlock and protection logic related to safety of individual drive and plant equipment. All inputs required for protection system shall be on high priority basis.

In the event of either loss of control power or control signal input to the drive, the drive shall remain in its last position unless specifically required otherwise. The system shall be designed such that no upset occurs either to process or to the drive when the power is restored.

**6.20.7** Interface of the system with M.C.C / Switchgears, and contactors (AC&DC) shall be in the form of potential free contacts via interposing relay modules mounted in the respective switchgear or MCC unit. All other interfacing relays shall be mounted in a separate cabinet or a separate section of the PLC cabinet.

**6.20.8** For AC solenoids and contactors directly driven from output cards, arc suppressors shall be provide across the coil.

#### **6.21.0 Displays**

**6.21.1** Displays shall not be limited to no. of screens as dictated by the bidder. It is bidder's responsibility to develop and establish the displays as per process and complete plant requirement to meet the total satisfaction of the owner and efforts shall be made by the bidder to establish displays till the successful handing over of the system without any cost implication to the owner.

**6.21.2** The operator station shall be responsible for handling all commands as well as generating desired displays, logs, reports, alarms and printouts. Security in different levels shall be provided to prevent unauthorized access to the system.



- 6.21.3** Programming shall also be permissible by drawing ladder or Boolean diagram or through any easily understandable language. Single programming instruction / command shall be sufficient to delete a program rung from memory. Similarly, any rung can be inserted into the existing program. The active and the standby CPU programs shall equalize automatically, once the new program is permitted to 'RUN'.
- 6.21.4** Updating time and reaction time (system's response to an operator's command) shall be provided for operator station as follows:
- a. Calling up a mimic : 1 sec or better
  - b. Updating status signal in mimic : 1 sec or better
  - c. Updating variables in a mimic : 1 sec or better.
  - d. Issuance of command to output : 2 sec. or better  
(without considering travel time and process lag)
- 6.21.5** Programmable Controller shall be responsible for real time process Parameter monitoring, storage and display. Basic requirements are (i) Operator Interface, (ii) Basic Calculation, (iii) Alarm Monitoring & Reporting, (iv) Display generation, (v) Logs, (vi) Trend Recording & (vii) Historical Storage & Retrieval.
- 6.21.6** The displays at the operator console shall be classified into overview Display, group display, point display, alarm display and trend display.
1. Overview display
    - This display is to enable the operator to set an overview of the entire plant section.
  2. Group display
    - The group display page shall display several sub-sections & present status information.
  3. Point display
    - Along with the specified parameter value, this page should indicate historical trend of the parameter.
  4. Trend display
    - This display include real time/historical trend display facility including Dynamic Graphic Display & Bar Graph Display.
  5. Alarm Message Display
    - It shall be possible to display process as well as system and diagnostic alarms for operator's attention and action. Alarm shall appear immediately on the operator station as and when they occur on priority basis. In addition to alarms appearing on displays, the system shall also be able to display alarm summary and alarm history listing the date and time of occurrence, tag number, point description, type of alarm (absolute



value or deviation), serial number of alarm in the sequence of occurrence etc. Alarm shall disappear from display only when they are acknowledged and cleared. Any abnormal condition in any sub-system or any other function devices shall be displayed as system alarm message on the operator console irrespective of display selected.

- 6.21.7** The system shall print the following logs as minimum as defined in the following clauses. The printing of these logs shall be initiated automatically at prescribed time intervals, or initiated on demand by the occurrence of predefined events.

**6.21.8 Shift/Daily Log**

A Shift/daily log shall be provided to furnish data for routine analysis of plant performance. This log shall be automatically printed at specified time each day and on demand at any time.

**6.22.0 Salient hardware / software features of the PLC system**

- 6.22.1** The salient hardware / software features of the PLC system for I/O handling shall be as follows.

- i. Input filters to attenuate noise.
- ii. SWC of 500V DC common mode and 500V AC peak to peak
- iii. Comm. mode noise rejection for analog inputs of 120dB at 50 HZ
- iv. Normal mode noise rejection for analog inputs of 60 dB at 50 HZ
- v. LED indicators on each card to show status of input
- vi. All the outputs shall be with individual fuse.
- vii. K-type thermocouple mV input where applicable.
- viii. Pt-100 four wire resistance thermometer input where applicable.
- ix. 24V DC power supply to field mounted two wire transmitters.

- 6.22.2** The salient hardware / software features of the CPUs as follows:

- a) Watch dog timer : periodical reset, alarm and interruption, if not reset within stipulated time.
- b) Max. Scan time for I/Ps : 1 sec. max.
- c) Maximum Scan Rate : 2.5 m.sec (per K word)
- d) Memory Capacity : 40% spare capacity after full utilization  
Expandable in multiples of 16K.



- e) Comm. Processor : Integral / Separate
- f) Battery backup for RAM : Ni-Cd / lithium type, at least for 360 hrs continuous Operations during power failure.
- g) Diagnostic feature : Periodic, automatic, self-diagnostic. Result available at the Operator's Station.

#### 6.22.3 Input / Output Modules:

Bidder to note that all I/O cards shall be sourced from their original manufacturers. Indigenous cards shall not be accepted. No. of channels per I/O card may reduce to meet the I/O cards features specified in the specification. The salient features of the Input / Output modules are as follows: Time stamping for SOE signals shall be at card level.

##### All I/O Cards

- 1. Ambient temp. : 0-50 deg.C
- 2. Surge withstand capability : IEC-255.4

##### a) Digital General

- 1. No. of channels / card : 16 max
- 2. Interrogation voltage : 24/48 VDC
- 3. Status Indicator : LED Type/channel
- 4. Isolation : Optical (channel to channel)

##### b) Digital Input Module

- 1. Contact bounces filtering : Adjustable time constant of 15m.sec.
- 2. Self-Diagnostic : Wire break, Short Circuit, Module fault

##### c) Digital Output Module

- 1. Output protection : Short ckt protected and individual fuse
- 2. Self-Diagnostic : Module fault

##### d) Analog General

- 1. No. of channels/card : 8 channel max.
- 2. Isolation : Galvanic/Optical (channel to channel)



3. Status Indicator : LED Type/channel

**e) Hi-Level Analog Input Module**

1. Type of input : 4-20mA DC & 1-5VDC
2. A/D Converter : 16 bits + Sign (or better)
3. Accuracy :  $\pm 0.1\%$  or better
4. Diagnostic : A to D / Channel fault, Short circuit, wire break
5. Power of transmitter : 24 V DC 2W type

**f) Low Level Analog input Module**

1. Type of output : PT-100; T/C (As required)
2. C-J-C : On Module
3. Accuracy :  $\pm 0.1\%$  or better
4. A/D converter : 16 bits + sign (or better)
5. Diagnostic : A to D / Channel fault, short circuit, wire break

**g) Analog Output Module**

1. Type of output : 4-20mA DC
2. Accuracy :  $\pm 0.1\%$  or better
3. Load : 600 Ohm
4. Diagnostic : Channel fault

The maximum number of channels with LEDs indications that can be provided in a single module shall be:

1. Digital input module/ Digital output module - 16
2. 4-20mA Analog input modules - 8
3. Thermocouple / RTD input module - 8
4. Analog output module - 8

Input/output modules shall have the following features:

The functions performed on digital inputs shall include:

1. Signal isolation (optical)



2. Fuse protection & monitoring
3. Short circuit protection
4. Contact bounce protection
5. Contact monitoring for trip and causes of trip inputs
6. Contact interrogation at 24/48 V DC
7. Configurable as status input, latched input or pulse input
8. Direct or reverse sense
9. Alarming of abnormal state

Digital outputs shall have the following characteristics:

1. Individually fused
2. Individual contact suppression
3. Configurable as momentary, latched or pulse- width modulated outputs
4. Individually definable default state
5. Output read back verification
6. Short circuit protection

Analog inputs can be 4-20 mA DC, RTD, thermocouple. A/D converter shall have a minimum resolution of 12 bits. Functions performed on analog inputs shall include

1. Signal isolation (Galvanic/opto coupling)
2. Fuse protection and fuse failure detection
3. Transmitter power supply at 24V DC
4. Input filtering for noise level
5. Cold junction compensation for thermocouples
6. Transmitter monitoring for parity, wire break, live zero and end limit values
7. Monitoring of A/D conversion
8. Test for substituted value
9. Conversion to engineering units
10. Test for normal or extended range
11. Detection of open circuit for thermocouples
12. Alarm limit testing for high, low, high high and low low substituted values
13. Rate of change - positive and negative dead band
14. All analog signals fed to the control system shall be acquired and validated.

Analog outputs shall be 4-20 mA DC with the following characteristics:

1. Direct or reverse operation
2. D/A per output and power regulator per output
3. Loop check back of output
4. Default options upon failure
5. segment output characterization
6. Go to zero current

#### 6.23.0 Specifications for Operator Station, Engineering Stations

Each operating station & Engineering work stations and any other work stations/PC envisaged in plant shall meet following minimum requirements & as per latest trends at the time of supply:



- On board Intel – Xeon quad core, 3.46 GHz processor with 1066 MHz bus with Hyper threading or higher
- 4GB DDR3 RAM (min.)
- 1 x 500 GB IDE Hard Disc Drive of 7200 RPM or higher
- 1024 MB Graphic Accelerator
- System chipset - Intel
- 2 x RS - 232 ports
- 1 x parallel port
- 4 nos. USB ports. (2nos. on front side)
- 1 x 52X CD R/W Drive & 16 X DVD Drive
- 2 x Ethernet (10 / 100 / 1000MB) cards (Industrial Grade)
- UXGA graphics and monitor 1920 X 1080, 256 colours with MRPII compliant, viewing angle 178° vertical & Horizontal and fastest response time.
- 1 x windows latest & proven version of Windows OS with Multimedia
- Ethernet adapter
- Third party operating system, graphical users interface and software, if required.
- Optical mouse
- Sound card
- Internal speakers
- Wireless internet & Blue tooth Interface
- Redundant power supply (In built)
- General MS Windows latest, MS-Office Professional, Adobe
- Acrobat, anti-virus McAfee or equivalent, etc.
- Application engineering & HMI software - to suit project Specific requirement
- All OWS shall be interchangeable
- Regular timely Updation of software & Anti-virus.

#### **7.0.0 PERIPHERALS FOR OPERATOR STATION, ENGINEERING STATION & SERVER SYSTEM**

##### **7.1.0 Full flat Monitors with LED back lighting**

**7.1.1** The **bidder** shall furnish OS/ES/LVS PC with colored full flat monitors with LED back lighting. OS/ES/LVS PC with monitors shall have a fast cursor control device like a track ball/optical mouse. All monitors shall be of high resolution colour graphics type and with not less than 32 colours. The picture frequency shall not exceed 85 Hz. The resolution required is 1920 X 1080 pixel or better. The picture shall be stable and completely free of any flickering. The screen illumination shall be enough to give good readability. The screen dimensions shall not be less than 27" screen diagonal.

**7.1.2** Antiglare hard coating shall be provided. High reliability and long life 27" (Industrial type) or better size monitors shall be supplied by the bidder. Monitors shall be equipped with all adjusting elements accessible on the front plate. Monitors with 3D capabilities for graphics shall be provided by bidder.

**7.1.3** Monitors along with keyboard & optical mouse shall be mounted on supervisory control console specified elsewhere in the specification.



#### 7.2.0 Key Board

- 7.2.1 Functional key boards for plant operator station shall be of special type adapted to operation tasks and monitor functions. It shall contain all keys necessary for plant operation arranged in an ergonomically manner. Multi- function keys shall be provided with automatic display for modified functions. Freely programmable keys (Minimum 101) shall be available for special user application.
- 7.2.2 Key Board shall be integrated into supervisors control consoles horizontal part.
- 7.2.3 Provision of functional keyboard shall be in addition to facility for operator control through mouse/track ball.
- 7.2.4 Membrane type keyboard shall be provided for operator interface with process for plant control and display functions to access plant data in conjunction with control operating stations. Membrane keypad shall be assignable with LED alarms, dedicated display selection keys with spare provision, hardware locking facility to set operating station in engineer, supervisor or operator mode. The keyboard shall have a minimum of 101 configurable keys for assigning most frequently used displays. A minimum of forty of those keys shall have two independently lit LED's used for event-specific alarm annunciation.
- 7.2.5 Keyboard shall be provided to enable the shift supervisor to develop graphic displays, control system software and system configuration for the PLC. It shall be possible to perform operating interface functions from engineering station. Assignable function keys shall be provided for execution of command, program etc. hardware facility shall be provided to set operating station in engineer or operator mode. QWERTY type keyboard shall be provided for engineer's functions. QWETRY type Key Board may be offered alternatively for OWS.

#### 7.3.0 Printers

##### Laser Jet printer

Printing Speed	26 ppm (min)
Resolution	1200 X 1200 dpi Memory 128 MB (min)
External Port	1 no USB 2.0 port, and TCP/IP 10/100 Ethernet, Blue tooth interface
Duty Cycle	15,000 pages per month
Pages size	A4, A3, and Transparency etc. with automatic duplex printing facility. Paper tray – 2
Noise level	Below 50 DB

#### 7.4.0 Hard Copy Facilities

The system shall be capable of copying hard copy of Operating station graphics through a video colour copier switch able to any operating station. The printer / copier offered shall be capable of copying operating station image in 20 seconds.



#### 7.5.0 DVD Writer

Engineering & Supervisor station shall be provided with DVD writer. The DVD writer should be capable to read and write any DVDs as well as CDs and shall be provided with all required hardware interface including error detection and correction. The DVD writer shall meet following minimum requirements:

DVD write speed : 16x  
CD write speed : 24x  
Cache / Buffer size : 2MB  
Buffer under protection technology

#### 7.6.0 Laptop

The Laptop shall be of latest specification and shall meet the following minimum requirements:

- Intel Centrino Mobile Technology.
- Intel Core - i7 Processor with 3.46 GHz, 4 MB L2 cache, 1066MHz
- FSB.
- 17" WXGA LED Screen with wide angle viewing.
- 320 GB 7200 rpm HDD with shock absorber.
- 4 GB 800 MHz DDR3 SDRAM (slot for 1no. additional RAM slot should be provided)
- 1 x windows XP Professional or latest & proven version of Windows OS with Multimedia
- Slim type DVD-RW/DVD ROM combo drive.
- Internal 10/100/1000Mbps Ethernet card
- IEEE 802.11B connectivity port
- IR port
- Optical mouse
- 2Nos. USB ports & Wireless INTERNET & blue tooth interface
- External mouse connectivity and optical mouse
- Minimum 8 hrs battery backup.
- Recovery software tools.
- Sound cards
- Internal speakers
- General MS Windows latest, MS-Office Professional, Microsoft
- Visual Studio, Adobe Acrobat, anti-virus McAfee or equivalent, etc.
- Application engineering & HMI software - to suit project specific requirement

#### 7.7.0 Software License:

- a) The Bidder shall provide software license for all software being used in PLC / any other electronic/microprocessor based system. The software licenses shall be provided for the project (e.g. Organization or site license) and shall not be hardware/machine-specific. That is, if any hardware/machine is upgraded or changed, the same license shall hold good and it shall not be necessary for Owner to seek a new license/renew license due to upgradation / change of hardware / machine in PLC / any other electronic/microprocessor based system at site. All licenses shall be valid for the continuous service life of the plant.



- b) All statutory compliances, licenses, NOC's & certificates shall be in bidder's scope as such these will be arranged by the bidder & handed over to the Owner.
- c) In case the s/w license is dependent on no of points, then quantity to be considered is 30% above the finally implemented points.
- d) Laptop shall be provided with all master software loaded and engineering of PLC & any other control system. Similarly additional laptops shall be provided with all master software loaded and engineering of PLC system. One no. Laptop with necessary master software loaded for the control System shall be supplied individually.

#### 7.8.0 Software Upgrades

For Owner support, the Bidder shall periodically inform the designated officer of the Owner about the software upgrades/new releases that would be taking place after the system is commissioned so that if required, same can be procured & implemented at site.

#### 7.9.0 Software Documentation and Software Listings

All technical manuals, reference manuals, user's guide etc., in English required for modification/editing/addition/deletion of features in the software of the PLC /any other microprocessor based control system shall be furnished. The Bidder shall furnish a comprehensive list of all system/application software documentation after system finalization for Owner's review and approval.

#### 7.10.0 Programming, Diagnostic and Engineering Work Station

7.10.1 The Engineering stations provided with PLC shall have all the function of programming/ configuration/modification/ reconfiguration and documentation. The features and facilities to be included are as under:-

- Configuration or re-configuration of a system.
- Possibility to introduce or modify parameters.
- Documentation of system configuration.
- Calculation program functions.
- Graphic editing program.

7.10.2 This work station shall be able to design, configure, monitor document or trouble shoot the process activities as desired.

7.10.3 The work station shall be used for designing and redefining control strategy, configure system modules, modify the configuration, build and implement computing logic's, alarms and display functions, save and retrieve system configuration schemes, monitor process variable, tune or adjust process parameters, display and trend information, produce system documents etc. The station shall be able to produce generic logic control drawings, configuration drawings etc.



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- 7.10.4 Control engineering software system shall include text, computer aided design, ladder diagrams, logging data base, graphic package etc.
- 7.10.5 Combined with a printer, the engineering station generates logic control drawings configuration drawings, module list, specification list, and function blocks for cross reference list.
- 7.10.6 Engineering station shall have capability of online and offline program modification without affecting the performance of the system / process. While online, connected to process, the engineering station shall provide real time tuning and trouble shooting. On offline, the engineering station allows control system configuration.
- 7.10.7 The proposed work station can be used to implement or redefine process control strategy for control computing, logic, alarm, list display of process functions. In addition, the station shall have elaborate facility for diagnostic functions.
- 7.10.8 The diagnostic station shall assist in detection of system faults and malfunctions and faults in field inputs along with identification of their locations. It provides automatic display and recording of such disturbance and thereby enhances the system availability. Sensors, binary switches, transmitters, input/output processing modules, controllers, peripherals and multipurpose bus communication system etc. are fully and comprehensively monitored. For this purpose all processors, modules etc. shall have self-diagnostic features and disturbance shall be communicated to central diagnostic station. All failures, anomalies and missing functions shall be automatically detected, alarmed & displayed with clear text, showing the exact origin and the kind of failures. The failure shall also be signaled at concerned equipment.
- 7.10.9 Detailed information of disturbance message shall be displayed in engineer's OS and printout. Typically an engineer's OS shall also have facility to windows for progressive detailing of diagnostic information wherein a permanently displayed window for plant diagnostics shows disturbance of the over-all system level. By activating a cursor/key a station diagnostic window is opened to show the details of station with all installed equipments. The diagnostic data for an item of equipment identified as disturbed can be called up for subsequent windows and finally the last window can be opened to obtain information such as type, location and possible causes of disturbance and suggestion for its rectification. Any alternative method of diagnostic display is also acceptable, which provides the detailed information during disturbance.
- 7.10.10 The system shall have extensive diagnostic software to identify all failures up to card level as well as field inputs. This shall include failure of power supplies, I/O cards, peripherals controllers etc. Failure of analogue I/O cards, binary cards / modules shall also be displayed on the engineering cum diagnostic station. The alarms regarding major subsystems shall be displayed on the alarm OS. Further details shall be available on the engineer's/ programmer's OS in form of a graphic and in other display formats. The field input faults/ failures shall be reported with nature and type of fault/failure clearly identified.



## 7.11.0 Communication Network Bus System

### 7.11.1 Bus System and Data Highway Characteristics

#### 1) Bus System

Basically two types of bi-directional bus systems shall be envisaged.

- a) Remote bus system to communicate between stations by use of co-axial cable or fiber optic cables. Industrial grade managed type Ethernet switches within built diagnostic features, 20% spare ports & redundant 24V DC power supply shall be provided with control system.
- b) Local bus to communicate between the different modules/cards of the same station/system and extensions.
- c) The bus system shall have the following features.
  - Redundancy in the system for high reliability of communication. The redundant buses work continuously. All bus couplers; bus interfaces etc. shall also be redundant.
  - Insensitivity against external disturbances, noises etc. Insensitivity of a fault in one bus system to other bus system.
  - High data transmission rate to communicate with the system response requirement.
  - Availability of information of all modules at each point of the system. The characteristics of the local bus (I/O Bus / Peripheral Bus) and control bus (Data highway) shall be as follows or better:

#### 2) I/O Bus / Peripheral Bus / Local Bus / Cubicle Bus

- Redundant : yes
- Transmission rate : 10 Mbps or better
- Transfer procedure : SDLC
- Control : Master-Slave
- Data Protection : 16 bit CRC

#### 3) Control Bus (Data Highway)

- Redundant : yes
- Transmission rate : 100 Mbps or better
- Control : Master less Token Passing
- Transfer procedure : SDLC
- Data Protection : 16 bit CRC
- Proprietary Bus : yes
- Ethernet,TCP/IP : No
- Standard : IEEE 802.4.

### 7.11.2 Industrial Ethernet Bus for MIS (To make the System Open)

- Redundant : Yes
- Transmission rate : 1GBPS (min.)



### 7.11.3 Highway Characteristics

Communication between the operator station and the functional groups of control microprocessors shall be by means of redundant data highways. The system shall be fully operational with one highway out of service, with no degradation in performance. The data highways shall be effectively immune to the types of electrostatic and electromagnetic interference that can be expected in the power plants. To end this, fiber optic highway is preferred. If the bidder does not supply a fiber optic highway, he must state, in detail, the precautions which must be observed in installing the highway in order to immune interferences and shall also state whether precaution must be observed to avoid ground loops due to differences in ground potential throughout the plant.

The protocol employed will be the Bidder's standard provided that it meets the following requirements.

- No single failure will prevent the orderly and timely transmission of data.
- Check before execute will be employed for all changes in plant status transmitted over the data highway. As a minimum this will include set point changes, control drive bias changes, transfers between automatic and manual, changes in control drive positions, open and close instructions.
- In case of failure of any station on the highway or its physical removal, shall not interrupt communication of other stations.
- Both redundant highways shall operate at all times. There shall be no need to "fail over" and initialise to a standby cable. Diagnostics to check the status of both the highways will run continuously. Failure of a data highway or one of the stations of the highway shall be alarmed and reported on the appropriate video screen display.
- The data highway transfer rates shall be a minimum of 100 mega baud.
- Hot repair capability of the highway shall be furnished

The communication network shall have the possibility of adopting "open architecture" to enable the user to get the benefit of flexibility in choosing hardware & software. Network shall also be provided with external surge protection system and industrial firewall.

### 7.12.0 System Grounding

- i) The automatic control system shall be designed for grounding to the station ground mat at a single connection point. Insulated ground bus from this point shall be furnished to the control logic cabinets and shall be connected to an insulated copper grounding strap in each cabinet. The control panel and local instrument cabinets shall be grounded to the station ground mat.
- ii) Shields on electronic cables shall be grounded as required. When shielding terminations are required in cabinets furnished under this specification, suitable terminals and supports shall be furnished.



- iii) The control logic cabinets shall be equipped to accept the single point system ground, which at this point will be isolated from the building ground. Any internal component grounds or commons shall be connected at the system ground, which shall be kept isolated from the building ground.
- iv) Any required electrical ground or common from components not mounted in the control logic cabinets shall be brought to a terminal block connected within the component. This terminal block connection shall be located with the other terminals and shall be available from connection through the shield of the field wiring to the system ground specified within the logic cabinet. Isolation from building ground and case ground shall be inherent in the component design.

## **8.0.0 VIBRATION MONITORING AND ANALYSIS SYSTEM**

### **8.1.0 General**

- 8.1.1 The vibration monitoring and analysis system shall provide critical analysis of health of rotating machines on continuous on-line basis and shall guide the plant maintenance personnel regarding the nature of fault and the maintenance action required.
- 8.1.2 The system to be provided shall include all necessary hardware, software, firmware and interfaces, all special and field signals cabling required for implementing a fully functional system. Bidder's offered system shall include but not limited to the details specified in subsequent paragraphs.

### **8.2.0 Design Requirements**

- 8.2.1 The vibration monitoring and analysis system shall provide condition monitoring and analysis of the bearings of all critical machines, equipment's with HT drives and their driven equipment and shall comply with
- 8.2.2 VMAS system shall comply strictly with API 670 (latest edition).
- 8.2.3 The vibration monitoring and analysis system shall be complete with velocity type vibration sensors, signal conditioning cards, amplifiers, special cables, vibration monitor (if required) etc. together with all necessary equipment and accessories.
- 8.2.4 Vibration sensors shall be provided for measurement in both X (horizontal) and Y (vertical) axis at 90° angle to each other for each bearing i.e. for DE and NDE of both motor and its driven equipment side.
- 8.2.5 Vibration sensors shall be provided for Key phasor measurement.
- 8.2.6 For bearings of high speed machines (= / >1500 rpm) accelerometer type sensor and for low speed machines (<1500 rpm) velocity type sensor shall be provided. Necessary, one or two stage integrators for obtaining vibration measurement in terms of displacement shall be provided in the system.



- 8.2.7** Vibration pickup shall meet the following requirements:
- Pick-up sensitivity-Minimum 4 mv / mm / second
  - Enclosure protection- IP 65
  - Pickups suitable to function in temperature range of (-) 10° to (+) 200° C.
- 8.2.8** Vibration monitoring system shall provide the vibration measurement in the form of 4- 20 mA and PF contacts (Alarm and trip) to be directly connected by hardwired cable to plant PLC for monitoring.
- 8.2.9** Vibration monitoring and analysis system shall be an independent microprocessor based system (PC based). The system for the plant equipment shall be interfaced with PLC system through redundant communication link. The system shall interface with plant PLC for any process signals which may be required to perform condition monitoring functions through soft link.
- 8.2.10** Vibration analysis system shall be knowledge based with the capability of dynamic data analysis and provides complete information about machines. This will include machinery management software including analysis of generator overhang for data acquisition and predictive maintenance.
- 8.2.11** The vibration analysis system shall be able to carry out the following tasks:
- 8.2.12** To determine the exact nature of fault in the rotating machines like misalignment, shaft crack, bearing looseness, dynamic un-balancing of rotor etc. indicating the magnitude of vibration and phase angle information and the corrective action to be undertaken by maintenance personnel. For example, in case of dynamic un-balancing of rotor, the system shall provide the guidance about the approximate mass needed to be added to the rotor with the direction information.
- 8.2.13** To provide the guidance about predictive maintenance requirement of the machines. Predictive maintenance requirement guide shall also include the "Period of safe operation of machines available at any given point of time."
- 8.2.14** The analysis system shall be able to carry out the following types of analysis to meet the tasks of analysis system detailed above. The system shall not require the intervention of vibration expert to determine the nature of the fault:
- 8.2.15** On line spectrum/harmonic analysis of the vibration measurements.
- 8.2.16** The system shall have facility to generate and analyze the following:
- Bode Plot
  - Time wave form
  - Orbit Analysis
  - Shaft centerline
  - Cascade Plot
  - Water fall



- g) Bar graph
- h) Current values
- i) Spectrum
- j) Alarms - amplitude and spectral
- k) Data collection during start up and coast down
- l) Operating point for pumps and fans

- 8.2.17** The analysis software should be capable of outputting direct message on video monitor of the exact nature of fault.
- 8.2.18** The system shall have facility to store bulk data for 5 years duration with facility for retrieval of the same. The system shall have facility to share all the data in the hard disk/ back up media and provide user friendly utilities to retrieve and analyze stored data.
- 8.2.19** The system shall be provided with redundant UPS power supply. The power supply provision shall be such that on failure of one power supply the other power supply shall cater to the requirement of the equipment so as never to hinder the functioning of the system in any manner due to power supply failure.
- 8.2.20** The system shall be time synchronized with Plant redundant time synchronization system for time stamping.
- 8.2.21** Provision for removal and online replacement of module shall be possible to be carried out, when the system power is ON Condition.
- 8.3.0 VMAS Hardware & software**
- 8.3.1** Vibration analysis system for plant shall include all hardware and software as required for proper functioning of the system including but not limited to the following:
- a) One (1) no Server (With PC, LED display, Keyboard /Mouse ) cum operator station.
  - b) Vibration analysis software with all relevant users' license.
  - c) Server & User PCs operating licenses with screen size of 27" or more.
  - d) Bulk data storage and retrieval facility
  - e) Redundant softlink link with all necessary hardware and software.
  - f) Time synchronization with Plant master clock system.
  - g) System cables etc.
- 8.3.2** All software user licenses shall be valid for entire life of power plant. User should not have to pay any recurring license fee during the usage period of the system.
- 8.3.3** It shall be possible to upgrade the installed system with the latest available version of the software model during the plant life.



#### 8.4.0 Design data

##### 8.4.1 Server Cum Operation station Unit

Enclosure	: 6U Rack Mountable server / Tower type Server
Processor	: Intel Xeon Quad (4) Core 64 bit Processor capable 3.6 GHz with 16MB L3 cache memory per processor, Dual independent 1333 MHz System bus (2 way SMF) or better.
Memory	: 64GB ECC DDR - 3, 800 SDRAM
Video	: Integrated with 64MB SDRAM
Resolution	: 1920 x 1080
Drives	: HDD - RAID 5 (1 TB) Ultra 320 SCSI adaptors with internal storage capacity 3.6 TB DVD/CDROM - 24X CD - RW/DVD IDE combo USB - 4 ports DAT - 36 / 72 GB
Peripherals	: PS/2 keyboard Optical Mouse
Operating system system	: Latest & proven version of Windows Operating
Backup & Disaster Recovery	: VERITAS \ CA \ Tivoli \ any other
Environmental	: Operating Temp range - 10°C to 35°C Humidity range - 8 to 80% (Non-Condensing) Vibration 0.25 G at 3 to 300 Hz for 15 Minutes.
Software	- General MS Windows latest, MS-Office Professional, Adobe Acrobat, anti-virus McAfee or equivalent, etc. Application engineering & HMI software - to suit project Specific requirement
Miscellaneous	: i. 1 Parallel port ii. 1 Serial port iii. 4 - 10/100/1000 MB/1GB network ports iv. Two non-boards and two added v. External SCSI port vi. Dual hot plug power supplies



- vii. Dual Hot plug fans
- viii. 2 PCI Express slots (1x4 lane and 1x8 lane)
- ix. 2 PCI X slots (64bit/100MHz)
- x. 2 PCI slots (one 32bit/33MHz, 5V & one 64bit/66Mz)
- xi. Redundant Server shall be provided,
- xii. LED based 24" sized Monitors.

#### 8.4.2 System Implementation

The system shall be delivered fully implemented and shall be user tested at site. It is the contractor's responsibility to demonstrate the proper functioning of the system to user's personnel.

#### 8.5.0 Testing Requirements

**8.5.1** A 100% integrated system simulation test shall be carried out in the package vendor's shop to test all hardware and software.

**8.5.2** The FAT (Factory Acceptance Test) and SAT (Site Acceptance Test) shall be carried out as per final approved drawings / documents.

#### 8.5.3 Test requirements as follows:

- a. Test shall be performed with the completely assembled system and also with complete monitoring and analysis software and performing all functions expected out while in actual service and with VMAS configuration as finalized.
- b. Process input / output conditions and other load on the system to be stimulated either by hardware / software.
- c. All system software & application software to be loaded and operational on the system prior to FAT refer relevant sections.
- d. The complete system shall be examined at the factory for workmanship, assembly and FAT, mechanical safety, materials, wiring, connections, parts, finish, operation and strict conformance to this specification and approved design layouts and detail drawings. All tests including functional tests shall be conducted as per relevant Indian/ International standards and this specification.

#### SAT (Site Acceptance Test)

All tests as per FAT have to be repeated at site after commissioning using the real time data.



## 9.0.0 FIELD AND MEASURING INSTRUMENTS

### 9.1.0 General Requirements

- 9.1.1 Instruments, control devices and other equipment accessories covered under this specification shall be furnished in accordance with I&C specification sheets and drawings enclosed herewith and the requirements of all applicable clauses of this specification.
- 9.1.2 The Instrumentation and Control equipment shall conform to all applicable codes and standards. All equipment and systems shall also fully comply with the design criteria stated.
- 9.1.3 The Instrumentation & Control equipment and accessories shall be from the latest proven design for which the performance and high availability have been demonstrated by a considerable record of successful operation in power station service for similar applications. The bidder shall furnish sufficient evidence to fully satisfy the Owner in this regard.
- 9.1.4 The Bidder shall furnish all Instrumentation & Control equipment and accessories under this specification as per technical specifications, ranges, makes and model numbers approved by the Owner during detailed engineering.
- 9.1.5 All instruments, devices and accessories furnished by the Bidder as per this specification shall be designed and constructed to perform normally and meet all guarantee when subjected to the environmental and service conditions and other applicable specification documents.
- 9.1.6 The necessary root valves, impulse piping, drain cocks, gauge zeroing cocks, valve manifolds and all other accessories required for mounting/erection of all local field instruments shall be provided by Bidder as per approved hook up drawings.
- 9.1.7 In general front draw out type instruments with plug-in facility at the rear for connecting flexible cables for power supply and signal shall be provided. Separate plugs shall be provided for connecting power supply and signal wires.
- 9.1.8 The plug & sockets shall be polarized to prevent wrong connections and have facility for secure coupling in plug-in position to prevent loose connections.
- 9.1.9 Every instrument requiring power supply shall be provided with a pair of easily replaceable glass cartridge fuse of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.
- 9.1.10 All field instruments shall be weatherproof, drip tight, dust tight and splash proof suitable for use under outdoor ambient conditions prevalent in the subject plant. All field-mounted instruments shall be mounted in suitable locations where maximum accessibility for maintenance is achieved. The enclosures of all electronic instruments shall conform to IP-65 unless otherwise specified (Explosion proof for NEC class 1, Division 1 area) and an anti-corrosive paint



shall be applied to the field mounted enclosures / instruments. All the field instruments shall also be provided with SS tag nameplate and double compression type nickel-plated brass cable gland. Gaskets, fastener, counter and mating flange shall also be included wherever required with instruments.

#### **9.2.0 Minimum Requirement of Field Instruments**

**9.2.1** Following minimum requirement of field instruments shall be fulfilled by Bidder (In addition, Redundancy criteria for instruments shall be as specified elsewhere in specification): -

- 1) Level Transmitter, Level switches for very high / high / normal / low / very low interlocks (type as per Owner approval).
- 2) Tapping points/test points shall be provided.
- 3) All Thermocouples & RTDs shall be Duplex.
- 4) All Field Instruments used in acid or alkaline atmosphere shall be with standard anti-corrosion coating i.e. the combination of polyurethane and epoxy resin baked coating (ANSI/ISA-71.04).
- 5) All primary instruments installed at "Minus level or Floor" shall be with protection class of IP 68.
- 6) Transmitters (all type) as on required basis for monitoring interlocks & controls as per redundancy criteria.
- 7) 6 no. duplex or 12 no. simplex embedded temperature detectors for various motor stator windings and duplex RTDs for motor/pump bearing temp.
- 8) All field mounted push button, selector switch etc. shall be as per IEC or NEMA 4X protection.
- 9) All limit switches shall be conforming to IEC-60947-5-1.
- 10) For all instruments envisaged for sea water applications, they shall be provided with wetted parts of Monel / Hastelloy C.
- 11) Primary Elements: Flow nozzles shall be made of stainless steel, with three sets of pressure taps installed in the pipe wall where required. Installation of flow nozzles and pressure taps shall be made in the pipe
- 12) Paddle type orifice plates shall be used for other flow measurements where flanged construction and higher pressure loss are acceptable. Orifice plates shall be made of stainless steel. Orifice flanges shall be of the raised face weld neck type with dual sets of taps.
- 13) Construction and installation of flow nozzles and orifices shall conform to the requirements of ASME Performance Test Code PTC-19.5, and discharge coefficients shall be predicted in accordance with data published in ASME Research Report on Fluid Meters.



- 9.2.2** Above are the min. requirements, however actual quantities shall be as decided during detailed engineering based on redundancy criteria. Other pressure gauges for systems shall be decided during detailed engineering.
- 9.2.3** It is envisaged to use separate instrument / switches for initiation of interlock and trip circuits. The proposal shall include adequate number of pressure, differential pressure, level, flow and temperature switches to meet the systems functional requirements. Where blind type of pressure, differential pressure and flow switches are employed, the necessary provision shall be made for connection of test gauge. All switches shall be provided with snap action DPDT contacts and shall be equipped with plug in type connections for terminating field wiring.
- 9.2.4** Switch actuation point shall be field adjustable with a calibration scale to indicate the set point. Switches shall have capacity of 5.0 amps at 240V AC or 0.5 amps at 220V DC. Level switches for general service shall be float type. Float material shall be stainless steel SS316.
- 9.2.5** Thermowells, sight-flow indicators, level gauges etc. shall be of a reputed make and type and shall be subject to the Owner's approval. The switches should be of type designed for alarm and interlock purposes. Thermometers and pressure gauges with contacts attached to perform these functions will not be acceptable.

Field instruments shall be supplied & offered as per data sheets specified below:

**9.3.0 Transmitters, Switches, Gauges and Panel Mounted Instruments**

- 9.3.1** Pressure, Differential Pressure, Level and Flow Transmitters (PT, DPT, LT & FT)
- a. Smart Transmitters of the electronic type shall be furnished.
  - b. Transmitters shall be equipped with mounting brackets suitable for a mounting in transmitter enclosures.
  - c. All supplied field instruments are HART compatible, Therefore HART calibrator is required for calibration.
  - d. In general, Transmitters are envisaged to be grouped at several places as to be decided during detailed engineering stage. For this purpose, suitable enclosures complete with all tubing, fittings, purge meters, loop cable trays etc. shall be provided.

**Type/Construction** : Sealed capacitance/ Inductance/ Silicon resonance type

Material

Body : Die cast Aluminum with epoxy coating for air & flue gas  
SS316 for other services

Diaphragm : 316 SS



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Measurement element	: Teflon seal
Valves	: Carbon steel for non-corrosive Applications SS316 for corrosive applications.
Output signal	: 4 to 20 m Amp. DC (Two wires) HART Compatible
Local Indicator	: LCD indicator (5 digit) with scale of Engg. Unit
Overall Accuracy	: $\pm 0.075\%$ or better of FSR
Turn down ratio	: 10:1 for vacuum / very low pressure application 30:1 for other applications
Stability	: $\pm 0.15\%$ for 5 years.
Response time	: 100 msec.
Power supply	: 24V DC nominal
Drive capability	: 500 Ohms minimum
Enclosure Class	: IP-65 (Explosion proof as per NEC article 500 for hazardous area)
Span and Zero	: Locally adjustable, non-interacting

Zero suppression / elevation: At least 100% of Span

### Connection

Process	: Half (1/2) inch NPT (F)
Electrical	: Plug and socket, unused entry with blind plug.
Accessories	: Span and zero adjustment facility
For Absolute Pressure Transmitters	: Two (2) valve SS316 manifold
For Gauge & Vacuum pressure transmitter	: Three (3) valve SS316 manifold
For DP, level & flow Transmitter	: Five (5) valve SS316 manifold
For oil and corrosive liquids:	Separator diaphragm seals
For all transmitters	: Mounting bracket
Mounting	: Local (in LIE/LIR)



- e. In case it becomes necessary to use a DP transmitter for pressure measurement, then a 3-Valve manifold shall be used in place of 2-valve manifold. Manifold shall not be mounted on the transmitter; It shall be non-integral type. Pulsation dampeners shall be used where the process media is unstable for measurement such as the discharge of a pump. Overrange protection shall be used where necessary. The coil siphons & condensate pots shall be used for steam services. Transmitters shall be provided with suitable drain & vent points.
- f. As for the water flow/ steam flow measurements, necessary flow elements/transmitters are chosen in the process line and supplied such that their algebraic summation shall be mass balanced for calculating the system efficiency.
- g. Contacts less, electronic 2-wire position transmitters shall be provided for all inching type motorized valve and dampers.
- h. For acid and alkali applications, only non-contact type level transmitters like acoustic, ultrasonic, radar based shall be provided by bidders.
- i. Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application. For hazardous area, explosions proof enclosure as described in NEC article 500 shall be provided.
- j. LVDT type is not acceptable.
- k. Transmitters & other HART based instruments shall be supplied along with 3 Nos. of universal type hand held/portable pressure calibrators. Temperature transmitters shall be supplied along with 3 Nos. of hand held/portable mV source generators.

### 9.3.2 Pressure Switches (PS) & Differential Pressure Switches (DPS)

Applicable Standards	: IS3624 - 1966/ISA-RP-8.1 except as modified in spec.
Type/Construction	: Bellows /Sealed Diaphragm for low pressure / vacuum and Piston Actuated preferable for high pressure. Indicators with contacts are not acceptable.

#### Materials-

Bellows	:	316 SS
Bourdon tube	:	316 SS
Movement	:	316 SS



Protective Diaphragm	: Die-cast aluminum with stoved enamel black finish. Epoxy coating shall be provided for corrosive atmosphere.
Accuracy	: $\pm$ One (1) percent or better
Repeatability	: $\pm$ 0.5(half) percent or better
Setting & Differential	: Adjustable
Over pressure range	: Fifty(50) percent of full scale.
Contact	:
Number	: DPDT /2 SPDT
Type	: Auto reset with internal Adjustable snap action micro switch
Rating	: 5 Amp, 240V AC / 0.5 Amp, 220V DC
Connection - instrument Electrical	: Half (1/2) inch NPT male Process : Suitable for Plug & socket connection. All the switches are internally connected and brought to the surface with amphenol male/female connection. Cabling need not terminated inside the switch. Cable ends are to be soldered in connector and to be inserted for easy maintenance.
Over range protection	: Fifty (50) percent of full scale
Enclosure Accessories	: IP 65
3 / 5 valve manifold	: For all switches
Self-cleaning type Pulsation dampeners/Snubber (Material SS316)	: Pump and compressor discharge lines
Syphon	: For all steam lines
Protective separating diaphragm Mounting	: For Corrosive liquid lines. : Local (in LIE/LIR)

### 9.3.3 Pressure & Differential Pressure Gauges (PG & DPG)

Applicable standard : IS: 3602-1966, IS/3624, ASME B 40.1



Sensing Element and Materials	: Bourdon for high pressure, diaphragm/bellow for low pressure of all materials in SS 316
Case	: SS 316/ Die-cast aluminum with stoved enamel black finish. Epoxy coating shall be provided for corrosive atmosphere.
Protective Diaphragm	: Teflon
Dial size	: 150mm with shatter proof glass
Scale Details	: Graduations in black lines on white dial, 270 Deg pointer deflection scale provided with glass cover. Smallest scale division shall be one (1) percent of full scale value or smaller. Pointer stop for all gauges.
Accuracy	: ± One (1) percent or better
Connection - Instrument Process	: 1/2 inch NPT Male Bottom
Mounting	: Local : 1/2 inch NPT Male (Back entry) mounted on local gauge board.
Accessories	
3 way needle valve/manifolds	: For all gauges
Self-cleaning type Pulsation dampener/snubber	: Pump and compressor discharge lines
Syphon	: For all steam lines
Protective separating	: For fuel oil and corrosive liquid lines
Other particulars	
Zero & span adjustment Safety device	: For all gauges
Housing	: IP 65
Ranges 5 to 20 Kg/cm <sup>2</sup>	: Rubber blow out disc with open front construction
Ranges above 20 Kg/cm <sup>2</sup>	: Neoprene safety diaphragm at the back with solid front construction
Over range protection	: Fifty (50) percent of full scale



- : Movement mechanism shall be glycerin filled for oil services & vibration prone area.
- : For corrosive liquid lines diaphragm type sensors required. Armored capillary of 10 mtrs for Corrosive liquid service
- : Contact type pressure gauges are not acceptable for interlock & protection.

Identification : Identification engraved with service legend or laminated phenolic name plate.

#### 9.3.4 Resistance Temperature Sensors with thermowells

Applicable Standard	: ASME PTC 19.3 / DIN 43760 for RTD -Latest Revision
Element	: Platinum, R0=100 ohm 4 -wire Duplex
Sheath Material/ Insulation	: 316SS metal sheathed /Compacted Magnesium Oxide
Sheath OD	: 8 MM
Terminals	: Spring loaded
Calibration	: As per DIN Standard - 43760, Class A
Head	: Die Cast Aluminum (Screwed) with galvanized chain
Response Time	: < 20 Sec for measurement < 10 Sec for Control
Accuracy	: $\pm 0.35^\circ \text{C}$ or class A DIN 43760 whichever is better.
Electrical connection	: Plug in connector type
Enclosure	: IP 65

#### Thermo well

Applicable Standard	: ASME PTC 19.3 TW - 2010
Construction	: Tapered drilled from Bar stock for SS316 material thermowell. (Straight for Air & Gas systems)



Material	: - 316 SS - water services - Inconel for air services
	Bidder shall provide calculation for thermo well as per ASME - PTC-19.3.
Process Connection	: i) M33 x 2 ii) Flanged for Air & Gas systems with mating flanges
Immersion Length	: Within ±10 mm of center line of pipe
Extension neck length	: Minimum 100 mm above Insulation of pipe and Minimum 160 mm when there is no insulation on pipe.
IBR Certification	: For high pressure service, Steam Temp., Fuel oil temp. Measurement as per IBR rules and regulations

**Note :**

Extension/Compensating cable exposed to atmosphere in the conventional method melts away in the high temperature. Hence The terminals of temperature sensors shall not be at the high temperature zone. The temperature sensors wires are to be laid up to JB though SS tube of required diameter and the head shall be placed nearer to the JB.

### 9.3.5 Thermocouples with thermowells

Applicable standard	: ASME PTC 19.3- Latest Revision
Element	: Duplex
- Sheath	: 8 MM OD
- Sheath Material	: 316 SS
- Spring Loaded	: Yes
- Nipple/Union	: Yes
- Packed connector	: Compacted magnesium Oxide ungrounded
- Type	: i. Type K (Chromel - Alumel) ii. Type R (Platinum Rhodium- Platinum)
- Gauge	: 16 AWG wire of Chromel – Alumel (Type – K ) or 24 AWG wire Pt-Rhodium Pt (Type R) depending on operating temperature range (Ungrounded type )
Head	: IP 65 / Die Cast Aluminum
Electrical connection	: Plug in connector type.



### Thermowell

Applicable Standard	: ASME PTC 19.3 TW (latest)
- Construction	: Tapered Drilled from Bar stock for SS316 material thermowell. (Straight for Air systems)
- Material	: - 316SS for water/steam services - Inconel for air services
	Bidder shall provide calculation for thermowell as per ASME - PTC-19.3.
- Process Connection	: (i) M 33 x 2 (ii) SS316 Flanged, for Air & Gas systems, with mating flanges.
- Extension	: Threaded union 1/2" NPT (F) with two nipples of SS 316 having 1/2"NPT (M) threads at both ends
<b>Accuracy</b> (For Type K T/C)	: $\pm 1.1 \text{ deg.C}$ (for 0 to 277 deg.C) $\pm 0.4 \text{ percent}$ (for 277 to 1280 deg.C) Class-A
For Type S & R T/C	: $\pm 0.6 \text{ deg.C}$ or $+ 0.1\%$
For Type T T/C	: $\pm 0.5 \text{ deg.C}$ or $+ 0.4\%$
Accessories	: Bolts, nuts and gaskets for flanged connections.
Response Time	: < 20 Sec for measurement < 10 Sec for Control
Immersion length	: Within $\pm 10 \text{ mm}$ of center line of pipe
Extension neck length	: minimum 100 mm above insulation of Pipe and minimum 160 mm when there is no insulation on pipe.

#### Note :

Extension/Compensating cable exposed to atmosphere in the conventional method melts away in the high temperature. Hence, the terminals of temperature sensors shall not be at the high temperature zone. The temperature sensors wires are to be laid up to JB though SS tube of required diameter and the head shall be placed nearer to the JB.



### 9.3.6 Temperature Switches (TS)

#### Type/Construction

- Switch : Industrial type Mercury in steel with capillary and separable thermowell and contacts directly connected to Bourdon element/vapour pressure sensing, liquid filled bellows type preferred.

- Thermowell : Bar stock

#### Material

- Thermowell & Bulb : 316 SS

- Capillary : Armoured Stainless Steel

- Bourdon : 316 SS

- Bourdon Movement : SS 316

- Casing : Die-cast aluminum with stoved enamel black finish Epoxy coating shall be provided for corrosive atmosphere.

Setting and Differential : Adjustable

Accuracy :  $\pm$  One (1) percent of setting and differential

Repeatability : One half (1/2) percent of setting

#### Contacts

- Number : DPDT/2 SPDT

- Type : Auto reset with internal Adjustable snap action micro switch

- Rating : 5 Amp, 240V AC / 0.5 Amp, 220V DC

#### Connection

Pipe : M33 x 2

Thermowell : To suit switch



Electrical	:	Suitable for Plug in type. All the switches are internally connected and brought to the surface with Amphenol male/female connection. Cabling need not be terminated inside the switch. Cable ends are to be soldered in connector and to be inserted for easy Maintenance.
Enclosure protection	:	IP 65
Other Particulars	:	
- Capillary length	:	As per requirement
- Immersion Length	:	Within $\pm$ ten (10) mm of center line of pipe with adjustable nuts.
- Extension neck length	:	Minimum 50 mm above insulation of pipe / As per approved hookup drawings.
- Packing glands	:	Yes
N.B	:	Switches designed for cross ambient operation shall be used in applications where the ambient temperature will approximate or exceed the switch set point.

### 9.3.7 Temperature Gauges (TG)

Applicable standard	:	IS : 3602, BS:5235 ISA:RP:8.1 except as modified in this specification
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#### Type/Construction

- Thermometer	:	Industrial type, Inert gas type
- Thermowell	:	Bar stock

#### Material

- Thermowell & Bulb	:	316 SS
- Movement	:	316 SS
- Capillary	:	Armoured SS (Applicable for capillary Type)



- Casing	: SS 316/ Die-cast aluminum with stoved enamel black finish. Epoxy coating shall be provided for corrosive atmosphere
Dial Size	: 150mm with shatter proof glass
Scale Details	: 270 degree dial rotation/deflection. Graduations in black lines on white dial provided with glass cover. Smallest scale division shall be one (1) percent of full scale value or smaller. Pointer stop for all gauges
Accuracy	: $\pm$ One (1) percent or better
Response time	: Maximum 15 seconds without thermowell
Connection	
- Pipe	: M33 x 2
- Thermowell	: To suit instrument
Other Particulars	
- Capillary length	: 5Meters/10 Meters as required
- Immersion Length	: Within $\pm$ ten (10) mm of center line of pipe with adjustable nuts.
- Extension neck length	: Minimum 50 mm above insulation of pipe /As per approved hookup drawings.
- Stop at Maximum value	: For all gauges of scale
- Pointer	: Externally adjustable Contact type Temp. gauges are not acceptable for interlock & protection.
Enclosure protection	: IP 65

### 9.3.8 Test Thermowells (TT)

Applicable Standard	: ASME PTC 19.3 TW ( latest )
Type/Construction	: Machined from Bar Stock
Material	: 316 SS



### Connection

- Pipe	:	M33 x 2
- Test Instrument	:	To suit test instruments
Accessories	:	Plug with chain

Test wells shall be provided as required to meet ASME test requirements.

### 9.3.9 Ultrasonic Level Transmitter (for Water sump/Tank level measurement)

Type	:	Non-contact Microprocessor based 2 wire type, HART protocol compatible
Principle of Operation pulse	:	Detection of reflected ultrasonic
Measuring Ranges	:	Up to 30 meters (typical)
Signal Processing	:	Microprocessor Controlled Signal Processing
Operating Freq.	:	10 KHz to 50 KHz (typical)
Display	:	Head mounted Large alpha-numeric back lit LCD/LED
Calibration & Configuration	:	Accessible from front of panel
Diagnosis	:	On-line
Status	:	For power, Hi / Lo / V. Hi / V. Lo- level indication, fault etc.
Construction	:	Plug-on board
Power supply	:	24 V DC +/- 10% or 230 VAC 50 Hz
Signal Output	:	Galvanically isolated 4-20mA DC with <b>HART protocol</b>
Hysteresis	:	Fully adjustable preferred
False signal tolerance	:	Transmitter shall be capable of ignoring false echos
Output contacts	:	2SPDT Potential free changeover contacts @ 8A 230V AC.
Accuracy & Repeatability	:	$\pm 0.25\%$ of span or better



Temperature compensation	:	To be provided with transducer
Resolution	:	$\pm 0.1\%$ of span
Operating temp.	:	Transmitter-50 deg C and Sensor - 80 deg C
MOC Sensor	:	Body- PVDF and Face – Polyurethane or Corrosion resistant material to suit Individual application requirement
Humidity	:	1% to 95% non-condensing.
Enclosure	:	IP-65 Epoxy painted die cast Aluminum or SS316L housing.
Cable Connection	:	Plug and socket.
Mounting	:	2" - 4" NPT or flanged
Accessories	:	Cable gland, prefab cable, mounting accessories like EPDM seal, SS316 flanged etc.
		Additional separate local display unit with large Alphanumeric back light LCD/LED & to be provided for the applications which will be decided during detailed engineering.
		All weather canopy for protection from direct sunlight and direct rain.
		All mounting hardware and accessories required for erection and commissioning mounting fittings material shall be SS 316.

#### 9.3.10 Guided Wave Radar/Radar Level Transmitter

Type	:	Guided wave Radar (Contact type)/Radar (Non-contact type).
Application	:	For Low pressure Vacuum vessels.
Environment Class	:	Highly abrasive with Gases and Fumes
Orientation	:	Vertical



Probe Type	:	Flexible Single lead with chuck
Probe Material	:	SS 316L
Connection Size & Type	:	2" Flanged ANSI 300 lb SS316L material
Connection material	:	SS 316L
Accuracy	:	$\pm 5$ mm
Resolution	:	$\pm 1$ mm
Type (Transmitter)	:	SMART, 2 Wire
Operating Principle	:	Time Domain Reflectrometry
Signal Output and Electrical Connection	:	4-20mA DC with <b>HART protocol</b>
Electrical Connection	:	1/2" NPT
Enclosure Class	:	IP 65
Electrical Power	:	11-42 V DC
Housing material	:	Die Cast Aluminum
Vent & Drain Plug material	:	SS
Side Flange Material	:	SS
Local Display	:	Provided (LCD Digital)
Units of Measurement	:	Length M

#### 9.3.11 3 D Type Acoustic Wave Level Transmitter

Type	:	Acoustic Wave Level Transmitter (3D type)
Temperature compensation	:	Required for high temp applications
Operating Principle	:	Non - Intrusive acoustic wave transmission & Reflection
Frequency Range	:	3 - 10 KHz
Accuracy	:	$\pm 0.25$ % for even surface & $\pm 0.5$ % for uneven surface.



Resolution : 1 MM

Output : 4-20mA DC with HART

**Local Display Unit:**

Type : Head mounted LCD Display with Engg. Units

Location : Suitable location at bunker / Silo operating floor area

Protection Class : IP 65

**Material of construction:**

Housing : Polypropylene

Flange : Polypropylene

**Sizes:**

Flange Size : 2" ANSI 300 # RF SS

Electrical connection size : 1/2" NPT (F)

Accessories : i. Double compression type Nickel Plated Cable glands  
ii. Suitable Mating Flange, necessary gaskets  
iii. Local display unit & Suitable mounting brackets, necessary mounting hardware for Local display unit  
iv. Complete software as required to have 3 D view on monitors

**9.3.12 Level Switches (LS)**

Type/Construction : a) External float cage type with magnetic switch actuator for tanks and vessels.  
b) Displacer -Top mounted for all clean water sumps.  
c) Conductivity type for high Pressure and high temperature enclosed vessel

**Materials**

- Body : Cast Carbon Steel suitable for specified pressure and temperature ratings



	: For corrosive liquids suitable anti-corrosive coat/lining shall be provided.
- Float/Displacer	: 316 SS
-Wire rope	: 316 SS
Differential & Setting	: $\pm 12$ mm minimum (Adjustable) Contacts
-Number	: DPDT/2 SPDT
- Type	: Snap action micro switch Auto reset with internal Adjustable
- Rating	: 5 Amp 240V AC, 0.5 Amp 220V DC
Connection - Process	: One (1) inch Scrd NPT Female One (1) inch ANSI Flanged Four(4) inch ANSI Flange for sump services.
Electrical	: Suitable for Plug in type. All the switches are internally connected and brought to the surface with Amphenol male/female connection. Cabling need not terminated inside the switch. Cable ends are to be soldered in connector and to be inserted for easy maintenance.
Enclosure protection	: IP 65
Temperature/pressure Rating	: As per service conditions
Accessories	: Counter flanges, still pipe of requisite length with anticorrosive coating for sump services.

### 9.3.13 Capacitance Type Level Switch

Type	: Capacitance type
Probe	: a) Rod or suspended electrode  b) Rope type probes may be used only where required probe length is greater than 3 meters.
Probe Mounting	: Stainless steel 1-1/2 ANSI RF Flange / $\frac{3}{4}$ " NPT (M)
Material of construction	: 316 SS
Insulation	: PTFE Part/Full as per service.



Enclosure	: Powder/Epoxy coated Die cast Aluminum. With neoprene gasket conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area)
Repeatability	: $\pm 0.5\%$ of full range.
Ambient temperature	: 0-60 °C.
Mounting	: On top
Supply voltage	: 240V AC, 50Hz / 24V DC
Relay output	: 2SPDT
Contact rating	: 5A min. at 240V AC on resistive load
Response time	: 100 msec or better
Cable connection	: 3/4" ET
Accessories	: Counter flange, Cable gland, prefab cable and stainless steel name plate engraved with alpha-numeric.

#### 9.3.14 RF Type Level Switch

##### Electronic Controller

1. Input Supply	: 240 V AC (+/-10%), 50 Hz (+/- 5%)
2. Construction	: Cast Aluminum Housing
3. Relay Output	: 2 Nos. Relay Changeover Potential Free Contacts (2SPDT)
4. Contact Rating	: 5A at 240 V AC & 0.5 at 220 V DC
5. Class of Protection	: IP-65
6. Ambient Temperature	: 55 Deg. C(Max)
7. Local Indication	: Local LED Indications
Green	: Normal Level
Red	: Alarm Level
Yellow	: Probe Healthy
8. Cable connection	: 3/4" ET(2 Nos.) for Supply and Output 5/8" ET(1 No.) for Probe Connection
9. Repeatability	: 100%



## B. Sensing Probe

1. Type of Probe : Rigid
  2. Material : Stainless steel SS 316
  3. Probe Head Housing : Cast Aluminum
  4. Insulation (B/W Active & Shield And Shield & Ground) : PTFE
  5. Probe Head Protection : IP-66
  6. Mounting : Side Mounted
  7. Cable Connection : 5/8" ET (1No.)
  8. Process Connection : 40 NB BSP THREADED
- C. Signal Cable : Coaxial cable for Connection Between Sensing probe and electronic Controller (@ 10 Mtrs. Per Level Probe)
- D. Application : Silos

### 9.3.15 Level Indicators (Gauge Glass) (LI)

- Type/Construction : a) Reflex  
b) Tubular (For tanks open to atmosphere only)
- Material:
- a) Glass : Tempered toughened borosilicate resistant to thermal shock
  - b) Body material : Forged Carbon steel / SS 304
  - c) Integral cocks and : i) Forged carbon steel with drain valves stainless steel internals  
ii) Rubber lined corrosion resistant stainless steel 316 (for demineralized and Osmosis water service)
  - d) Fittings : i) Forged carbon steel  
ii) Rubber lined 316 steel/PVC for corrosive liquids Demineralized and Osmosis water service)  
iii) 304 Stainless Steel for non-corrosive liquids
  - e) Packing : Teflon



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Dial size/scale	:	150 mm /1.4 Meters maximum length with shatter Proof glass
Scale details	:	Aluminum/SS316 scale Graduated in mmwc
Connection	:	25 Nb/40 Nb ANSI Flanged
Enclosure protection	:	IP 65
Accessories	:	a) Integral cocks b) Drain/vent valves 15 NB c) Bolts, nuts and gaskets for all KEL-F shield for transparent type d) Illuminating lamps as required e) Periscope as required
Tests	:	Tested at two hundred (200) percent of the maximum process pressure
Other details	:	For larger lengths, additional gauge glasses shall be provided with minimum of 50 mm overlap.

#### 9.3.16 Vortex Flow Meter

##### Sensor

Type	:	Vortex
Output Signal	:	Pulse.
Material of Construction	:	AISI 316
Sensor Seal	:	PTFE / higher based on temperature.
Flow range	:	As required.
Linearity	:	$\pm 0.25\%$ or better.
Repeatability	:	$\pm 0.02\%$ or better.
Ambient temperature	:	50 deg C
Mounting	:	On-Line mounting with flanges of stainless steel.
Enclosure	:	IP 65.
Accessories	:	Nuts, bolts, gaskets etc.

##### Transmitter

Electronics	:	Solid State.
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Power Supply	: 240V AC, 50Hz.
Input	: Input from Sensor.
Display	: 4 1/2 digit LCD.
Output	: Isolated 4-20mA DC HART.
Measuring Accuracy	: $\pm 0.5\%$ of full scale range.
Totalized Value	: Required.
Housing	: IP-65 (Explosion proof for NEC Class-1, Division 1 area)
Nameplate	: Tag number, service engraved in stainless steel tag plate.
Accessories	: Clamping strip, bracket, prefab cable etc. Special tool kit for calibration / configuration.

#### 9.3.17 Flow Transmitter (Ultrasonic)

Type	: ULTRA SONIC, 2-wired.
Sensing element	: Non-contact.
Output	: 4-20mA with HART Protocol.
Accuracy	: $\pm 0.1\%$ FS.
Supply	: 24 V DC.
Enclosure class	: IP-65.
<b>Transmitter</b>	
Mounting	: On Nozzle.
Mounting position	: Top mounted.
Housing	: Plastic.
Display	: Head mounted LCD Display & remote display.
Accessories	: As per process requirement.
Process connection	: 1/2" NPT.
Electrical connection	: 1/4" NPT.



Turn Down ratio	:	1:100.
Measuring range	:	Adjustable (as per process requirement).
Totaliser	:	Required.
Enclosure class	:	IP-65.

#### 9.3.18 Positive Displacement Flow Transmitter

Positive displacement flow transmitters shall be offered. An electronic totalizer shall be provided for each flowmeter with IP 65 protection and the location of the totalizers shall be acceptable to the Owner. Air eliminators shall also be provided to ensure maximum accuracy.

#### 9.3.19 Electromagnetic Flow Meter

Electromagnetic flow meters shall have separate transmitter having accuracy  $\pm 0.2\%$  with zero stability feature, electrode material SS-316, liner material Teflon and enclosure IP65, local digital display, 4-20 mA output HART signal with zero and span field adjustable.

#### 9.3.20 Flow Gauges (FG)

Type/Construction	:	a) On-line type rotameter for 50 Nb & below lines.
		b) Bypass type rotameter for above 50 Nb lines.

##### Material

- For On-line type

Metering tube : Borosilicate glass

Float : 316 SS

Packing : Teflon

End fittings : 304 SS

- For bypass type

Metering Tube : Borosilicate glass

Float : 316 SS

Packing : Teflon

End fittings : 304 SS



Orifice Plate	: 316 SS
Carrier ring	: 304 SS
Flanges & Mating flanges	: Same as pipe material, 200 lbs ANSI - RF.
Impulse pipe	: Same as pipe material.
Fittings	: 2000 ANSI, SW ends to match with pipe material.
Dial size / Scale length	: 250mm.
Scale Details	: Direct reading type engraved on detachable aluminium scale.
Accuracy	: $\pm$ Two (2) percent.
Reproducibility	: Half (1/2) percent.
Connection	: SCRD NPT
Enclosure class	: IP-65.
Accessories	: a)Isolating valves (for Bypass type only). b)Bolts, Nuts and Gaskets as required.
Tests	: Shall be tested at two hundred (200) percent of the maximum process pressure.

### 9.3.21 Sight Flow Glass Indicators

Type/Construction	: Rotary type/ Flapper type as per process requirement.
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#### Materials

Body	: Carbon steel.
Glass	: Toughened Borosilicate
Gaskets	: Neoprene.
Bolts & Nuts	: SS
Flappers / Rotating Wheel	: 316 SS
Flappers / Rotating Wheel holder	: 304 SS



Process Connection	: SW
Enclosure class	: IP-65.
Accessories	: Bolts, Nuts, Cover plates and Gaskets as required.
Tests	: Tested at two hundred (200) percent of the maximum process pressure.

#### 9.3.22 Solid Flow Meter

Type	: Online Impact type Microprocessor Based.
Measuring Principle	: The system measurement is basically pertains to the measurement of horizontal deflection using LVDT, created by the impact of solid flow upon online sensing plate. The horizontal deflection being proportional to the impact forces, LVDT convert this horizontal movement into electrical signal. The inbuilt integrator convert this signal into time based flow rate indication & provide totalized flow also.
Sensing plate	: 316 SS
Sensing head	: Sensing mechanism shall be mounted outside the process flow line.
Enclosure	: 316 SS
Enclosure protection	: IP 65
Class	
Accuracy	: +/-1%
Repeatability	: +/- 0.2%
Drift	: Both zero & span $\pm$ 2% / month.
Output	: 4-20mA DC isolated, load 600 ohm (min)
Digital communication	: yes, (HART) facility.
Power Supply	: 240 V AC, 50Hz.



Ambient condition	: Temperature -60°C, RH-95%. Environment - Highly Dusty.
Accessories	: Shall be complete with all the accessories including digital display for flow rate, integral vents, baffles for air separation, etc., whichever required for satisfactory operation.

**Note:-**

1. The above on line flow meter shall not create any obstruction on flow.
2. User's list shall be submitted to support on proven satisfactory performance for similar Process application.

#### **9.3.23 Dew Point Meter**

Type	: 2 Wire Loop Powered Dew point transmitter
Overall Range	: -60°C to +20°C Dew point
Accuracy	: $\pm 2^\circ\text{C}$ Dew point
Material	: SS316 (wetted parts)
Features	: <ul style="list-style-type: none"><li>i) Automatic calibration</li><li>ii) Can be Configured for Linear 4-20mA signal in °C &amp; °F Dew point, ppm(v), ppb(v), g/m3</li><li>iii) Temperature Compensation</li><li>iv) Failure Diagnostics</li><li>v) Long Term Stability</li><li>vi) Fast Response</li><li>vii) IP 65 / NEMA4X Protection</li><li>viii) Supplied with Calibration Certificate Traceable to National &amp; International Humidity Standards</li><li>ix) Sensor protection with sintered filter</li><li>x) Local LCD Display for Dew Point</li></ul>

#### **9.3.24 pH Analyzer**

- a) pH at the CW return line.
- b) Solid state / microprocessor based system with system accuracy of +/- 0.01 pH, auto span and zero calibration, manual zero and span calibration, integral indicator, automatic ultrasonic cleaner, iso-potential adjustment having flow type cells.



- c) Output shall be isolated 4-20 mA DC linear signal. Power supply 240V AC, 50 Hz.
- d) The pH shall have built-in reference chambers.
- e) For pH measurement, reference calomel / silver, silver-chloride electrode shall be of rugged and sealed construction moulded in glass coupled polypropylene. Electrical connection shall be made directly on to the outer end of the element ensuring better electrical performance of the electrode.
- f) Wherever, variations in sample temperature may occur, automatic temperature compensation device shall be provided.
- g) Accessories shall include preamplifier, screened junction box for electrode.

#### 9.3.25 Silica Analyzer

- a) Silica analyzers shall be continuous colorimetric type with accuracy of  $\pm 5\%$ , response time better than 10 min for 90% change including sample switching, six numbers of sample streams with sample shut-off solenoid valve. The analyzer shall also include features such as auto temperature compensation, auto calibration and zero check. The analyzer shall be provided with integral indicator.
- b) Housing for analyzer shall be waterproof with IP65 protection. Output shall be isolated 4-20 mA DC linear signal. Power supply 240V AC, 50 Hz.
- c) Fault diagnosis data shall include faults in analog/digital circuits, calibration fault, no reagent, power supply failure and silica concentration high/low.

#### 9.3.26 Chlorine (FRC) Analyzer

- a) Chlorine analyzers at the CW return line.
- b) Microprocessor based Continuous flow through sample type with automatic temperature compensation shall be provided.
- c) The chlorine analyzer shall be continuous flow through type with accuracy of minimum  $+/-2\%$  of span with automatic temperature compensation. Power supply 240V AC, 50 Hz.
- d) Accessories like flow regulator, Flow gauges, Sample rate set valves, etc. and other accessories as required to make the system complete.

#### 9.3.27 Junction Boxes

Bidder shall note that the Analog and digital signals shall be wired to different junction boxes.

- |                 |  |
|-----------------|--|
| (i) No. of ways | 12/24/36/48/64/72/96/128 with 20% spare terminals. |
|-----------------|--|



(ii) Material	4mm thick fibre glass reinforced polyester.
(iii) Type	Screwed at all four corners for door. Door handle shall be self-locking with common key. Door gasket shall be of synthetic rubber.
(iv) Mounting clamps and structures	Suitable for mounting on walls, columns,, Etc, accessories
	The brackets, bolts, nuts, screws, double compression glands and lugs required for erection shall be of brass, included in Bidders scope of supply. Race ways for routing of cables inside JBs shall be provided.
(v) Type of TB	Rail mounted maxi termi or cage-clamp type suitable for terminal conductor size upto 2.5 mm <sup>2</sup> . A M6 earthing stud shall be blocks provided.
(vi) Protection class	IP:65 minimum and Explosion/Flame Proof as per area classification.

### 9.3.28 Interposing Relays (IPR)

Electromagnetic type IPRs with modular design, plug-in type connections, suitable for channel/DIN rail mounting in cabinets; coil rating 24V D.C; 2 set of change over contacts rated for 0.5A 220 V DC / 5A 240 V AC. Freewheeling diode across relay coil and self-reset type status LED indicator flag (electronic) shall be provided. Manual forcing/override facility is required. The test voltage for relay shall not be less than 4 KV with operating temperature from -20 deg. C to 60 deg. C. The relay shall have the necessary approvals like V0 inflammability class in accordance with UL94", IEC60664/ IEC60664A/DIN VDE 0110.

### 9.3.29 Digital Indicator

Type	: Programmable electronic digital indicator with floating point decimal.
Input	: 4-20 mA DC/1-5V DC/RTD/T/C.
Number of inputs	: One
Range	: As per requirement/adjustable by end user through key pad available on the indicator.
Number of digits	: Four plus sign
Digit height	: 20 mm or larger



Display	:	Fluorescent red
Input over range/open	:	All digits to flash sensor (T/C)
Input hold time	:	0.7 seconds max.
Accuracy	:	$\pm 0.05\%$ of span
Power supply	:	240V AC, 50Hz
Mounting	:	Flush panel, compatible for mounting on mosaic grid panel
Size	:	96x48 mm
Other Particular	:	Indicator receiving thermocouple Signal shall have automatic cold junction compensation. Retransmission Output 4-20 mA isolated required. : 24 V DC inbuilt power supply : Alarm contact with 2 NO/NC contact (rating 5A/230 V AC)

### 9.3.30 Receiver Indicators (Single/Dual Channel)

Type	:	Analogue indicator
Input Signal	:	Universal input (T/C, RTD, 4-20 mA, Voltage)
Scale	:	Range fully configurable and programmable
Measurement Accuracy	:	$\pm 0.2\%$ of span + 1 count
Resolution	:	0.5% Span
Dead band	:	$\pm 0.2\%$ of span
Repeatability	:	0.2% of span
Full scale response time	:	Less than two (2)seconds
Power Supply	:	240V AC, 50 Hz
Connection	:	Plug in type
Accessories	:	Mounting Bracket for Bins



Other Particulars	: Indicator receiving thermocouple Signal shall have automatic cold Junction compensation.
	: Retransmission Output 4-20 mA Isolated required.

#### 9.3.31 Ammeters (AMM)

Input	: 4-20 mA DC
Mounting	: Flush panel, compatible for mounting on mosaic grid panel
Face Dimensions	: 96 x 96 mm
Scale/Type	: Moving coil, circular, FSD 240
Zero adjustment	: Screw on meter face
Accuracy	: $\pm 1$ percent (class 1)
Indication	: Pointer with scale
Magnetic Shield	: Shielded Case
Quantities	: For all HT Motors & LT motor with rating $\geq 30$ KW and other critical application motors/drives.

#### 9.3.32 Voltmeter

Input	: 4 - 20 mA DC
Mounting	: Flush Panel, compatible for mounting on mosaic grid panel
Face Dimension	: 96x96 mm
Range	: As per requirement
Accuracy	: $\pm < 0.5 \%$
Indication	: Digital type 4 1/2 digit
Magnetic Shield	: Shielded Case
Connection	: Plug in type
Quantities	: For 240 V AC input power supply, UPS power supply, 24V DC interrogation voltage & 220 V DC.



### 9.3.33 Push Buttons (PB)/ ILPBs for On/Off, Open/Close

Type	: Momentary / Miniaturised suitable for mosaic grid 24x48 Mm with 2 PB and 3 coloured LED.
Contact Configuration	: 2 NO + 2 NC
Contact Material	: Hard Silver Alloy
Contact Rating	: 500V / 10 A
Insulation Voltage	: 2 KV for 1 minute between terminals and earth
Lamp Rating	: a) Voltage : 240 V AC b) Watt : 2 Watt (approx.)
Colour	: Red, Green, Amber, Yellow

### 9.3.34 Push Button For Desk Release,

Push button for desk release	: Momentary mosaic grid mounted
Desk lamp test desk ack	: 24x48 mm size, single PB 18x40 mm

### 9.3.35 Push Button for Sequence Start/Release

Push Button for Sequence Start/Release: Momentary (Miniaturised) suitable for mosaic grid 24x48 mm 3 PB + 5 LED

### 9.3.36 Push Button for Annunciation

Contacts	
- Number & Type	: As per requirement
- Breaking capacity	: 0.5 Amp, 220V DC 10 Amp, 600V AC Different colours for Accept/Ack - Green, reset Grey, test - Yellow & Audio Ack - Black.

## 9.4.0 Control Valves, Actuators & Accessories

### 9.4.1 General Requirements

The control valves and accessories equipment furnished by the Bidder shall be designed, constructed and tested in accordance with the latest applicable requirements of code for pressure piping ANSI B 31.1, the ASME Boiler & pressure vessel code, Indian Boiler Regulation (IBR), ISA, and other standards specified elsewhere as well as in accordance with all applicable requirements of the "Federal Occupational Safety and Health Standards, USA" or acceptable equal standards. All the Control Valves, their actuators and accessories to be furnished under this Subsection will be fully suitable and compatible with the



modulating loops covered under the Specification. All the control valves and accessories offered by the Bidder shall be from reputed, experienced manufacturers of specified type and range of valves.

#### 9.4.2 Control Valve Sizing & Construction

The design of all valve bodies shall meet the specification requirements and shall conform to the requirements of ANSI (USA) for dimensions, material thickness and material specification for their respective pressure classes.

Control valves for steam and water applications shall be designed to prevent cavitation, wire drawing, flashing on the downstream side of valve and downstream piping. Thus for cavitation/flashing service, only valve with anti-cavitation trim shall be provided. Detailed calculations to establish whether cavitation will occur or not for any given application shall be furnished.

Control valves shall have leakage rate as per leakage Class-IV.

The control valve induced noise shall be limited to 85 dBA at 1 meter from the valve surface under actual operating conditions. The noise abatement shall be achieved by valve body and trim design and not by use of silencers.

#### 9.4.3 Valve Construction

All valves shall be of globe / Butterfly body design & straightaway pattern with single or double port, unless otherwise specified or recommended by the manufacturer to be of angle body type. Rotary valve may alternatively be offered when pressure and pressure drops permit.

Valves with high lift cage guided plugs & quick-change trims shall be supplied. Cast Iron valves are not acceptable.

Bonnet joints for all control valves shall be of the flanged and bolted type or other construction acceptable to the Owner. Bonnet joints of the internal threaded or union type will not be acceptable.

Plug shall be of one-piece construction cast, forged or machined from solid bar stock. Plug shall be screwed and pinned to valve stems or shall be integral with the valve stems.

All valves connected to vacuum on downstream side shall be provided with packing suitable for vacuum applications (e.g. double vee type chevron packing) Valve characteristic shall match with the process characteristics.

Extension bonnets shall be provided when the maximum temperature of flowing fluid is greater than 280 deg. C,

Flanged valves shall be rated at no less than ANSI press class of 300 lbs

#### 9.4.4 Valve Materials

- 1) The exact body and trim materials shall be finalized during detailed engineering depending on the service applications.



Valve material shall be as specified in Supplier's approved Control Valve Specification sheets. The following table defines abbreviations used for valve materials:

S.No.	Abbreviations	Description
a)	BR	Bronze ASTM B 61
b)	CS	Carbon Steel Forged - ASTM A 105 Cast - ASTM A 216 Grade WCC
c)	1 - 1/4 CR	1-1/4 percent chromium alloy steel Forged - ASTM A182 Grade F11 Cast-ASTM A17 Grade WC6
d)	2 - 1/4 CR	2-1/4 percent Chromium alloy Steel Forged - ASTM A 182 Grade F22 Cast - ASTM A 217Grade WC9
e)	5 CR	Five percent chromium alloy steel Forged - ASTM A 182Grade F5 Cast - ASTM A 217 Grade C5.
f)	SS	Stainless Steel AISI Type 316 ASTMA351 Grade CF8M

- 2) Body material shall be selected by the bidder to be compatible with the nature of the fluid, service conditions, and piping material to which it is welded and shall be subjected to Owner approval. In general, cast or forged carbon steel bodies shall be provided for non-corrosive process applications up to 275 Deg.C. Alloy Steel castings shall be provided when the media is non-corrosive and the temperature exceeds 275 Deg.C and is within 550 Deg.C. Stainless Steel of suitable grade shall be provided when media is corrosive and the temperature is below 300 Deg.C.

Sr. No.	Service	Body Material
1.	Non Corrosive, Non Flashing, and non cavitations service for process temp. up to 275 deg. C	Cast Carbon Steel ASTM A216 Gr. WCB/WCC
2.	Non Corrosive, Non Flashing, and non cavitations service for process temp. above 275 deg. C. and up to 550 deg. C.	Cast Alloy Steel ASTM A217 Gr. WC9
3.	Severe Flashing/ cavitations service	Cast Alloy Steel ASTM A217 Gr. WC9
4.	Low Flashing/ cavitations service below 275 deg. C.	Cast Alloy Steel ASTM A217 Gr. WC6

- 3) Unless otherwise specified, all control valves shall have stems, guide bushings, plugs, seat rings, stem lock pins, stuffing box parts, and other



trim, all made of stainless steel. Valve guide posts and bushings shall be Stellite faced for valves where specified. Stellite faced guide posts and bushings shall be differential hardened. For applications involving high pressure drop as also for flashing and cavitation services, trim material shall be properly chosen to ensure required degree of hard facing (such as 17-4 PH SS) so as to avoid erosion.

Sr. No.	Service	Trim Material
1.	Non Corrosive, Non Flashing, and non cavitations service for process temp. up to 275 deg. C.	SS316 Stellited
2.	Non Corrosive, Non Flashing, and non cavitations service for process temp. above 275 deg. C. and up to 550 deg. C.	SS316 Stellited
3.	Severe Flashing/ cavitations service	440 SS
4.	Low Flashing/ cavitations service	17-4 PH SS

- 4) Where stellite facing is not specified, hardened stainless steel shall be furnished for all surfaces subject to wear.
- 5) Manufacturer recommended materials for cage guided valves may be substituted for materials specified provided they satisfy the specified service conditions. Also where substitutions are made, the manufacturer shall guarantee performance of recommended materials to be equal to or better than the specified materials for conditions specified.

Bidder may offer valve with body and trim material better than the specified material and in such case, bidder shall furnish the comparisons of properties including cavitations resistance, corrosion resistance, temp. resistance, erosion resistance, hardness etc. of the offered material vis a vis specified material for owner approval.

#### 9.4.5 End Preparation

- 1) Valve body ends shall be butt-welded type.
- 2) Flanged ends shall be of a pressure class equal or greater in pressure-temperature rating to the body design pressure and temperature indicated on the control valve. Unless otherwise specified, steel flanges shall be raised face type. Flanged ends for valves shall be in accordance with ANSI B 16.5.
- 3) Welded end for control valves where specified shall be socket-weld per ANSI B 16.11 for control valves of sizes 50 mm (2") and below and Butt welded connections per ANSI B16.25 for control valves 65 mm (2-1/2") and above. The end preparation for butt welded control valves shall be matched to the corresponding details for the piping on which the valve is installed.
- 4) All end preparations shall be as per Owners requirements indicated during Contract stage.



#### 9.4.6 Valve Actuators

All Control Valves shall be furnished with Pneumatic Actuators. The Bidder shall be responsible for proper selection and sizing of valve actuators in accordance with the pressure drop and maximum shut off pressure and leakage class requirements. The valve actuators shall be capable of operating at 60 deg.C continuously.

Valve actuators and stems shall be adequate to handle the unbalanced forces occurring under the specified flow conditions or the maximum differential pressure specified. An adequate allowance for stem force, at least 0.15 Kg/sq.cm. per linear millimeter of seating surface, shall be provided in the selection of the actuator to ensure tight seating unless otherwise specified.

The travel time of the pneumatic actuators shall not exceed 10 seconds.

#### 9.4.7 Control Valve Accessory Devices

All pneumatically actuated control valve accessories such as air locks, hand Wheels/hand-jacks, limit switches, Microprocessor based Positioner, diffusers, external volume chambers, position transmitters (capacitance or resistance type only), reversible pilot for Positioner, tubing and air sets, solenoid valves and junction boxes etc shall be provided as per the requirements.

##### 1) Specifications for Microprocessor Based Positioners:

1	<b>Electrical</b>	a) Input signal	4-20 mA
		b) Power Supply	Loop powered from the output card of Control system.
		c) Hart Protocol	Compatibility for remote calibration & diagnostics (Super-imposed Hart signal on input signal (4-20 mA)
		d) Valve position	Non-contact type position sensing with 4-20 mA output signal
2	<b>Environment</b>	a) Operating temp	-30 to 80 Deg C
		b) Humidity	0-95 %
		c) Protection Class	IP-65 Minimum
3	<b>Test reports / Certificates</b>	Factory Valve Signature Tests reports ( Pr vs valve travel and reports/ travel vs I/P signal) are to be provided.	
		Test certificates as per manufacture standard / relevant standard are to be submitted	
4	<b>Configuration / Calibration</b>	Remote calibration, auto & manual calibration shall be possible. Universal HART calibrator to be provided.	
5	<b>Operating</b>	Operating Range	Full range & split range signal.
6	<b>Modes</b>	Valve Action	Direct & Reverse valve action (selectable)
		Flow characterization	Possible to fit valve characteristic curve - Linear & Equal Percentage.



7	<b>Fail safe / Fail Freeze</b>	Fail safe/Fail freeze feature is to be provided. (In case, the fail freeze feature is not intrinsic to the positioner, Bidder shall achieve the same externally through solenoid valve connected in the pneumatic circuit).	
8	<b>Pneumatic</b>	Air capacity	Sufficient to handle the valves selected / boosters to be supplied if required.
		Air supply pressure	To suit air supply pressure/quality available.
		Process connection	1/4 inch NPT
9	<b>Electrical cable entry</b>	1/2-NPT, side or bottom entry to avoid water ingress.	
10	<b>Performance</b>	Characteristic Deviation	<=0.5 % Of Span
		Ambient Temp Effect	<=0.01 % / Deg C Or Better
11	<b>EMC &amp; CE Compliance</b>	Required to International Standard like EN/IEC.	
12	<b>Accessories</b>	In-built operator panel	Display with push buttons for configuration and display on the positioner itself (password protected/hardware lock).
		Press gauge block	For supply & output pressure.
		Mounting assembly	On as required basis.

## 2) Limit Switches:

Valves shall be provided with limit switches. Switches shall have not less than two normally open and two normally closed contacts in both open and close directions. Electrical rating of the limit switch contacts shall be 240V AC, 5 amp or 220V DC, 0.5 amp, limit switches should be micro switch type or owner approved equal. The enclosures of the limit switches shall be as per NEMA-4 Standard. Limit switches shall be constructed to withstand the temperatures encountered in the actual service. Explosion proof construction shall be furnished where required by applicable code or these specifications. Limit switches shall be factory mounted on the valves with check limit switch operation prior to shipment.

Limit/micro switches can be offered as an integral part of Smart valve Positioner.

## 3) Solenoid Valves:

- a) Solenoid valves shall be selected to incorporate body construction, trim materials and internal arrangements suitable to the application and shall be acceptable to the Owner. Solenoid enclosures shall be NEMA-4 / IP 65 unless otherwise specified. Solenoid coils shall be Class-H High temperature construction and shall be suitable for continuous duty.
- b) Each solenoid valve shall be furnished with form U internal valve arrangement, Class H high temperature coil, threaded conduit connection, and other electrical and mechanical requirements as specified. The complete data such as material of construction, coil ratings, connection



sizes, body rating etc shall be furnished along with the proposal. These shall be subject to Owner approval during detailed engineering stage.

- c) Solenoid valves shall be provided with pneumatic operated control valves/dampers hooked up with process interlock requirements and where direct tripping is involved. The number of ways for solenoid valve shall be provided as indicated below, however the no. of ways for solenoid valve shall be based on client approval during detail engineering and same has to be supplied by bidder without any commercial or price implication.
- Two (2) way solenoid valves shall be provided, where process line of less than 50mm with low pressure and temperature application.
  - Three (3) way solenoid valve shall be provided commonly, where the pressure is admitted or exhausted from a diaphragm valve or single acting cylinder, e.g, Pneumatic operated spray water block valve.
  - Four (4) way solenoid valve shall be provided for operating double acting cylinders, e.g, Pneumatically operated on-off type dampers.
  - All solenoid shall be with varistor, LED indication, surge suppress diode and circuits and with plug in connector connection.

#### 4) Air Filter Regulator (AFR)

Constant bleed type AFR with an accuracy of  $\pm 1.0\%$  inlet pressure range of 5-8 kg/ cm<sup>2</sup> and suitable spring ranges (AFR) for use with positioners in control valves, control damper, E/P convertors and shut off valves for phosphor bronze filter element; Filtering particles above five microns. Weather and water proof enclosure. Material of accessories will be SS316.

Air filter regulators shall be provided as follows:

- (a) Air supply line to valve positioners / power cylinders
- (b) Air supply line to electric to pneumatic converters.
- (c) Air supply line to pneumatic interlocked block valves.
- (d) For each instrument rack, field instruments enclosure for purging.

#### 5) Power Cylinders (Pneumatic)

Mounting Type	: a) Fixed position mounting (End mounting). b) Trunnion mounting
Control Signal	: 0.2 to 1 Kg/Sq. cm. from I/P converter for modulating purposes. 24V/48VDC operated solenoid valve operating on pneumatic line. The Pilot solenoid will have separate coils for open closing purpose.
Supply Air	: 0-7 Kg / Cm <sup>2</sup> .
Selection	: Based upon thrust / torque, stroke length, angular movement, full-scale travel time, repeatability, space factor



etc. Provision for air-to-open and air-to-close operation

Casing	: IP-65.
Accessories (as required)	: a) Air lock relay b) Hand wheel. c) Air filter regulator with gauge. d) Volume Booster. e) Limit Switches. f) Positioner with Input, Output and supply pressure gauges. g) Pilot Solenoid Valve (Double Coil type) h) Position Transmitter (4-20 mA DC linear output, LVDT or non-contact type)
Fail-safe operation	: Stayput, open or close position on pneumatic / electrical power supply failure as per process safety criteria.
Repeatability	: Better than 0.5% of full travel.
Hysteresis	: Less than 1% of full travel.

#### 9.5.0 Flow Elements

The equipment furnished to this specification shall conform exactly to the requirements herein, unless modified by the respective datasheet of the equipment.

##### a) Orifice Plate

Features	Essential/Minimum Requirements
Type	Concentric as per ASME PTC-19.5 (Part-II), ISA RP-3.2, 1960 or BS-1042
Material	316 SS <ul style="list-style-type: none"><li>▪ Thickness 3 mm for pipe dia. upto 250 mm</li><li>▪ 6 mm for main pipe dia above 250 mm</li><li>▪ 10 mm for main pipe dia. 500 &amp; above.</li></ul>
Material of branch pipe	Same as main pipe
Root valve type	Globe
Root valve material	316 SS



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Root valve size	1 inch
Impulse pipe of same material up to root valve	Required
Tappings	Flanged weld neck. 3 pairs. of tapping.
Beta Ratio	0.34 to 0.7
Beta Ratio calculation to be submitted	Yes
Assembly drg. and flow Vs DP Curves	Yes
Accessories	Root valves, flanges, Vent/drain hole (As required)

Bidder shall submit certified flow calculation and differential pressure vs. flow curves for each element for Owner's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for Owner's approval. One Flow element of each type shall be calibrated in the test laboratory for validation of computated flow calculations.

**b) Flow Nozzle**

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Features	Essential/Minimum Requirements
Type	Long radius, welded type as per ASME PTC-19.5 (Part-III) or BS-1042
Material	316 SS
Thickness	Suitable for intended application
Material of branch pipe	Same as main pipe
Root valve type	Globe
Root valve material	316 SS
Root valve size	1 inch
Impulse pipe of same material up to root valve	Required
Tapping	D and D/2 (3 Nos. of tappings)
Beta Ratio	Around 0.7



Beta Ratio calculation to be submitted	Yes
Assembly drg. and flow Vs DP Curves	Yes
Accessories	Root valves, vent and drain hole.

Bidder shall submit certified flow calculation and differential pressure vs. flow curves for each element for Owner's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for Owner's approval. One Flow element of each type shall be calibrated in the test laboratory for validation of computed flow calculations.

The design, material, construction features, manufacture, inspection and testing of flow elements shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the latest applicable standards.

## **10.0.0 ERECTION HARDWARE**

### **10.1.0 General Requirements**

- 10.1.1** This section covers the material requirement for instrument connection to process, instrument process, piping, tubing, supports, transmitter racks and main accessories to be furnished under this specification and the requirements of installation and routing. Impulse lines, fittings and other accessories required for the erection of complete Instrumentation and Control System supplied under various packages of this specification shall be supplied on "as required" basis. Bidder shall offer all necessary items for this section based on his experience on similar plants, plant layout diagrams, installation drawings and other applicable sections of this specification. Based on the good engineering practices, Bidder shall furnish installation drawings during the engineering of the system for Owner's review and approval. The installation of the drawings shall be suitable for his installation of his range of instrumentation.
- 10.1.2** The Bidder shall furnish and test all required erection hardware, which is necessary for proper installation and interconnection of the equipment/systems furnished by the Bidder and their integration with main equipment/systems as per the enclosed installation drawings and other applicable clause. The Bidder shall furnish all hardware and accessories to ensure that the equipment/systems furnished form a complete and operational system meeting the intent and requirement of this specification.
- 10.1.3** All materials, furnished shall conform to the latest editions of America National Standard Code for Pressure piping, Power piping, ANSI B311.1, ANSI B16.11, ASME Boiler and Pressure Vessel Codes, IBR and other applicable ASME, ANSI and Indian Standards. Schedule numbers, sizes and dimensions of all carbon steel, stainless steel and alloy seamless steel pipe shall confirm to ANSI B.36.10



and of stainless steel pipe shall conform to ANSI B 36.19 unless otherwise specified.

- 10.1.4** Instrument erection hardware which includes all junction boxes, cable trays, cable glands, lugs, cable ties, support, local panels, pneumatic and process hook up hardware, Impulse piping & fittings and other erection materials and accessories required for the system supplied.
- 10.1.5** All materials supplied under this section shall be suitable for intended service; process operating conditions and type of instruments used and shall fully conform to the requirements of this specification.
- 10.1.6** The Bidder is responsible for the performance of the equipment furnished on system basis any shortfall in erection material observed during erection stage shall be compensated by the Bidder at no extra cost.

#### **10.2.0 Process Connections**

The type of instrument source connection shall depend upon the process parameters and the tapping size. The source connection drawings shall be finalized during the engineering stage, Refer Hookup diagram.

#### **10.3.0 Impulse Piping System**

##### **General**

Impulse piping system consists of primary impulse pipes/tubes, valves, fittings, valve manifolds and other accessories between the source connection point (source shut-off valve onwards) and all instruments/devices. Impulse pipe span for supporting clamp shall be 1.5 mtr. This will also include all piping and valves etc. required for instrument drain and vent connections. The Bidder shall furnish and test all items required for completeness of this specification.

#### **10.4.0 Air Supply Piping**

The piping for air supply shall be as specified below (However, Bidder shall supply the materials as required basis to complete the system in all respect)

##### **1. Individual Supply Lines and Control Signal Lines:-**

Air lines shall be  $\frac{1}{4}$  inch size, connected by brass/SS316 flare less tubing fittings. Copper tubing shall be light drawn tampered tubing conforming to ATM B75 except copper tubing in tubing cables shall be annealed soft temper tubing conforming to ASTM B68 or B75. Fittings on the branch line to facilitate connections to the individual supply line shall be cast brass screwed type.

##### **2. Flexible Hoses:-**

Flexible hoses shall be  $\frac{1}{4}$  inch rubber hose with Buna-N liner steel wire braid reinforcement and rubber outer covering complete with  $\frac{1}{4}$  inch brass fittings and shall have swivel male pipe threads. Each hose shall be one meter in length.



3. Pipe Material Specification:-

The piping material shall be carbon steel hot-dipped galvanized inside and outside as per IS-1239 or the equivalent of these standard heavy qualities with screwed ends. The piping threads shall be as per ASA B.2.1

4. Isolating Valves:-

Gate valves as per ASTM B62 inside screw rising stem screwed female ends as per ASA B.2.1 valve bonnet shall be union type and trim shall be stainless steel body rating 150 pounds ASA. Valves sizes shall be  $\frac{1}{2}$  inch to 2 inch.

5. Fittings:-

Forged cast steel A234 Gr. WPM galvanized inside and outside; screwed as per ASA B2.1 dimensions as per ASA B16.11, rating 2000 pounds, elbows and soft seats. The size of the fittings shall be  $\frac{1}{2}$  inch through 2 inch.

6. Air Filter Regulator Set:-

An instrument Air Filter Regulator Set with mounting assemblies shall be provided for each pneumatic device requiring air supply. The filter shall be of size 5 microns and material sintered bronze. The air set shall have a 2 inch size pressure gauge and built in filter housing blow-down valve. Filter regulators shall be suitable for 10 Kg/Sq.cm. maximum inlet pressure. The connection size shall be  $\frac{1}{4}$  inch NPT. A  $\frac{1}{2}$  inch instrument air supply isolating valve shall be provided for each pneumatic device requiring air supply.

#### 10.5.0 Process Connections

Following type of source connections shall be provided by the Bidder on equipment/piping for instrumentation purpose.

1. Source valves for pressure and differential pressure measurements as per enclosed instruments source connection details.
2. Threaded/weld able stubs for thermowells of various sizes for temperature elements as per enclosed source connection details.
3. Source valves with socket welded connections for level services as per enclosed instrument source connection details.
4. For control actuators at the master operating spindles/levers of the final control elements.

However, if the source connection details, as illustrated, do not match with the connection ports of the instruments, the same may be altered in consultation with Owner.



#### 10.6.0 Impulse Tubing

High pressure and high temperature services (Water)	Seamless Alloy Steel piping to ASTM A335 GR.P22 (schedule 160 for high pressure & high temperature)
Low pressure and Low temperature services(Water)	Seamless carbon steel piping to STM A106 Gr.B
Low pressure and low temperature services (Air)	ERW carbon steel piping to IS 1239: 1973 Heavy class System
Analysis system	Seamless stainless steel piping to ASTM A312 GR. TP-321

#### 10.7.0 Fittings Double compression type

- i) Material for socket weld fittings      ASTM A105 ASTM A182, Gr. F22 6000/3000 lbs
- ii) Dimensions of fittings      ANSI B16.11

#### 10.8.0 Valves

- i) 3-way valves      SS body/Forged CS body stellated internals and SW ends as per requirement for 2500 lb/600 lb ASA ratings.
- ii) 3-valve/5- valve manifolds      FAS body/FCS body 316SS stellated internals with NPT(F) SCRD ends for 2500 lb/1500 lb/600 lb ASA ratings.
- iii) 2-valve manifolds      FCS body, 316SS stellated internals, NPT(F) SCRD ends.
- iv) Isolation and drain valves      Globe valves with FAS

#### 10.9.0 Condensation vessels

body/FCS body, 316SS stellated internals, SW ends for 2500 lb/1500 lb/ 600 lb ASA ratings.

#### 10.10.0 Flexible conduits with fittings

Lead coated, paper insulated, heat resistant flexible metal conduits with necessary fittings.



## 10.11.0 Guideline for Installation and Routing Of Instrument Piping

### 10.11.1 General Requirements

The following general erection guidelines have been enumerated here to enable the Bidder to estimate the requirement of instrument piping in plant:-

1. All instrument piping shall be in accordance with good engineering practice. It shall be finalized during engineering stage. Instrument piping shall be complete with fittings, valves and other required accessories.
2. Instrument piping shall not be routed:
  - a) Across equipment removal areas
  - b) Below mono-rails and cranes
  - c) Above or below removable gratings
  - d) Above or below cable trays.
3. Primary Impulse Piping System:
  - a) The primary impulse piping system shall include the instrument piping and all required accessories from process tap off point (root valves onwards) up to the respective instruments. From the same source, Tee off for instruments are not allowed. Separate tapping shall be provided for each instrument. The Bidder shall provide the necessary fittings and accessories along with impulse pipes for completeness and arrangements as per the finalized Instrument Installation Diagrams. Special accessories such as reservoirs and other devices shall be installed as required for flow primary element connection as required by the design of instruments, in accordance with the instructions of the instrument manufacturer.
  - b) The Bidder shall prepare impulse pipe routing drawings.
  - c) Impulse piping shall include a blow-down line and shut-off valve adequate for the duty requirements and for withstanding continuous design pressure and temperature of process medium. For process pressure above 40 Kg/Cm<sup>2</sup>g, double valves shall be used before connecting to the blow-down header (This arrangement shall be provided for installation for the new transmitter if the existing transmitter has the same arrangement.)
  - d) To assure a constant static head the connections from low pressure steam and low pressure liquid filled lines should preferably slope downward continuously towards the instrument as the instrument is mounted below the source point. If downward slope is not feasible or the instrument is mounted above the source point, the line should slope upward continuously and a "pigtail" installed at the instrument to assure a water seal for temperature protection. Upward sloping liquid lines should be used only if the process pressure is sufficient to assure a head of liquid at the instrument. Horizontal runs



should have a slope of not less than 40 mm per meter and must be adequately supported to maintain a constant slope. Vacuum connections to the condenser should always slope upward to the instrument.

4. Primary process piping for steam flow, liquid flow and manometric level measurement systems should preferably slope downward from the primary element connections to the instrument. Primary piping for flue gas and air flow measurement systems should preferably slope upward from the primary element connections to the instrument. If these requirements cannot be met, special venting or drain provisions will be required. Horizontal runs must have a slope of not less than 40 millimeters and must be adequately supported to maintain a constant slope.
5. Primary process piping from the field which enters the instrument enclosure from the bottom shall extend into the enclosure approximately 150 millimeters and be equipped with a socket weld to flare less tubing coupling of stainless steel. This coupling shall be used to connect the field primary process line to the enclosure process line. The field primary process line shall be anchored to the enclosure angle with U-bolts. Holes for supporting U-bolts shall be field or drilled. All impulse piping shall be supported rigidly at an interval not exceeding 1.5 meters so as to prevent excessive sag in piping. Process piping shall not be used for supporting impulse piping.
6. Impulse lines subject to severe sonic pulsations shall be of sufficient length and of suitable configuration to scatter harmful sonic wave energy before it reaches the instrument.
7. Impulse piping shall be installed to permit thermal expansion without placing excessive stress on the piping and without affecting the gradient of slope. Long continuous straight runs of piping shall always be avoided. If required, expansion loops shall be provided at least every 2.5 meters to break the continuity.
8. All welded and screwed fittings shall conform to ANSI B16.11. Threads of piping components shall be taper pipe thread in accordance with ANSI B2.1. All threads shall be clean machine cut with all burrs and chips removed. Lubricants shall be of dry filch type. Any one of the following compounds may be used as a pipe thread sealer. Bidder shall supply adequate amount of his preferred sealer for erection purpose. Teflon tape shall not be used as a pipe thread sealer.
9. Instrument Air Piping System:-

Instrument Air shall be made available by the bidder at 3.5 to 7.0 Kg/cm<sup>2</sup> pressure. The instrument air may be arranged as under:-

For the control valves and power cylinders in Owner's scope but controlled by bidder's control system, the instrument air requirement for E/P converter shall be tapped from the nearby instrument air header laid by bidder / already laid existing piping with accessories available near the control valves or damper.



Air supply piping shall be installed at site always with a slope of over 1/100 to prevent accumulation of condensed water within the pipe.

All joints in the instrument air sub-header shall be of screwed type.

#### **10. Signal / Control Air Tubing System:-**

Necessary tubes with fittings and accessories for output signal from pneumatic instruments mounted in the field and control signals to final control elements shall be covered under this tubing system.

3 Valve manifold shall be used, wherever Diff pressure transmitter/ switch have been used for pressure measurement.

5 Valve manifold shall be used for Diff. Pressure & Flow measurement Transmitters/Switches.

#### 11. Code for Racks and Associated Equipment ANSI C83.9-1972

## 12. Code for pressure piping, welding and Hydrostatic testing

ANSI B-31.1

### **13. Flexible conduits with fittings**

Lead coated, paper insulated,  
heat resistant flexible metallic  
conduits with necessary fittings.

### 10.11.2 Transmitter & Switches Enclosures

In general, process parameter transmitters & switches installed at outdoor location and in areas where they are subjected to splashing oil, water, steam etc., shall be mounted in closed type transmitter rack. For other areas (indoor), open type racks may be used for installation of transmitters and process switches. However the actual requirement shall be finalized during detailed Engineering considering following:-

1. Transmitter/Switches enclosures shall be free standing, enclosed type offering protection against dust, moisture and vermin. Enclosures shall be suitable for outdoor installations, in thermal power plants.
  2. The enclosures shall comprise of Galvanized Sheet mounting plate internally. Also external-mounting brackets in Polyamide or Stainless Steel shall be available and shall be weather proof. Panel thickness shall be 3 mm for instrument supporting faces and back and for remaining sides shall be 2 mm.
  3. Instrument piping inside the enclosure shall conform to the specification and in line with typical installation drawings enclosed with the specification.
  4. Blow down header shall be provided inside the enclosure as called for.
  5. Bulk head connection shall be provided to receive and terminate the impulse pipes from root valves.



6. Instrument tubing, fittings and isolation, drain valves shall be to ANSI code for pressure piping. Piping/tubing shall be subject to hydrostatic tests at 1.5 times maximum system pressure.
7. Support angles shall be provided for valve manifolds, wiring trays etc. Enclosures shall be complete with necessary bulk head fittings, junction boxes, drain header and other accessories as needed on the basis of approved hook up drawings.
8. Sufficient spacing among adjacent transmitters shall be maintained to offer easy accessibility and operational convenience. The enclosure shall be designed with sizes to suit the grouping and to completely include all the hardware for hooking up the transmitters to the process on the basis of approved installation diagrams. A maximum of Six (6) transmitters are envisaged to be grouped in one enclosure.
9. The field devices like switch devices, limit switches, position transmitters, solenoid valves etc shall be provided with removable type insert & screw type connectors, or terminal heads suitable for easy maintenance and testing of these equipment items.
10. All spare contacts/terminals on relays, control switches, limit switches or similar devices, process switches, duplex RTDs & Duplex T/Cs shall be wired to accessible terminal blocks/JBs for Owner's future connections. All wiring leaving a junction box or enclosure shall leave from terminal blocks and not from other devices in the enclosure. Two (2) pair cables shall be provided for terminating the transmitter to local JBs.
11. Auxiliary equipment such as relays, terminal blocks etc shall be readily accessible and servicemen shall have direct access to the equipment without removal of barriers, cover plates or wiring.
12. All electrical cables shall be conservatively selected for the electrical and environmental conditions of the installation and shall be of the best construction for the service conditions encountered. Oil resistant and proper temperature applicable cable shall be used throughout.
13. A minimum of twenty (20) percent spare terminals shall be provided. Only one wire per terminal shall be used on the outgoing side of these blocks (for cable panel). Any common connections required shall be provided on the panel side of the block. All incoming power terminals are to be clearly identified in a manner distinctly different from all other terminals and grouped in a logical pattern.
14. Each wire is to be identified at both ends corresponding to wire number shown in wiring diagrams.
15. All wire terminations at terminal, shall be made with compression type connections properly sized for the conductor and the terminal. The connector shall be constructed of fine grade high conductivity copper and shall be tin plated. No more than two wires shall be connected to a terminal. Vertical wiring on the panels between the terminal blocks and the devices shall be



enclosed in non-metallic raceways or punched metal raceways with removable cover. Horizontal wiring between the raceways and the devices may run exposed. Wiring on the panels shall be formed neatly with wires neatly grouped in packs using non-metallic bends, and with group substantially supported along the panel.

16. Wire stripping shall be done in such a manner that conductor will not be nicked or cut.
17. The entire arrangement of wiring and arrangement of connections/ terminal blocks shall be acceptable of the Owner's Engineer.
18. Switches for temperatures, flow, level, pressure etc. required for unit protection/interlock shall be triplicated.
19. Each instrument shall be provided with nameplate and labels etc.

#### **10.11.3 Local Instruments, Local Boards and Tapping Points**

- i. All local gauges as well as sensors and switches for parameters like pressure, temperature, level, flow etc for safe and efficient operation of equipment under the scope of specification, shall be provided by bidder as approved by Owner. Such equipment shall be listed by the Bidder detailing the items with the respective functions in service. All field mounted instruments shall be mounted in such a way as not to be affected by vibration & environmental conditions. Racks to mount these instruments shall be furnished by bidder complete with requisite erection hardware, tubings and junction boxes with all terminals of the instruments duly wired complete with cable glands. Groupings of instruments, actual number of racks for instruments and its construction shall be to Owners approval.
- ii. Transmitters provided shall be mounted in transmitter enclosures to Owner's approval. The junction box for electrical connections shall be outside the transmitter enclosures.
- iii. All erection hardware required for complete installation/ implementation of entire instrumentation specified is included in bidders scope. Any change in size, type, and rating or in quantity deemed necessary during engineering shall be supplied within package price with no additional financial implication to Owner.
- iv. Bidder's scope includes providing counter flanges on pipe lines/ vessels to suit Owner arranged flanged devices. Counter flanges shall be complete with gaskets, nuts, bolts and other requisite accessories for proper installation.
- v. Separate and independent tapping on equipment/associated piping shall be provided to suit the philosophy of redundant primary sensors. Separate sensors for control and monitoring etc are as decided by Owner. This shall include application such as first stage pressure. Wherever the process value being measured needs to be compensated for temp, pressure variations, the tapping points for such compensating elements shall be provided in requisite number along with the tapping for the process value.



- vi. Tapping points shall include probes, wherever applicable, for analytical measurements and sampling.
- vii. For direct temperature measurement of all working media, one stub with internal threading of approved pattern shall be provided along with suitable plug and washer. The Bidder will be intimated about thread standard to be adopted.
- viii. The following shall be provided on equipment by the Bidder. The standard which is to be adopted, will be intimated to the Bidder.
  - 1. Temperature test pockets with stub and thermowell
  - 2. Pressure test pockets

#### 10.11.4 Size of tapping point stub, number and size of root valves for different types of measurements

Size of tapping point stub, number and size of root valves for different types of measurements are as follows:

Sl. No.	Quantity of root valves	Size of stub and root valve	Service Condition
<b>Pressure and Differential Pressure Measurement</b>			
(i)	2	25NB	> 40 bar(g) OR 425degC
(ii)	1	15NB	< 40 bar(g) AND 425degC
Level Measurement			
<b>Level Gauge &amp; Switch</b>			
(i)	2	25NB	> 40 bar(g) OR 425degC
(ii)	1	25NB	< 40 bar(g) AND 425degC
<b>Level transmitter (displacement type)</b>			
(i)	2	40NB	>40 bar(g) OR 425degC
(ii)	1	40NB	<40 bar(g) AND 425degC
<b>Stand pipe for level measuring instrument</b>			
(i)	2	80 NB	>40 bar(g) OR 425degC
(ii)	1	80 NB	< 40 bar(g) AND 425degC
<b>Flow Measurement</b>			
(i)	2	25NB	> 40bar(g) OR 425degC
(ii)	1	25NB	< 40 bar(g) AND 425degC

#### Note:-

- 1). Rating of piping / fittings / valves etc. is subjected to the final design pressure & temperature during the detailed engineering, as per ANSI B 31.1.
- 2). In case temperature is more than 540 deg C, the material shall be P-91 only.
- 3). Material shall be compatible with that of the impulse pipe material and design parameter.



## 11.0.0 INSTRUMENTATION AND CONTROL CABLES

### 11.1.0 General

Bidder's scope of supply, laying, erection & commissioning of instrumentation and control cables shall include the following:-

- a) Bidder shall supply, lay, erect, terminate all the control, instrumentation, interfacing (coaxial, fiber optic) cables etc.
- b) All cables from sensors and contacts in field to the bidder's local junction boxes for field transmitters/sensors/switches etc.
- c) All interconnecting cables and prefabs between bidder's supplied local JB, local instrument/transmitters, cabinets, panels and termination cabinets and interconnecting cables between Bidder's panels to equipment / instruments/ Plant Control Room. All field JB's / all field instruments / MCC / SWGR to PLC cabinets in LER / PLC cabinets/Relay cabinets/local control panels /desk etc. All power, Signal & Special cables from Sensor to JB, JB to MCC, JB / Drives to PLC, MCC / SWGR to PLC cabinets wherever one end or two ends are in EPC bidder's scope. Cables shall be supplied, laid, terminated by EPC bidder including preparation of Cable schedule and supply of cable Trays irrespective of other end scope.
- d) All cables interconnecting computers and peripherals.
- e) All co-axial cables/fiber optic cables and any other special cables for interfacing with other packages via soft link (covering all packages irrespective of scope).
- f) All Extension cables.
- g) Interfacing cables (Coaxial, fiber optic etc) between Owners supplied control systems/DDCMIS to Bidder's PLC.
- h) Preparation of Complete cable schedule, Interconnection diagram & JB schedules shall be in bidder scope.
- i) All external field signals for PLC shall be terminated in separate marshalling/ termination cabinets. Under no circumstances, field cabling to be directly terminated in PLC system cabinets.
- j) All Instrument cables shall be paired cables.
- k) All cables shall be provided with anti- termite, Anti Rodent & moisture resistant properties.
- m) All spare contacts/terminals on relays, control switches, limit switches or similar devices, process switches, duplex RTDs & Duplex T/Cs shall be wired to accessible terminal blocks/JBs for Owner's future connections. All wiring leaving a junction box or enclosure shall leave from terminal



blocks and not from other devices in the enclosure. Two (2) pair (individual & overall shielded) cables shall be provided for terminating the transmitters & switches i.e Analog & Binary signals to local JBs. Similarly four (4) pair (individual & overall shielded) cables shall be provided for terminating the Duplex (4 wire) RTD to local JBs. 10% spare pairs or min 1 pair cable (whichever is more) shall be provided with all type of cables.

- n) 10% spare pairs or min 1 pair cable (whichever is more) shall be provided with all type of cables.
- o) 20 twist per meter for instrumentation cable shall be provided for 0.5 sqmm cable and 13 twist per meter shall be provided for 1.5 sqmm.
- p) All others cables not included above however required for completeness and operation of plant.

#### **11.2.0 Specification and Standards**

Except where specified otherwise all materials, cables and construction shall conform to the Indian Electricity Act and Rules and the Indian and other international standards with latest revisions and amendments issued up to date.

#### **11.3.0 Cable Specifications**

##### **11.3.1 General**

All materials shall be new and of tested quality conforming to applicable National and Manufacturer's Standards and Indian Electricity Rules.

All materials shall be transportable to and suitable for installation at site with ease and without any damage. It shall give continuous reliable operation over long period under worst specified site conditions.

All materials shall be designed to withstand extremes of all magnetic, electrical, mechanical and thermal stresses which may be encountered during normal and abnormal operating conditions.

##### **11.3.2 Cables – Design Criteria**

Cables shall be so designed and manufactured that damage does not occur in handling, during transit, storage, installation and operation under any or all the climatic and operating conditions which they may be subjected to. Outer sheath of cables shall have rodent and termite repulsion property.

Cables shall be suitable for laying in conduits, ducts, trenches, trays or for direct burial in ground in both and wet locations.

Cables shall be capable of operating satisfactorily under the power supply voltage and frequency variations as specified in the specification. Current ratings and ratings factors of cables shall not be worse than the ones specified in IS: 3961.



Performance characteristics of cables shall be based on the following conditions of laying:

1. All cables shall be laid in multilayer and touching each other
2. Cables shall be suitable for laying in duct or burying in ground up to a depth of 1.5 meters with uncontrolled back fill and chances of flooding by water.

All instrumentation cables shall be flame retardant low smoke (FRLS) type and fire stop sealing shall be provided in the cable gallery along with fire retarder cable coating compound.

Fillers in multiple conductor cables shall be flame retardant and moisture resistant.

The color of inner sheath and outer sheath shall be black and sky blue respectively.

All cables shall be provided with marking including manufacturer's name, year of manufacturing, insulation material, conductor sizes, no of pairs, voltage ratings, type of cable, etc, progressive markings to read marking of the length of the cable at each meter interval and "FRLS" at every 5 meter interval.

All external field signals for DDCMIS / DCS shall be terminated in separate marshalling / termination cabinets. Under no circumstances, Field cabling to be directly terminated in DDCMIS / DCS system cabinets.

All spare contacts/terminals on relays, control switches, limit switches or similar devices, process switches, duplex RTDs & Duplex T/Cs shall be wired to accessible terminal blocks/JBs for Owner's future connections. All wiring leaving a junction box or enclosure shall leave from terminal blocks and not from other devices in the enclosure. Two (2) pair (individual & overall shielded) cables shall be provided for terminating the thermocouples, transmitters & switches i.e Analog & Binary signals to local JBs. Similarly four (4) pair (individual & overall shielded) cables shall be provided for terminating the Duplex (4 wire) RTD to local JBs. 10% spare pairs or min 1 pair cable (whichever is more) shall be provided with all type of cables.

Cables for analog signals shall be instrumentation cable of 0.5 sq. mm copper conductor size with individual pair shielding & over all shielding.

Cables for binary signals shall be instrumentation cable of 0.5 sq. mm copper conductor size.

Cable for power supply to each solenoid valves shall be power cable of min. 3C x 2.5 Sq.mm copper conductor size. Specification shall be as mentioned elsewhere in the Electrical part.

Control cable of 1.5 / 2.5 sq mm shall be multicore having overall shielding and specification similar to Instrumentation cable except insulation and voltage grade which shall be 1100 V and shall confirm to IS 1554.



All instrumentation cables covered in this specification shall comply with VDE 0815, VDE 0207, Part 4, Part 5, Part 6, VDE 0816, VDE 0472, SEN 4241475, ANSI MC 96.1, IS-8784, IS-10810 (latest editions) and its amendments read along with this specification.

### 11.3.3 Cable Specifications

Cable shall have the following specification: -

Sr.No	Description	Cable N (Overall shielded)
1.	Voltage Grade and Type	225 V grade multipair annealed tinned copper conductor overall shielded armoured instrumentation
2	Not Used	
3.	Conductor	Nominal 0.5 Sq. Area concentric lay Annealed tinned high conductivity stranded 7x0.3 mm dia. Electrolytic Copper conductor.
4.	Insulation	Extruded HR PVC type - C to IS:5831
5.	Shield	Minimum 0.06mm thick aluminum mylar tape shall be provided on each pair with hundred percent coverage, 20% overlap and tinned copper drain wire of diameter 0.51 sqmm with 7 strands (20 AWG).
6.	Inner sheath	FRLS HR PVC type ST-2 to IS:5831/VDE 0207 .
7.	Armouring	Galvanized steel wire/strip to IS:3975 & IS 1554 Part II
8.	Outer sheath	FRLS HR PVC type ST-2 to IS:5831/VDE 0207
9.	Lay	Twisted pair with 20 lay/mt
10.	Tests for FRLS Properties	<ol style="list-style-type: none"><li>Flammability Test - The cables shall pass the requirement of IEEE-383 fire propagation test in this regard.</li><li>Smoke generation by Sheath under fire When tested as per ASTM-2843, the cable shall meet the requirement (60%) smoke density.</li><li>Acid gas generation of sheath during fire When tested as per IEC-754-1, the maximum Acid gas should be less Than 20% by weight.</li><li>Oxygen Index Test The oxygen index when tested under ASTMD 2863 shall be minimum 29.</li><li>Water immersion test shall be carried out as per VDE 0815 Swedish Chimney Test</li></ol>
		<b>Other Tests</b>
		1 Fire resistance test to IS-5831 for 20



Sr.No	Description	Cable N (Overall shielded)				
		minutes. (PVC insulation & sheath of electrical cables)				
		2 Thermal stability at 200 deg. C to IEC-540 for 100mts.				
		3 Rodent and termite proof.				
		4 Heat shock test to IEC-502.				
11.	Conductor and Pair	The wires of pairs shall be coded by base colours on insulation which are repeated in every unit. Base colours of the pairs in a unit shall be as follows:				
		Pair	1	2	3	4
		a) Wire	Blue	Grey	Green	White
		b) Wire	Red	Yellow	Brown	Black
		The units shall be coded by colours of rings on the insulation cores as tabulated below in order to distinguish between wires of various units in cables				
		Unit:		Ring Colour:	Ring Group	
		1		PINK	I	
		2		PINK	II	
		3		PINK	III	
		4		PINK	IIII	
		5		PINK	IIIII	
		6		PINK	IIIIII	
		7		ORANGE	IIIIIII	
		8		ORANGE	IIIIIIII	

The vertical lines under column (Ring Group) in the above table indicate number of rings at intervals of approx 60 mm length of the wires of the units. For cables above 4 pair, each 4 pair units shall be open helically lapped with numbered binder taped for the purpose of binding & unit identification.

12	<b>Marking</b>	Progressive sequential marking of the length of the cable at every one meter & progressive markings to read "FRLS" at every 5 meters shall be provided on the outer sheath of all instrumentation cables.
13	<b>Electrical Properties at 20 Deg.C</b>	
a)	a) Conductor resistance of the loop not greater than	78.4 Ohms/Km for 0.5 sq mm. Conductor size
		24.6 Ohms/Km for 1.5 sq mm. Conductor size.
b)	Insulation resistance not less than	100 Meg Ohms/Km
c)	Mutual capacitance at 0.8	100 nF/Km



	KHz not greater than	
d)	Test Voltage-cond/cond. And cond/shield	2000 Vrms
e)	Characteristic impedance at 0.8 KHz	340 Ohms for 0.5 sq mm. Conductor size.
		230 Ohms for 1.5 sq mm. Conductor size.
f)	Image attenuation at 1 KHz	1.2 dB/Km
g)	Image attenuation at 10 KHz	0.29 dB/100 m
h)	Cross talk attenuation at 0.8 KHz greater than	70 dB/Km
i)	Coupling capacitance at 0.8 KHz not greater than	200 pF/100 m
j)	<b>High Voltage Test :</b>	<b>Duration</b>
	Conductor to Conductor	2000 Vrms, 50 Hz for 1 min.
	Conductor to Shield	1000 Vrms, 50 Hz for 1 min.

#### 11.3.4 Cable Specifications

Cables shall have the following specifications:-

Sr.No	Description	Cable M ( Individually and Overall shielded)
1	Voltage Grade and Type	225 V grade multipair annealed tinned copper conductor individual pair and overall shielded armoured instrumentation cable.
2	Conductor	Nominal 0.5 Sq.mm. area concentric lay annealed tinned high conductivity stranded 7 x 0.307 mm dia. Copper conductor.
3	Insulation	Extruded HR PVC type-C to IS:5831
4	Shield	Through aluminum mylar tape min 0.06 mm (0.075 mm) with min 20% overlap and 0.51 sq.mm dia tin coated copper drain wire (7 stranded -20 AWG) laid under the contact with aluminum side of the tape.
5	Inner sheath	FRLS HR PVC type ST-2 to IS:5831/VDE 0207
6	Armouring	Galvanized steel wire/strip to IS:3975
7	Outer sheath	FRLS HR PVC type ST-2 to IS:5831/VDE 0207
8	Test for FRLS properties	"See details as specified in Cable Type N".
9	Colour Coding & Marking	"See details as specified in Cable Type N".
10	Electrical Properties	"See details as specified in Cable Type N".



### 11.3.5 Specification for Co-axial Cables Cable-C

Co-axial cables are used for high frequency equipments and systems for transmission and reception purposes and computers. Co-axial cable should have minimum following characteristics:-

Construction	: Solid silica coated, annealed copper conductor.
Di-electric	: Low loss solid polyethylene foam, semi and spaced construction.
Outer conductor	: Braided or longitudinal tube of copper or Aluminum giving 100% coverage with slight overlap.
Outer sheath	: FRLS PVC
Diameter over Di-electric	: 7.24 sq.mm.
Outer diameter	: 10.29 sq.mm.
Nominal impedance	: 75 ohms
Nominal capacitance	: 20.5 pF/ft.
Nominal attenuation	: 8 dB at 1000 MHz Per 100 ft.

### 11.3.6 Fiber Optic Cable

A	Fiber:	
1	Type	Multiple single mode/Multi-Mode Fiber to avoid usage of any repeaters.
2	Core Diameter	$62.5 \pm 3$ microns
3	Cladding Diameter	$125 \pm 2$ microns
4	Fiber Proof test	As per Manufacturer's standard
5	Coating Diameter	As per Manufacturer's standard
6	Number of Fibers/core	Four OR Six (Colour Coded) with min. 100% spare core (Fibers)
7	Standard	As per Manufacturer's standard
B	Numerical Aperture	
	0.275	
C	Bandwidth & Attenuation:	
1	Bandwidth @ 850 nm	160 MHz-Km min
2	Attenuation @ 850 nm	4.0 dB/Km max



<b>D</b>	<b>Cable Construction:</b> Optic Fibre cable shall be galvanized corrugated steel taped armoured, fully water blocked with central dielectric material	
1	Outer Colour	Orange
2	Outer Jacket	Polyethylene 1.0 to 1.5mm thick, Flame retardant & UV resistant.
3	Inner Jacket	Core-locked flame retardant polyethylene
4	Filler / Strength member	As per Manufacturer's standard
5	Central Strength member	Glass reinforced plastic (GRP) and Buckle resistant
<b>E</b>	<b>Stripping Ability</b>	All layers easily removed with Commercially available tools
<b>F</b>	<b>Installation:</b>	
1	Minimum bending radius	As per IEC/EIA & other international standard
2	Maximum Tensile Load	As per IEC/EIA & other international standard
3	Method of laying	Directly laid in cable trays / duct bank / clamped with available structure
4	Pulling	Ordinary cable grips
<b>G</b>	<b>Storage Temperature</b>	- 20 ° C to 60 ° C
<b>H</b>	<b>Operating Temperature</b>	- 20 ° C to 65 ° C
<b>I</b>	<b>Test Specification (EIA – STD – RS – 445 or Equivalent):</b>	
1	Impact Resistance	50 impacts
2	Crush	440 N/Cm
<b>J</b>	<b>Moisture Resistance</b>	Water blocking layer
<b>K</b>	<b>F.O. Cable Testing</b>	All Fiber Optic Cables shall be Tested as per IEC/EIA & other international standard using Optical Time Domain Reflector (OTDR) meter

Fibre optic cables routed underground shall be through suitable grade permanently lubricated HDPE protection pipe as per IS49884, IS12235 & TEC.G/CDS-08/01 of suitable size @ 53% fill factor.

#### 11.3.7 Data Cable

Data transmission cables are control & signal cables used in electronics of computer system, electronic control equipment etc. in power plant data processing system. The cable has an overall screening which suppresses external electrical influences and ensures precise pulse transmission. The screen braiding of tinned copper wires is wrapped around the core or inner sheath.



- i) Min. bending radius for flexing : 15x cable diameter.
- ii) Temp. Range : (-30 to +80) deg. Centigrade
- iii) Loop resistance : Max.78.4 ohm/km.
- iv) Inductance : 0.65 mH / Km.
- v) Coupling : 200 pF / Km.

Co axial and fibre optic cables are also used as data cables.

**NOTE:** All cables near high temperature zone shall be high temp cables, which shall be terminated at a junction box in normal temperature zone. Thermocouple extension cables and copper conductor cables for high temperature applications shall be with insulation of individual conductor and outer sheath of extruded FEP (i.e. Teflon) as per VDE 0207 Part 6 and ASTMD 2116. The thickness of insulation shall be 0.5 mm nominal (i.e. 0.4 mm minimum). These cables shall be single / Multipair twisted & shielded.

#### 11.3.8 Instrumentation cable interconnection and termination philosophy

The cable interconnection philosophy to be adopted shall be such that extensive grouping of signals by large scale use of field mounted Group JBs at strategic locations (where large concentration of signals are available, e.g. switchgear) is done and consequently cable with higher number of pairs are extensively used. The details of termination to be followed are mentioned below.

Application		Type of termination		Type of cable
FROM (A)	TO (B)	END A	END B	
Valves/ Dampers drives (Integral Junction box)	Marshalling cubicle / local group JB / Termination / Control Cabinets / System Cabinets	Plug in connector	Post Mounted Maxi termi/ cage clamp type	N
Transmitters	Integral Junction box	Plug in connector	Maxitermi/ cage clamp (rail mounted) type	M
MCC/SWGR	Marshalling Cubicle /local group JB / Termination / Control Cabinets / System Cabinets	Maxitermi/ cage clamp (rail Mounted) type	Post mounted Maxi termi/ cage clamp type	N
Local Junction box, MCC / SWGR	Group JB	Maxitermi / cage clamp (rail mounted) type.	Maxitermi/ cage clamp (rail mounted) type	N
Field mounted	Group JB	Maxitermi /	Maxitermi/	N



Application		Type of termination		Type of cable
FROM (A)	TO (B)	END A	END B	
Instrument / Switches		cage clamp (rail mounted) type.	cage clamp (rail mounted) type	
Inter marshalling termination cabinet	Electronic system cabinet	Post mounted Maxitermi / cage clamp type	Post mounted Maxitermi / cage clamp type	M & N
Marshalling termination in cabinet	Desk mounted equipments	Post mounted Maxitermi / cage clamp type	Plug-in connector / Cage clamp type (rail mounted)	M & N
Motor current transducer in MCC	PLC system	Post mounted Maxitermi / cage clamp type	Plug in connector/ Cage clamp type (rail mounted)	M
PLC cabinets	PC, Printers	Plug in connector	Plug in connector	Mfr's std. However, connection between PLC and the remote I/Os shall be through fibre optic cable by Bidder if length is>300 M & coaxial cable if length<300 M
Detectors / Any loop device	Detector / Isolator / Interface Unit	-	-	Shielded twisted, PVC Cu. FRLS cables type S – This cable shall satisfy requirements of Article 760 NFPA 70.
JB	Fire Alarm Panel			Shielded twisted, PVC Cu. FRLS cables type S – This cable shall satisfy requirements of Article 760 NFPA 70.

### 11.3.9 Cable installation and Routing

All cables assigned to a particular duct/conduit shall be grouped and pulled in simultaneously using cable grips and suitable lubricants. Cables removed from one duct/conduit shall not be reused without approval of Owner.



Cables shall be segregated as per IEEE Std.-422. In vertically stacked trays, the higher voltage cable shall be in higher position and instrumentation cable shall be in bottom tier of the tray stack. The distance between instrumentation cables and those of other system shall be as follows:

From 11 kV/6.6 kV/3.3 kV tray system	-	914 mm
From 415V tray system	-	610 mm
From control cable tray system	-	305 mm

Cables shall terminate in the enclosure through cable glands. All cable glands shall be properly gasketed. Fire proof sealing to prevent dust entry and propagation of fire shall be provided for all floor slots used for cable entrance.

All cables shall be identified by tag. Nos. provided in Owner's approved format at both the ends as well as at an interval of 5 meters.

Line voltage drop due to high resistance splices, terminal contacts, insulation resistance at terminal block, very long transmission line etc. shall be reduced as far as practicable.

The cables emanating from redundant equipment / devices shall be routed through different routes.

#### 11.3.10 Cable laying and Accessories

##### A) Cable laying

Cables shall be laid strictly in line with cable schedule.

##### B) Identification tags for cables:

Indelible tags to be provided at all terminations, on both sides of wall or floor crossing, on each conduit/duct/pipe entry/exit, and at every 20 m in cable trench/tray.

##### C) Cable tray numbering and marking:

To be provided at every 10m and at each end of cable way & branch Connection.

##### D) Joints of cable shall not be permitted.

##### Buried cable protection

With concrete slabs; route markers at every 20 meters along the route & at every bend.

##### E) Road crossings

Cables to pass through buried high density PE pipes encased in RCC. At least 300 mm clearance shall be provided between:



- HT Power & LT Power cables,
- LT Power & LT Control/Instrumentation cables,

Spacing between cables of same voltage grade shall be in accordance with the derating criteria adopted for cable sizing.

F) Segregation (physical isolation to prevent fire jumping)

- a) All cable associated with the unit shall be segregated from cables of other units.
- b) Interplant cables of station auxiliaries and unit critical drives shall be segregated in such a way that not more than half of the drives are lost in case of single incident of fire.

G) Cable clamping

All cables laid on trays shall be neatly dressed up & suitably clamped/tied to the tray. For cables in trefoil formation, trefoil clamps shall be provided.

H) Optical Fiber cables

For cables to existing central control room, bidder shall use the existing cable trays.

FO cables which are buried, shall be buried in a separate trench approximately at 1 meter depth & to be laid in 2" GI / rodent proof HDPE conduits covered with sand, brick, and soil along the pipe line route.

While crossing roads - to be laid in GI / rodent proof HDPE conduits with sand filling at bottom and sand, soil filling at top with cement concrete.

While crossing canals/river- to be laid in GI/ rodent proof HDPE conduits within hume pipe.

Bidder shall supply and install all cable accessories and fittings like Light Interface Units, Surge suppressors, Opto isolators, Interface Converters, Fiber Optic Card Cage, Fiber Optic Line Driver, Modem (for Optical Fiber Cables), cable glands, Grommets, lugs, termination kits etc. on as required basis.

Bidder shall furnish two completely new sets of cable termination kits like Crimping tools, maxi-termi / wire-wrap tools etc., which are required for maintenance of the system as per the type of termination used.

Separate cable tray for all the cable of CW system and main plant CCR shall be laid by the bidder.

#### 11.3.11 Conduits

All rigid conduits, couplings and elbows shall be hot dipped galvanized rigid mild steel in accordance with IS :9357 Part-I and Part- II. The conduit interior and exterior surfaces shall have continuous zinc coating with an overcoat of



transparent enamel lacquer or zinc chromate. Flexible conduit shall be heat resistant lead coated steel, water leak, fire and rust proof. The temperature rating of flexible conduit shall be suitable for actual application. Test Certificates for conduit shall be furnished by the Bidder.

#### 11.3.12 Type and Acceptance Tests for Instrumentation Cables

After completion of manufacture, type and acceptance tests as specified in relevant standards and herein shall be conducted and requisite number of copies of test certificates as per Distribution Schedule shall be furnished.

The Owner may, at his discretion, waive type tests provided type tests reports of tests carried out on identical materials(s)manufactured by the Bidder in India are furnished. The Bidder shall furnish copies of such type test reports with the Bid or indicate when they expect to make these available. After completion of manufacture, following minimum type and acceptance tests as specified in relevant standards and herein shall be conducted and requisite number of copies of test certificates shall be furnished. The Owner may, at his discretion, waive type tests provided type tests reports of tests carried out on identical materials(s)manufactured by the Bidder in India are furnished. The Bidder shall furnish copies of such type test reports with the Bid or indicate when they expect to make these available.

##### I. Type Tests:

The type tests shall be carried out on one drum out of every 10 drums or less for each size of cable in each lot, in presence of Owner's representative as per applicable standards in Govt. approved Laboratory if adequate testing facility is not available at works of the supplier.

Sr. No.	Name of Test	Governing standard	Special requirements as per Owner's specification.
1.	Annealing test (for copper)	IS : 8130/84	As per IS: 8130/84
2.	Conductor resistance test		As per G.T.P.
3.	Per sulphate test (for tinned copper wire)	IS : 8130/84	As per IS: 8130/84
4.	Test for armours wires /strips	IS : 3975	As per IS:3975
5.	Test for measurement of DC resistance of armour	IS: 1554 (I)	As per GTP
6.	Test for measurement of thickness of insulation & sheath & other dimensions.	IS 694 / IS : 1554 (I)	As per GTP
7.	Measurement of volume resistivity of HRPVC insulation	IS : 5831-1984	$3.5 \times 10^{14}$ Ohm-cm at 27°C / room temp. (Min). $3.5 \times 10^{11}$ Ohm-cm at 85°C (Min.)



Sr. No.	Name of Test	Governing standard	Special requirements as per Owner's specification.
8.	Tensile strength and elongation test for insulation & sheath.	IS:5831/1984	As per IS:5831/84
9.	Ageing test for insulation & sheath. Loss of mass test for PVC insulation & sheath.	IS:5831/1984	As per IS:5831/84
10.	Shrinkage test for PVC insulation & sheath.	IS:5831/1984	As per IS:5831/84
11.	Shrinkage test for PVC insulation & sheath	IS:5831/84	As per IS:5831/84
12.	Hot deformation test for PVC insulation & sheath	IS:5831/1984	As per IS:5831/84
13.	Cold bend test for PVC insulation.	IS:5831/1984	As per IS:5831/84
14.	Cold impact test for PVC sheath.	IS:5831/1984	As per IS:5831/84
15.	Heat shock test for PVC insulation & sheath.	IS:5831/1984	As per IS:5831/84
16.	Thermal stability test for PVC insulation and sheath.	IS:5831/1984	As per IS:5831/84
17.	Test for bleeding and blooming of pigments for PVC insulation of sheath.	IS:5831/1984	As per IS:5831/84
18.	Colour fastness to water.	IS:5831/1984	As per IS:5831/84
19.	Colour fastness to day light.	IS:5831/1984	As per IS:5831/84
20.	High voltage test (water immersion test)	IS:1554(I)	IS:1554(I)
21.	Test for rodent & termite repulsion property of sheath.	-	Presence of lead shall be detected.
22.	Oxygen index test on inner & outer sheath material.	ASTM:D-2863/77	Min.29
23	Temp. index test on inner & outer sheath material	ASTM:D-2863/77	Min.250°C
24	Acid gas emission test on inner & outer sheath material.	IEC-754-1	Acid gas generation shall be less than 20% by weight.
25.	Smoke Density test on inner & outer sheath material	ASTM-D-2843/77	Min. 40% light transmission during test.
26.	Flammability test on finished cable samples as per following methods:		



Sr. No.	Name of Test	Governing standard	Special requirements as per Owner's specification.
	i. Swedish chimney test ii Vertical tray flame propagation test. iii. Single vertical cable fire resistance test.	SS-424-14-75 Cl. F-3 IEEE-383  IEC-332-1	SS-424-14-75 Cl. F-3 IEEE-383  IEC-332-1
27.	Tests for all electrical properties at 20°C & maximum operating temp. as per GTP.	As per GTP	As per GTP

## II Routine Test:

Routine test shall be carried in presence of Owner's representative for all types of cables.

- |                         |             |                           |
|-------------------------|-------------|---------------------------|
| 1. High voltage test    | IS:1554 (I) | 2 KV (RMS) for one minute |
| 2. Conductor Resistance | IS:8130/84  | As per GTP Test           |

## III Acceptance Tests:

Following tests shall be carried out on 1 drum out of every 10 drums or less for each size of cables in each lot, in presence of Owner's representative.

- |   |              |   |
|---|--------------|---|
| 1. High voltage test  | IS:1554 (I)  | 2 KV (RMS) for one minute   |
| 2. Conductor Resistance Test  | IS:8130/84   | As per NIT  |
| 3. Volume Resistivity   | IS:5831-1984 | (i) $3.5 \times 10^{14}$ -cm at 27 deg C/room temp (Min)<br><br>(ii) $3.5 \times 10^{11}$ ohm-cm at 85 deg C Min. |
| 4. Measurement of Mutual capacitance at 0.8 KHZ   |              | 100 NF/Km (max)   |
| 5. Calculation & Verification of Characteristic impedance on the basis of value obtain for mutual capacitance at 0.8 KHZ with the help of following formula |              |   |

$$Z = \frac{R}{2fc} \text{ 320 Ohms(nominal)}$$



where

Z = characteristic impedance in ohm

R = Loop resistance of cable per km in ohms at 20 0C

f = Frequency of test in Hz (800)

c = mutual capacitance per km.

6. Measurement of thickness of insulation and sheath & other dimensions	IS:1554 (I)	As per NIT
7. Tensile strength and elongation at break of insulation & sheath	IS:5831/84	IS:5831/84
8. Oxygen index test on inner & outer sheath at room temp.	ASTM-D-2863	Min.29
*9. Temp. index test on inner & outer sheath	--do--	Min.2500C
*10. Acid gas emission test on inner sheath & outer sheath	TEC-754-1	Max.20% by weight
11. Smoke density test on inner sheath & outer sheath	ASTM-D-2843	Min.40% light transmission during test
12. Flammability test	SS-424-14-75 Class F-3	SS-424-14-75 Class F-3

\* (If no. of drums selected for acceptance test for a particular cable size are more than one, the tests marked with \* i.e. 5 no. 9 &10 under acceptance tests shall be carried out on one drum only).

#### 11.3.13 Shop Tests

General Requirements:-

1. The equipment as per this section shall be subject to shop tests.
2. The Conductor shall furnish all materials, equipment, tools, instruments, bulkheads, blanking plates and all personnel required for completing these tests.
3. Personnel performing the tests shall be qualified and experienced. Tests shall be performed as many times as necessary to assure Proper quality of



materials and workmanship. If any test reveals Unsatisfactory materials or workmanship, such materials shall be Repaired or replaced to the satisfaction of the Owner.

4. Hydrostatic and pneumatic tests shall be performed on all pipes, Tubings and systems supplied by the Bidder and shall conform to ANSI B31.1 - Code for Pressure Piping.
5. Hydrostatic Testing

All instrument piping, which connects to process piping, shall be hydrostatically tested.

#### **11.3.14 Contract Quantities**

The Bidder shall furnish, test all required erection hardware which is necessary for proper installation and interconnection of the equipment/systems furnished by the Bidder as per this specification and their integration with main equipment/systems as per the requirements of this section, enclosed installation drawings and other applicable clauses. The Bidder shall furnish, all hardware and accessories to ensure that the equipment/systems furnished form a complete and operational system.

The Bidder's scope of work shall include supply and testing of impulse pipe lines, pipes, pneumatic pipes/tubing, valves, valve manifolds, fittings and all other accessories required for completeness of Impulse Piping System, Sampling piping system and Air piping system covering both air supply and pneumatic signal lines.

The quality of the erection hardware/equipment used for complete instrumentation and control equipment shall meet all the requirements indicated in the foregoing clauses.

The quantities of erection hardware/equipment to be supplied as part of the bid shall be to meet the complete requirements of the Controls and Instrumentation package and make it functional as per final detailed engineering. The erection hardware listed does not include bolts, nuts, angles, clamps, fixtures, glands and other hardware normally required for erection of equipments offered. These items shall be included whether specifically listed or otherwise by the bidder.

#### **12.0.0 PANEL AND DESKS**

##### **12.1.0 General Requirements**

- 12.1.1 All PLC/control system's electronic modules, power supply components, other control devices (except field mounted sensors/transmitters) and required for completeness of the system shall be housed in cabinets furnished by the Bidder. All equipment and dedicated cabinets required for termination, marshalling and proper interface within Bidder's system and also with other systems shall also be provided by the Bidder.



- 12.1.2 The cabinet mounted equipment shall be fully assembled, installed in mounting racks, wired and fully tested as per specification requirements and Owner approved drawings in the manufacturing works of a qualified manufacturer prior to shipment to the project site.
- 12.1.3 The Bidder shall ensure that the cabinets are complete and ready for installation before dispatch from manufacturing works. The installation work at project site for these cabinets should only involve connections through multi pair cables from marshalling cabinets (wherever provided) to system cabinets.
- 12.1.4 The Control cabinets shall house all types of modules / hardware to achieve all functions of Control System including signal conditioning modules, controller modules, I/O modules, communication controller modules, interposing relays and all other requisite hardware for a complete system.
- 12.2.0 Relay Based Local Control Panel/Desktop**
- 12.2.1 Local control panel shall be of 2.5 mm steel construction, free standing type, totally enclosed dust and vermin proof with enclosure protection class of IP-65 as per IS: 13947 Exterior color shall be as per shade no. RAL 7032 and Interior color shall be Brilliant white. Panel shall be mounted on vibration dampers secured to steel frame on to the floor. Equipment and relays mounted on the panel shall be easily accessible. The panel shall be supplied completely wired upto terminal blocks for connecting external cables entering the panel from the bottom. Blank removable gland plate shall be provided with double compression type cable glands/conduits knockout along with the panel.
- 12.2.2 Terminal block shall be rated 600 volts minimum and shall have strap screw less terminals suitable for connection with 2x2.5 sq mm copper conductors on each side. Terminal block shall be provided with white marking strips. Fuses shall not be mounted on terminal blocks. At least 20 percent spare unused terminals shall be provided on terminal block.
- 12.2.3 Relays, timers and other devices mounted on the panel shall have clearly visible identification marking. All fuses shall be HRC semiconductor type of AC supply. HRC link & fuse shall be of removable type having 45 kA rupturing capacity (min) for protection of various circuits.
- 12.2.4 The panel shall be provided with a 50x6 mm tinned copper earthing strip running throughout the length of the panel at the bottom. Panel shall be provided with space heaters with isolating DPN MCB, and thermostats, LED based illuminating lamps, complete with door switches; and 2 nos. 6 pin 5/15amps sockets with DPN MCB.
- 12.2.5 Panel shall have removable lifting eye bolts for safe lifting from top during handling. Control power supply shall be provided from dual redundant feeders with auto change over scheme, surge protection devices and Power/Volt/AM meter.
- 12.2.6 The panel shall be provided with push buttons, indicating lamps, annunciations, indicating instruments, interlock/ deinterlock switches etc., required for the complete system. Colored Mimic for respective plant lay out shall be provided.



- 12.2.7** 20% spare relays of each type and rating shall be mounted and wired in relays control panel/Desktop. All contacts of relays shall be terminated in terminal blocks of relay control panel/Desktop, Additionally in the relay control panel/Desktop, 20% spare terminal blocks shall be 'provided so that additional relays can be mounted and wired.
- 12.2.8** The annunciation system shall consist of panel mounted audio-visual windows of 50x75 mm provided with plug-in-type solid-state logic 16 nos. high intensity LEDs in parallel. Each local panel shall be provided with 30 nos min. facia windows. Initiating contacts may be either NO or NC; a jumper or switch shall be provided in each card to make it suitable for either type of contact. A set of acknowledge, reset and test push buttons shall be provided on the panel. All printed circuit boards shall be of epoxy fibre glass construction.
- 12.2.9** The sequence of annunciation shall be as follows:

<b>Condition</b>	<b>Visual</b>	<b>Audible</b>
Normal	OFF	OFF OFF
Alarm	Flashing	ON
Acknowledge	Steady	OFF
Return to Normal:		
a. Before acknowledge	Flashing	ON
b. After acknowledge	Steady	OFF
Reset:		
a. Alarm condition	No Change	No change
b. Return to normal	OFF	OFF

**12.3.0 Supervisory Control Panels and Desks**

**Control Desks**

- 12.3.1** Supervisory control desks for PLC and other systems shall be supplied for mounting the required operating station as mentioned and specified elsewhere in the specification. All furniture including chairs and tables for printers etc. shall also be provided by the bidder.
- 12.3.2** Industry standard wheel chairs with provision for adjustment of height shall be provided for the operator & other personal in control rooms. These shall be designed for sitting for long duration such that these are comfortable for the back. The exact details shall be finalized & approved by Owner during detailed engg.
- 12.3.3** Steel Almirahs shall be provided for keeping documents in control rooms. Glass doors for each rack shall be provided such that the documents are



visible from outside. Size of the rack shall be sufficient to easily fit technical manuals. The exact details shall be approved by Owner during detailed engg.

- 12.3.4 Suitable lockers (min. 4 nos) shall be provided in package control rooms for storing of personal articles of control room personnel. Details shall be finalized and approved by Owner during detailed engineering.
- 12.3.5 All furniture including chairs and tables for printers etc. shall also be provided by the bidder.
- 12.3.6 Care shall be taken to ensure ergonomically aspects so as to create ergonomically ideal work place considering physical aspects such as an average Indian person's size and reach, physiological aspects such as line of sight and field of vision and cognitive factors such as concentration and perceptivity. Extreme care shall be taken to design the desks with correct angles and dimensions.
- 12.3.7 Anti-shock matting for the panel shall be laid by the Bidder.
- 12.4.0 Termination/Marshalling Cabinets & Interposing Relay Panel**
- 12.4.1 Marshalling/Termination cabinets for the system shall be supplied for terminating all cables originating from the field, MCC/SWGR or any other source of signal and for distributing the signals to different functional panels and cubicles.
- 12.4.2 Incoming cables from the field, MCC/SWGR or any other source of signal shall be terminated in suitable terminal blocks in logical sequence.
- 12.4.3 Prefabricated cables with plug in connectors at both ends shall be used for extending the signals to the functional panels. Matching plug sockets shall be provided in the termination cabinets for terminating the plugs.
- 12.4.4 Interposing relay panels for the system shall be supplied for mounting interposing relays & terminating all cables originating from the DO cards and for distributing the signals to different MCC/SWGR panels and cubicles. IPR panels shall be placed in LCR.
- 12.4.5 The cabinet shall have internal illumination lighting fixtures.
- 12.4.6 Terminal blocks shall be located inside the cabinets on support wings fabricated of metal plates.
- 12.4.7 The plug socket shall be mounted on hinged plates to provide an access to the rear pins of the plugs.
- 12.4.8 General features of termination cabinets and accessories shall conform to the general design and construction specification of panels. Terminal blocks shall be Rail mounted Terminal blocks (Screw less cage clamp type) with markers.



#### 12.5.0 Constructional Features Of Panels, Consoles, Cubicles& Enclosures

- 12.5.1 All panels, cubicles, consoles, SOV panels and enclosures furnished as per this specification shall be of free standing type and shall be constructed of specified gauge of steel plates. The panel sheet thickness shall be not less than 2 mm. vibration isolating
- 12.5.2 The panels, consoles/desks shall be reinforced as required to ensure true surfaces and adequate support for instruments mounted thereon. All instrument cutouts, mounting studs, and support brackets shall be accurately located. All welds on the exposed panel surfaces shall be ground smooth. Finished panel surfaces shall be free from waves, bellies, or other imperfections. Unless specified, otherwise, panel doors shall be 4 points hinged and shall have turned back edges and additional bracing where required to ensure rigidity. Door hinges shall be of the concealed type. Door latches shall be of the three-point type to ensure tight closing. Door locks shall be furnished which will allow actuation of all locks by a single master key. All panels shall have removable lifting fire s for safe lifting from top during storage and installation handling.
- 12.5.3 Cabinet doors shall be hinged and shall have turned back edges and additional braking where required ensuring rigidity. Hinges shall be of concealed type. Door latches shall be of three-point type to assure tight closing. Detachable lifting eyes or angles shall be furnished at the top of each separately shipped section and all necessary provisions shall be made to facilitate handling without damage. Front and rear doors shall be provided with locking arrangements with a master key for all cabinets. If width of a cabinet is more than 800 mm, double doors shall be provided.
- 12.5.4 All panels shall be mounted on vibration dampers, which are secured to channels mounted on the floor. The channels shall be field welded to steel plates set into the concrete flooring. The steel plates shall be located such as to approximate the outline of panel bases. The exact mounting details shall be as approved by the Owner during detailed engineering stage. All panels shall be provided with adequate ventilation and packaging density of components shall be restricted so as to limit the temperature rise above ambient to 10°C under the worst conditions. All panels shall have auto on/off switch for internal lighting. All the power supply circuit for control panels shall be provided with auto changeover circuitry.
- 12.5.5 In each panel /cabinet, a 24 VDC Voltmeter digital type shall be provided to check the field interrogation voltage.
- 12.5.6 Exhaust fans with louvers & filters shall be provided on upper side to remove hot air in all consoles and panels.
- 12.5.7 Fire/Smoke detectors shall be provided inside the Control room mounted system/control cabinets.
- 12.5.8 Feeder failure/ healthy indication shall be provided in each cabinet & remote indication shall be hooked up to PLC/annunciation & suitably grouped.



- 
- 12.5.9 All the panels shall be equipped with Anti vibration pad of min. 15 mm size. Cable gland plate thickness shall be 3 mm.
  - 12.5.10 Panel shall be sealed for external dust.
  - 12.5.11 Doors shall be provided with neoprene gasket only.
  - 12.5.12 Surface Preparation and Painting

All panel exterior steel surfaces shall be ground smooth, and painted as specified below: Suitable filler shall be applied to all pits, blemishes and voids in the surfaces. The filler shall be sand blasted so that surfaces are level and flat, corners are smooth and even. Exposed raw metal edges shall be ground burr free. The entire panel surface shall be sand blasted to remove rust and scale and all other residue due to the fabrication operation. Oil grease and salts etc. shall be removed from the panels by one or more solvent cleaning methods. Alternatively 7 tank process shall be followed.

Two spray coats of inhibitive epoxy primer – surface shall be applied to all exterior and interior surfaces; each coat of primer surface shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final finish colour (Catalyzed epoxy finish) shall be applied to all surfaces of dry film thickness 2.0 mil. The finish colours for exterior and interior surfaces shall conform to the following shades:

Exterior - RAL7032

Interior - Brilliant white

The above color shade shall be applicable and uniformity shall be maintained for the complete plant.

Paint films, which show sags, checks, blisters teardrops, fat edges or other painting imperfections, shall not be acceptable and if any such defects appear, they shall be repaired by and at the expenses of the Bidder.

#### 12.6.0 Panel Wiring

- a. Interconnecting wiring shall be provided between all electrical devices mounted in the panels, and between the devices and terminal blocks if the devices are to be connected to equipment outside the panels. The Bidder shall install jumpers between terminal blocks as indicated on the Owner's schematic diagrams. All alarm contacts located within a panel shall be wired to terminal blocks. Thermocouple and other special circuits shall be field wires direct to instrument terminal blocks without the use of panel wiring.
- b. All Control and Instrument wiring used within the panels shall confirm to NEC and NEMA standards and shall be factory installed and tested at the works of a qualified manufacturer. All interior wiring shall be installed neatly and carefully, and shall be terminated at suitable terminal blocks. Sufficient clearance shall be provided for all Control and Instrumentation leads, and all incoming and outgoing leads shall be connected to terminal blocks suitably



located for connecting external circuits. The arrangements for circuits and terminal blocks shall agree with schematic diagrams furnished by the Owner. All panel wiring shall have appropriate ferruling for clear identification. Interior wiring shall be so arranged that the external connections can be made with only one wire per terminal point. Any common connections shall be made internal side of the terminal blocks. Common connections shall be limited to two wires per terminal. Instrumentation cable shield wires shall be connected to separate terminal at the terminal block.

- c. Signal circuit shields shall be grounded at the power supply end only or as recommended by manufacturer.
- d. All internal wiring (except low level instrument wiring) shall be National Electric Code Type SIS, Polymetric/Elastomeric insulated,  $1.5\text{mm}^2$  tinned copper stranded conductor, switchboard wire, or Owner approved equal.
- e. Panel wiring shall have a flame resistant insulation with adequately sized copper conductor based on current carrying capacities as etc forth by the National Electric Code.
- f. Wire sizes shall be as specified herein and suitable for intended applications.
- g. Wiring to door mounted devices shall be provided with (49 strand minimum) adequate loop lengths of hinge wire so that multiple door openings will not cause fatigue braking of the conductor.
- h. Wiring shall be arranged to enable instruments or devices to be removed and/or serviced without unduly disturbing the wiring. No wire shall be routed cross the face or rear of any device in a manner, which will impede the opening of covers or obstruct access to leads, terminals or devices.
- i. Panel wires shall be identified with wire number and each termination by means of Action craft products split sleeve or Borden Chemical Co. indelible tubing markers or Owner approved equal. Corrections and modifications of all panel wiring shall be Bidder's sole responsibility. Any corrections/modifications required at site for successful commissioning shall be done by the Bidder without any additional costs. Terminal lugs furnished must be of the compression, insulated sleeve, half ring tongue type. Open-ended terminal lugs will not be accepted. Wires shall not be looped around the terminal screws or studs.
- j. Wires shall not be tapped or spliced between terminal points.
- k. Panels, cabinets, consoles/desks will be provided with removable, gasketed cable gland plates and cable glands, for all floor slots used for cable entrance. Split type grommets shall be used for prefab cables.
- l. Internal wiring in factory prewired electronic systems cabinets may be installed according to the Bidder's standard as to wire size, insulation, and method of termination on internal equipment except that insulation for all wiring power supply wiring, and interconnecting cables between devices shall pass the following tests.



- Flammability test IEEE 383/1974
  - When tested under UITPP test method or ASTM 2893/77 light transmittance of 80%
  - When tested under IEC 754-1 maximum acid gas generation shall be 2% by weight
  - Oxygen index not less than 30 as per ASTM D 2863.
- m. All terminations for intra panel wiring inter panel cabling and connecting the Bidders panels, PB stations, control stations etc. shall be with cage clamp Screw less connections. Soldered connections are not acceptable. All field side or external input connections shall also preferably of cage Clamp/ Screwed less connection. Conductor Clamping shall also confirm to Standard IEC – 60947-1 & IEC-60947-7-1. Identification of conductors may be done by insulation colour coding identified on drawings or by printed wiring lists. Terminal blocks for connection of external circuits in to factory prewired electronic system cabinets shall meet all the requirements as described elsewhere in the specification. For all multicore cables, the outer sheath shall satisfy the properties identified above. However, for panel wiring, the wiring insulation shall also satisfy the properties identified above. The internal wiring shall be done in coloured wiring.
- n. Following wire size shall be utilized for internal wiring:
- 1) Current (4-20m A) : 0.75 sq.mm  
Low voltage signals  
(AI/AO & DI Signals)
  - 2) DO signals, Ammeter/  
Voltmeter circuit, control  
Switches, indicator, recorder
  - 3) Internal illumination : 2.5 sq.mm
  - 4) Size of Power supply cables shall be as below :-
    - i. 1 to 16 Amp - 2.5 sq.mm
    - ii. 17 to 20 Amp - 4 sq.mm
    - iii. 21 to 32 Amp - 6 sq.mm
    - iv. 33 to 40 Amp -10 sq.mm
    - v. 41 to 60 Amp -16 sq.mm
    - vi. Power earth - 4 sq.mm

#### 12.7.0 Instruments Mounting

Instruments and relays mounted on the panels shall be easily accessible for repair and replacement without disturbing other equipment their connected wiring. No special tools shall be needed for the purpose.



#### 12.8.0 Panel Illumination

Panels shall be provided with LED based illuminating lamps with door switch and six (6) point 6/16A, 240V AC universal type power sockets with switch for maintenance purposes. These switches shall be with quick make and break mechanism.

#### 12.9.0 Fuse Blocks

Where fuse blocks rated 30 amp. 250 Volts are required by the specifications or the manufacturer's design, they shall be modular type with Bakelite frame and reinforced retaining clips. Blocks shall be class H.2 pole, screw terminal fuse blocks. Blocks for other current and voltage ratings shall be similar in construction.

#### 12.10.0 Fuses

All fuses shall be fast acting semiconductor types for AC supply .For all DC Powered devices, similarly the fuses shall be fast acting compatible to DCDB fuse provisions. All the power supplies shall be provided with the protection of Fast acting semi-conductor fuses & MCB. Make of Fuses shall be GE or Siemens only.

#### 12.11.0 Moulded Case Circuit Breakers

Moulded case circuit breakers used in equipment covered under these specifications shall have not less than 5000 amp, Interrupting capacity at 220 Volts DC 10,000 Amp. Symmetrical interrupting capacity at 240 Volts AC. MCCB shall be provided at each main feeder line like ACDB & DCDB main feeders, PLC main feeder, control panels, UPS circuits etc.

#### 12.12.0 Grounding

All panels and cabinets shall be provided with a continuous bare copper ground bus of minimum 6 mm x 25/50 mm cross section. The ground bus shall be bolted to the panel structure and effectively ground the entire structure. Each Ground bus shall have provision at each end for connection of ground leaks (6 mm x 50 mm GI Flats) by suitable bolting. All system cabinets shall be brought to a common system ground by the bidder. Electronic earthing resistance shall be less than 0.5 ohms.

Each circuit requiring grounding shall be individually and directly connected to the panel ground bus by ring tongue type compression lugs. For electronic system cabinets the system ground bus shall be insulated from the cabinet enclosure and shall be separately connected to the system ground. All system cabinets shall be brought to a common system ground by the bidder.

The Bidder shall furnish his recommendations regarding grounding requirements for all equipment/systems and shall specifically indicate the deviations if any from the above requirements as a part of his proposal.

Separate Electronic earthing Pit for PLC panel earthing shall be provided.



#### 12.13.0 Terminal Blocks

For all inputs to the system emanating from the field or other systems, the bidder shall furnish terminals suitable for correct size of field cables.

All outputs going to MCC/SWGR terminal blocks, shall be rated 600 volts minimum and shall have strap screw less terminals suitable for connection of wires with ring tongue type lugs. Standard terminal blocks shall be screw less cage clamps type WAGO/Phoenix make. Terminal blocks shall be approximately sized for larger wire size of higher voltage insulated incoming conductors as necessary. All the TBs used shall be 6.6 polyimide to withstand corrosion and the metallic portion shall be coated against rust/corrosion. All metal parts should be non-ferrous in nature.

Terminal blocks shall be provided with white marking strips and are permitted by the safety codes and standards shall be without covers.

Fuses shall not be mounted on terminal blocks. Neither step type terminal blocks nor angle mounting of terminal blocks will be acceptable.

At least 20 per cent spare unused terminals shall be provided on each terminal block for circuit modifications and for termination of all conductors in a multi-conductor control cable with each panel, enclosure, cubicle, SOV Boxes etc.

#### 12.14.0 Name Plates and Labels

Name plates of adequate size shall be provided for each panel on front and rear of the panel. Instruments/other accessories mounted inside the panels shall have identification marking clearly visible from inside.

Devices to be mounted on the panels shall also be labeled on the panels shall also be labeled on the outside of the panel. Name plates shall be of polyamide sheets with black letters on white background. Name plates shall be attached to the boards by means of stainless steel panhead screws. Fuses provided for protection of various boxes shall be accessible for replacement. Fuse boxes shall be provided with circuit label and fuse rated current and voltage.

#### 12.15.0 Markings/Labels

All markers/labels shall be made of halogen & silicon free polyamide material with inflammability class V2 as per UL 94, ensuring scratch proof printing with the use of environment friendly solvent free ink & latest BLUEMARK UV technology so as to comply the WIPE RESISTANCE according to DIN EN 61010-1/VDE 0411-1.

#### 12.16.0 Assembly and Inspection

As soon as the panel's fabrication is over, Owner shall inspect the panels and further work on the panels, namely assembly, wiring and assembly of components shall be carried out only after the inspection.



### **13.0.0 MATERIAL SUPPLY, WARE HOUSING, ERECTION, TESTING AND COMMISSIONING**

#### **13.1.0 Material Supply and Warehousing**

##### **13.1.1 General Requirements**

This section covers supplies – cum – services bidder's responsibilities for packing, shipping, ware-housing and the installation and commissioning of all equipment and materials furnished and installed under this specification for complete C & I system. Though specifically the work of dismantling of the existing equipment / instruments is not mentioned here it shall be assumed as an integral part of erection work .The work involved in dismantling is elaborated while defining the scope of work and scope of supply in this specification. The requirements of this section supplement other applicable sections of this volume.

##### **13.1.2 Delivery Schedule**

The equipments specified herein are required to be delivered at site as per the agreed schedule Owner indicated. The delivery schedule shall be clearly indicated and guaranteed.

##### **13.1.3 Crating**

All equipment and materials shall be suitably coated, wrapped or covered end boxed or crated for moist humid tropical shipment and to prevent damage or deterioration during handling and storage at the site.

Equipment shall be packed with suitable desiccants sealed in water-proof, vapour-proof wrapping, and packed in lumber or plywood enclosures, suitably braced tied and skidded. Lumber enclosures shall be solid, not slatted.

Desiccants shall be either silica gel or calcium sulphate, sufficiently ground to provide the required surface area and activated prior to placing in the packaging. Calcium sulphate desiccants shall be of a chemical nature to absorb moisture. In any case, the desiccant shall not be of a type that will absorb enough moisture to go into solution. Desiccants shall be packed in porous containers strong enough to withstand handling encountered during normal shipment. Enough desiccants shall be used for the volumes enclosed in the wrapping.

Review by the Owner or Consultant of the Bidder's proposed packaging methods shall not relieve the Bidder of responsibility for damage or deterioration to the equipment and materials specified.

All accessory items shall be shipped with the equipment. Boxes and crates containing accessory items shall be marked so that they are identified with the main equipment. The contents of each box and crate shall be indicated by marking on the exterior.



All boxes, crates, cases, bundles, loose pieces, etc. shall be numbered consecutively Form No.1 upward throughout all shipments from a given port to completion of the order without repeating the same number.

All itemized list of contents shall be enclosed inside each case, and one other copy securely fastened to the outside of the case in a tin or light weight sheet metal envelope or pocket. The lists shall be plainly marked and placed in accessible locations to facilitate receipt and inspection. The packing list shall indicate whether shipment is partial or complete and shall incorporate the following information on each container, etc. according to its individual shipping number:

- a) Export case markings.
- b) Case number.
- c) Gross weight and net weight in Kilograms
- d) Dimensions in centimeters.
- e) Complete description of material including order number.

Packaging or shipping units shall be designed within the limitations of unloading facilities and the equipment which will be used for transport. It shall be the Bidder's responsibility to investigate these limitations and to provide suitable packaging to permit safe handling during transit and at the job site.

Electrical equipment Control and Instrumentation shall be protected against moisture and water damage. All external gasket surfaces and flange faces, couplings, motor pump shafts, bearings and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other substantial type covering to ensure their full protection.

Coated surfaces shall be protected against impact, abrasion, discoloration and other damage. Surfaces which are damaged shall be repaired.

All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors. All female threaded openings shall be closed with forged steel plugs. All piping, tubing and conduit equipment collections shall be sealed with metallic or other rough usage covers and taped to sealed the interior of the equipment piping, tubing or conduit.

Provisions shall be made to ensure that water does not enter any equipment during shipment or in storage at the plant site.

Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Bidder's expense.

#### 13.1.4 Shipping

The Bidder shall be fully responsible for the safe and timely delivery of all equipment and materials furnished under this specification.



The Bidder shall discuss with the Owner, the routing of shipments and shall route the same as indicated by the Owner, provided freight rates are no greater than by other routes.

Shipment of all equipment and materials across land shall be by truck or rail. The Bidder shall take into consideration the effects of shock and vibration to equipment during transit and shall provide safeguards against same. Transfer of equipment between carrier vehicles shall be held to an absolute minimum.

Ships used for the transportation of equipment shall have the capability of on-board lifting and off-loading all shipments of equipment and materials. "On deck" shipment will not be permitted unless prior approval has been obtained from the Owner.

#### **13.1.5 Factory Assembly**

All trend recorders, cathode ray tubes, keyboards and printers shall be individually packed for shipment. Electronic control modules of plug-in type shall be removed from equipment racks after factory check-out and individually packed for shipment. Other equipment shall be fully assembled at the factory, except for necessary shipping splits in cabinets.

#### **13.1.6 Consolidated shipments**

Except where authorized by the Owner in writing, the Owner will not accept direct shipments of bidder furnished materials and equipment from sub-bidders. The bidder shall assembly-shipping units composed of those items of materials and equipment, which he obtains from sub-bidders. Shipping unit assembly shall be at one of the bidder's regular business addresses. Each item shall be tagged with its individual identification used on the drawings for this contract and shipped as part of as shipping unit to the construction site.

#### **13.1.7 Shipping List**

The Bidder shall submit to the Owner duplicate copies of shipping notices describing each shipment of material or equipment. The shipping notices shall be mailed to arrive approximately 3 days ahead of the estimated shipment arrival. The addressed for each shipping notice will be determined later.

#### **13.1.8 Materials List**

The Bidder shall prepare and submit with the first shipping notice duplicate copies of an itemized materials list covering all material and equipment furnished under these specifications. The materials list shall be in sufficient detail to permit an accurate determination of the completion of shipment.

#### **13.1.9 Inspection at Job Site**

The Bidder shall inspect all shipments upon arrival at the job site to determine possible damage or shortages and to record the equipment received in each shipment. The Bidder shall maintain accurate upto-date records of all equipment and materials received. These records shall be itemized for ease of comparison



with the materials list specified above. All damages shall be corrected promptly and to the satisfaction of the Owner. The bidder shall submit to the Owner copies of all receiving and damage reports for a shipment within two working days immediately following receipt of that shipment. All report forms shall be furnished by the Bidder and shall be acceptable to the Owner.

#### 13.1.10 Receiving and handling

The Bidder shall be responsible for the prompt unloading of all equipment and materials furnished by these specifications and shall pay all demurrage incurred. The Bidder shall handle all equipment and materials carefully to prevent damage or loss, shall store them in an orderly manner and shall keep adequate and convenient records of their location and shall keep a continuously accurate inventory.

The Bidder shall be responsible for the return of his own special containers and shipping devices.

#### 13.1.11 Warehousing

The Owner will provide open space for construction of a warehouse of appropriate construction for storage of the bidder's equipment and materials. The Bidder shall be responsible for the construction of the warehouse and the interior partitions as required to separate his assigned space from that of other parties. The bidder shall be responsible for the safety and security of his property while in the warehouse. Space requirements shall be as mutually agreed between the Bidder and the Owner.

#### 13.1.12 Storage

Stored equipment and materials shall be adequately supported and protected to prevent damage. Equipment shall be moved into the permanent buildings or onto its permanent foundation as soon as construction will permit.

Stored materials and equipment shall not be allowed to contact the ground. In warehouses that do not have dry concrete or suspended floors, materials and equipment shall be stored on platforms or shorting.

Strip heaters and similar heating devices furnished with electrical equipment shall be electrically connected to provide protection during storage. Heaters shall be energized immediately upon placement of the equipment in storage. Equipment not having integral heating devices shall be heated by alternate methods acceptable to the Owner.

Mechanical dehydrators provided in the cubicles shall be maintained in operation from the date of receipt of equipment until directed by the Owner.

All storage equipment excluding warehousing shall remain the property of the Bidder and shall be removed from the job site following construction.



### 13.2.0 Erection & Commissioning

#### A) General Requirements

1. This section describe the scope of Bidder's responsibilities for erection & commissioning of the equipment / system, supplied by the bidder as part of this specification though even not specifically brought out under Any Clause. In general, bidder shall erect and commission all the equipments supplied under his scope.
2. The Bidder shall prepare detailed installation drawings for each equipment furnished under this specification for Owner review. Installation of all equipment / system furnished by this specification shall be as per Owner approved drawings. In general bidder shall erect and commission all the equipments supplied under his scope.
3. Erection procedures not specified herein shall be in accordance with the recommendations of the equipment manufacturers. These procedures shall be acceptable to the Owner.

#### B) Work Included

The Bidder shall be responsible for furnishing materials and performing field construction as outlined below:

1. Furnish all constructional personnel, tools, materials and equipment required to perform the work included under these specifications.
2. Furnish, install, terminate all cables including prefabricated cables, instrumentation cable, special cables like coaxial, fiber optic cables (soft link) required for the interconnection of all the bidder furnished components. This shall also include termination of all cables at Bidder's panel as well as other end panel irrespective of the scope of cable and panels at the other end.
3. Prepare cable ends and train into place all cable ends which terminate in the I/O sub-system cabinets, panels, desks, console and annunciate or logic cabinets.
4. Check for continuity and terminate both ends of all cables, which terminate in the I/O sub-system cabinets, panels, and desks, consoles supplied under the specification.
5. Installation of all cables and accessories including cable trays from primary sensor / transmitters to first junction box / marshalling box in field.
6. Furnish and install all cable accessories such as lugs, cable glands for all JBs, enclosures, panels, desks, consoles supplied by Bidder.
7. Scope of supply, laying, installation, termination of cables and loop check outs are included under this specification .Bidder shall include all the cables his scope in this and confirm compliance to scope specifically in his bid.



8. The bidder shall be fully responsible for correct installation of all thermowells (in bidder's scope) welding on stubs provided by SG/TG vendor on process pipe lines, though welding of these thermowells on stubs will be done by the Bidder.
9. Transmitters/instruments shall be installed using fabricated supports which are attached to the vertical members provided for this purpose. Construction shall comply with mounting recommendations of the instrument manufacturers. Brackets, clamps and other employed in the construction of supports. Painting of fabrication shall conform to the requirements for enclosure interiors.
10. For all mosaic panel mounted instruments in bidders' scope necessary supports and fixtures shall be provided to maintain the aesthetic look of panel after the removal of mosaic grids for this purpose. All prefab cables and other accessories required for these panels mounted instruments installations are in bidder's scope.
11. Nameplates shall be provided for all instruments and devices or instruments are themselves provided with a service engraving. Embossed plastic nameplates of acceptable design shall be provided inside the panel section for all devices located there.
12. Each terminal point shall be clearly identified. Sample terminals shall be identified by name and number. Stamped metal tags attached with stainless steel wire shall be provided at the sample inlet bulk head fittings.
13. Control panels and desks shall be mounted on vibration dampeners which are secured to channels mounted on control room floor. The channel shall be field welded to steel plate set into the control room floor concrete. The panels and cabinet in bidder's scope shall be appropriately mounted so as to match the cutouts provided for each cabinet and panel.
14. Primary impulse piping shall be supported at an interval not exceeding 1.5 meter. The bidder shall provide necessary fixtures either by welding or by bolting on columns and structures to support the pipe. Hangers and other fixtures shall be provided either by welding or by bolting on walls, ceilings and structures to support tube trays. Aluminum tubing supports with all necessary fittings, spacers and clamps etc. shall be provided by bidder. The Bidder shall clearly identify through colour marking or by other means the different type of impulse pipes, isolating valves etc. before these are to be stored at site.

### C) Equipment Installation

The Bidder shall furnish all construction materials, tools & equipment and shall perform all work required for complete installation, commissioning of all equipment furnished under this specification. The scope of installation shall include all work up to and including placing the equipment in successful operation. Erection procedures not specified herein shall be in accordance with the recommendations of the equipment manufacturers.



#### D) Installation Materials

All materials required for complete installation of the equipment shall be furnished except concrete bases with anchor bolts and grouting which will be provided by the Owner.

#### E) Regulatory Requirements

All installation procedures shall conform with accepted good engineering practice and to all applicable governmental laws, regulations and codes.

#### F) Equipment Assembly

Equipment installed under these specifications shall be assembled if shipped unassembled. The equipment shall also be dismantled and re-assembled as required to perform the installation and commissioning work described in this specification.

#### G) Equipment Setting

All free standing instrumentation cabinets and panels shall be located within the construction tolerance of plus or minus 3% of the location dimensions.

#### H) Free Standing Equipment

Free-standing cabinets shall be attached to the floor on concrete equipment bases of supporting steel as indicated on the manufacturer's approved drawings and the Owner's plant arrangement drawings. The cabinets shall be shimmed for proper alignment before bolting them to the floor. Adjacent enclosures shall be shipped to maintain mutually level appearance before they are attached to the floor. Vibration isolating pads of min. 15 mm thickness shall be furnished for all cabinets.

#### I) Defects:

All defects in erection shall be corrected to the satisfaction of the Owner and the Engineer. The dismantling and reassembly of bidder furnished equipment to remove defective parts, replace parts or make adjustments shall be included as a part of the work under this specification

#### J) Equipment Protection

All equipment to be erected under this specification shall be protected from damage of any kind from the time of contract award until handing over of each unit.

The equipment shall be protected during storage as described herein. Equipment shall be protected from weld spatter during construction.

Equipment having glass components or equipment having other easily broken components, shall be protected during the construction period with plywood



enclosures or other suitable means. Broken, stolen or lost components shall be replaced by the bidder.

#### **K) Repair of Painted Surfaces**

After erection, touch-up paint shall be furnished and applied to all abraded or damaged areas on ship painted equipment surfaces.

Surfaces shall be properly prepared before application of paint. The touch-up paint shall be of a type equivalent of the shop paint.

#### **L) Equipment Location guidelines**

1. All individual items of equipment not located in cabinets or on panels and racks are located approximately according to the floor elevation and the nearest burning column.
2. Solenoid valves, electric to pneumatic converters and other control loop accessories not located in enclosures or mounted on valves shall be mounted in easily accessible protected locations near the components with which they are associated.
3. All instruments to be locally mounted (those not in instrument enclosures or on valves) shall be mounted on building walls, columns, or local stands approximately 152 mm above floor level. These local instruments shall be mounted to permit ease of adjustment. Local instruments shall not be located outdoors except when approved by the Owner.
4. All brackets, stands, supports, and other miscellaneous hardware required for mounting devices shall be furnished.
5. Permanent temperature wells on the main steam, hot reheat and cold reheat piping shall not be installed until steam blowing has been completed.
6. Any required adapting hardware such as pipe bushings, nipples, drilled caps and the like shall be provided for complete installation of control devices into process connections

#### **M) Installation of Field Mounted Instruments and Devices**

The Bidder shall submit installation drawings for all field mounted equipment furnished under this specification for Owner's approval. These drawings shall meet the requirements of this specification applicable codes and standards and recommendations of manufacturers of instruments / devices. All installation work under this specification shall be strictly as per installation drawings approved by the Owner.

#### **N) Piping Connections Guidelines:**

1. All equipment having piping connections shall be leveled, aligned and wedged in place but shall not be grouted or bolted prior to the initial fitting and



alignment of connecting piping. All equipment shall, however, be grouted or bolted to its foundation prior to final bolting or welding of the connection piping.

2. All flanged joints shall be checked and retightened after approximately 10 days of operation at normal operating temperature.

**O) Equipment Check-out:**

1. All equipment shall be cleaned after installation. Equipment subject to pressure differential shall be checked for leakage.
2. After erection, all equipment having moving parts, having electrical apparatus, or subject to pressure differentials shall be trial operated.

**P) Conductor Accessories**

All conductor accessories including terminal materials, lugs, splicing materials, markers, tying materials, support, grips, insulating compounds, tapes.. cable cushioning and glanding materials shall be furnished and installed by the Bidder, if the end wire preparation is necessary to fit cables to individual system elements or components (printed circuit cards).

Bidder's installation instructions shall be obtained for cable accessories. These instructions shall be in the possession of the craftsmen while installing the accessories and shall be available to the Owner for reference.

**Q) Splicing Connectors**

Splices in control or signal conductors shall be made with compression type half ring type terminals lugs. The lugs shall be jointed using bolts, booth lock washers and hex nuts, each being of copper or copper bearing metal. Bolt size shall match the opening in the terminal lug.

**R) Crimping Hand Tools:**

The crimping hand tools used in securing the conductor in the compression type connectors or terminal lugs shall be those made for that purpose and for the conductor sizes involved. The crimping tools shall be of the ratchet type which prevents the tools from opening until the crimp action is completed. Such tools shall be a product of the connector manufacturer.

**S) Maxi-termi Connections:**

The connections from control cubicles to termination cabinets and other cubicles shall be maxi-termi type. For this proper maxi-termi clips and maxi-termi tools insufficient quantities shall be arranged.

**T) Support Grips**

Cable support grips shall be either split or closed woven wire type.



#### **U) Wire and Cable Markers**

Markers for wire and cable circuits shall be made of halogen & silicon free polyamide material with inflammability class V2 as per UL 94, ensuring scratch proof printing with the use of environment friendly solvent free ink & latest BLUEMARK UV technology so as to comply the WIPE RESISTANCE according to DIN EN 61010-1/VDE 0411-1.

Markers for wire and cable circuits shall be arranged to include a marker board, non-releasing holding device, and cable fastening tail. The marker board shall not be less than 1 cm wide, 2 cm long and 0.5 mm thick. One side shall be roughened to hold black nylon marking ink. Identification shall be permanent and water proof. The holding device shall be designed to allow the fastening tail to pass around the cable through the holding device, and prevent the removal of the tail without cutting it loose from the marker.

#### **V) Lacing Materials:**

Lacing materials for field installed cable shall be non-releasing nylon ties.

#### **W) Splice Insulation:**

Splices in control and signal wiring shall be insulated with all-weather vinyl plastic electrical tape.

#### **X) Installation:**

Immediately prior to the installation of each cable or cable group, the raceway route to be followed shall be inspected and ascertained to be complete in installation and free of all materials detrimental to the cable or its placement. All cable assigned to a particular duct or conduit shall be grouped and pulled in simultaneously, using cable grips and acceptable lubricants.

All cables shall be routed as required by the circuit schedule.

If at any time during the progress of the work the Bidder finds raceway which appear inadequate to accommodate the assigned cable, he shall notify the Owner at once and shall discontinue any further work on the questionable raceway until advised by the Owner as to how he shall proceed.

All cables shall be carefully checked both as to size and length before being pulled into conduits or ducts. Cable pulled into the wrong conduit or duct or cut too short to rack, train, and splice as specified herein, shall be removed and replaced by and at the expense of the Bidder. Cable removed from one conduit shall not be installed in another conduit or duct without permission of the Owner.

#### **Y) Termination**

The termination of cable shall be in accordance with the following requirements:-

1. Train cable in place and cut squarely to required length. Avoid sharp bends.
2. Remove necessary amount of cable jacket and insulation without damage to the conductor.



3. Install terminals or connectors as required ensuring a firm metal-to-metal contact.
4. Terminate cable shields on one end only to the grounding bus provided in each I/O sub-system cabinets. Isolate these shields at field terminations and in junction boxes cabinets and panels when shielded cables connect between such equipment and the I/O sub-system cabinets.

**Z) Cables:**

The Bidder shall furnish and pull prefabricated cables required for the interconnection of Bidder furnished components located in the Control Equipment Room and the Main Control Room in accordance with the requirements of this specification. These cables shall meet IEEE 383 flame retardant standards and shall have FRLS properties as furnished.

The Bidder shall connect both ends of each prefabricated cable specified to be furnished with the system.

Additionally, the Bidder shall terminate all cables which terminate in the I/O sub-system cabinets and as per cable interconnection scheme furnished with the specification. The Bidder shall take into consideration that cable end preparation is required for all the I/O termination at his cabinets, panels, desks, consoles for each cable.

The bidder shall furnish and install all impulse piping, isolating valves, fittings etc. required for installation of all field mounted instruments.

The bidder shall furnish all necessary supports and fixtures and shall erect them correctly for installation of all panel mounted instruments.

All insulated conductors furnished and installed by these specifications shall be electrically tested after installation.

All circuits shall be tested with circuit complete except for connection to equipment. Any circuit failing to test satisfactorily shall be replaced or repaired and retested as directed by the Owner.

All equipment and labour required for testing shall be provided by the bidder.

**13.3.0 Test after Installation**

All prefabricated cables furnished and installed under this specification shall be electrically tested after installation.

All cables shall be tested with the circuit complete except for connections to equipment.

All circuit failing in test satisfactorily shall be replaced or repaired and retested by the

Bidder at his expense, as directed by the Owner.



Cables which are only terminated by the Bidder shall be checked for continuity as they are terminated.

All equipment and labour required for testing shall be provided by the Bidder. Test instruments shall be directly traceable to the National Physical Laboratories as far as calibration is concerned.

#### 13.3.1 Continuity, Identification and Short Circuit Tests

All insulated conductors shall be tested for continuity and checked for conductor identification. In addition, all insulated conductors of multi-conductor cable shall be tested for short circuit. Short circuit tests shall include all tests necessary to confirm that no conductor of a multi-conductor cable is short circuited to another conductor in that cable.

#### 13.3.2 Insulation Tests

All insulated conductors shall be tested with a 1000 Volt megger or an equivalent testing device. Insulation resistance measurements shall be made between each conductor ground and between each conductor and all other conductor of the same circuit. Minimum acceptable resistance values shall be 500 mega-ohms.

#### 13.3.3 Additional Tests and Checks

The Bidder shall perform additional tests and construction checks in accordance with the sections of this specification dedicated to shop and site tests.

#### 13.3.4 General Tools & Tackles and Special Calibration Instruments

- i. Bidder must offer general tools & tackles and special calibration instruments required during start-up, trial run, operation and maintenance of the plant.

S. No.	Details
1	Crimp pliers, for ferrules as per DIN 46228 Part 1+4, 0.14 - 10 mm <sup>2</sup> , lateral insertion, square crimp
2	Cable cutter for copper and aluminum conductors
3	Stripping tool, for wires and conductors of 4 - 16 mm <sup>2</sup> , self- adjusting, stripping length up to 18 mm, cutting capacity up to 10 mm <sup>2</sup> stranded /1.5 mm <sup>2</sup> solid
4	Screwdriver, bladed, matches all screw terminal blocks up to 4.0 mm <sup>2</sup> connection cross section, blade: 0.6 x 3.5 mm, without VDE approval
5	Screwdriver, blade: 0.6 x 3.5 x 100 mm, length 180 mm
6	The digital multimeters with volt sensor function as per the internationally applicable standards IEC/EN 61010. The devices can be used in the case of voltages of up to 600 V, category III or 1000 V, category II.



## ii. Special Tools and Tackles:

In case PLC is not available for trial run/commissioning and as the command from local start pushbuttons shall be completed through PLC. The testing and commissioning tool shall be used for Trial run/test operation of any drive in absence of PLC during initial trial run and commissioning. While the tool shall be used for all type of drives envisaged in the contract technical specification, it is designed to be operated for one drive at a time. Portable trolley mounted system completed with necessary hardware like controller, I/O cards, relays, power supply modules, display etc. for operating the drives and monitoring its parameter shall be supplied by the bidder.

## iii. Testing and Commissioning:

Bidder shall provide all testing facilities for each and every equipment/instrument in his scope as per detailed description provided in this specification. It is Bidder's responsibility for correct installations and commissioning of all equipment/instruments in his scope. Bidder shall provide a group of highly skilled personnel for installation and commissioning of the entire equipment's supplied under this scope.

## iv. Type Test Requirements:

### General Requirements

The Bidder shall furnish the type test reports of all type tests as per relevant standards and codes as well as other specific tests indicated in this specification. A list of such tests are given for various equipment in table titled TYPE TEST REQUIREMENT FOR C&I SYSTEMS at the end of this chapter and under the item Special Requirement for Solid State Equipment / Systems. For the balance equipment instrument, type tests may be conducted as per manufacturers standard or if required by relevant standard.

- (a) Out of the tests listed, the Bidder / sub-vendor / manufacturer is required to conduct certain type tests specifically for this contract (and witnessed by owner or his authorized representative) even if the same had been conducted earlier, as clearly indicated subsequently against such tests.
- (b) For the rest, submission of type test results and certificate shall be acceptable provided.
  - i. The same has been carried out by the Bidder / sub-vendor on exactly the same model / rating of equipment.
  - ii. There has been no change in the components from the offered equipment & tested equipment.
  - iii. The test has been carried out as per the latest standards along with amendments as on the date of Bid opening but not more than five (5) year back.



- (c) In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the Bidder / sub-vendor within the quoted price and no extra cost will be payable by the Owner on this account

As mentioned against certain items, the test certificates for some of the items shall be reviewed and approved by the main Bidder or his authorized representative and the balance have to be approved by the Owner

The schedule of conduction of type tests/ submission of reports shall be submitted and finalized during pre-award discussion.

For the type tests to be conducted, Bidder shall submit detailed test procedure for approval by Owner. This shall clearly specify test setup, instruments to be used, procedure, acceptance norms (wherever applicable), recording of different parameters, interval of recording precautions to be taken etc. for the tests to be carried out.

The Bidder shall indicate in the relevant BPS schedule, the cost of the type test for each item only for which type tests are to be conducted specifically for this project. The cost shall only be payable after conduction of the respective test in presence of authorize representative of Owner. If a test is waived off, then the cost shall not be payable.

### 13.3.5 Special Requirement for Solid State Equipment / Systems

The minimum type test reports, over and above the requirements of above clause, which are to be submitted for each of the major C&I systems Analyzer instruments, various PLCs etc. shall be as indicated below:

i) Surge Protections for Solid State Equipment's/ Systems

All solid state systems/ equipment's shall be able to withstand the electrical noise and surges as encountered in actual service conditions and inherent in a power plant. All the solid state systems/ equipment's shall be provided with all required protections that needs the surge withstand capability as defined in ANSI 37.90a/ IEEE-472. Hence, all front end cards which receive external signals like Analog input & output modules, Binary input & output modules etc. including power supply, data highway, data links shall be provided with protections that meets the surge withstand capability as defined in ANSI 37.90a/ IEEE-472. Complete details of the features incorporated in electronics systems to meet this requirement, the relevant tests carried out, the test certificates etc. shall be submitted alongwith the proposal. As an alternative to above, suitable class of IEC-60255-4 which is equivalent to ANSI 37.90a/ IEEE-472 may also be adopted for SWC test.

- ii) Dry Heat test as per IEC-68-2-2 or equivalent.
- iii) Damp Heat test as per IEC-68-2-3 or equivalent.
- iv) Vibration test as per IEC-68-2-6 or equivalent.
- v) Electrostatic discharge tests as per IEC 61000-4-2 or equivalent.
- vi) Radio frequency immunity test as per EN 50082-2 or equivalent.



vii) Electromagnetic immunity as per EN 61131-2 or equivalent.

Test listed at item no. v, vi, vii, above are applicable for front end cards only as defined under item (i) above.

### 13.3.6 Type Test Requirement For C&I Systems

Sl No	Item	Test requirement	Standard	Test to be specifically conducted	Owner's approval req. On test certificate	Remarks
Col1	Col2	Col3	Col4	Col5	Col6	Col7
1	Elect. Metering instruments	As per standard (col 4)	IS-1248	No	Yes	
2	Electronic transmitter	As per standard (col 4)	BS-6447/ IEC60770	No	Yes	
3	Instrumentation Cables Twisted & Shielded	No	Yes			
4	Pressure gauge	Degree of protection test	IS-2147	No	No	
		Temp interference test	IS -3624	No	No	
5	Temperature gauge	Degree of protection test	IS-2147	No	No	
6	Degree of protection test	Degree of protection test	IS-2147	No	No	
		As per standard (col 4)	BS 6134	No	No	
7	Level switch	Degree of protection test	IS-2147	No	No	
8	Control valves	CV Test	ISA 75.02	No	Yes	
9	Flow Nozzles & Orifice plate	Calibration	ASME PTC, BS 1042	No	Yes	
10	PLCs	All tests as per IEC-1131	IEC-601131	No	Yes	
11	Junction Box	Degree of Protection test	IS-13947	No	Yes	
12	Battery charger (Not required for inbuilt chargers)	Degree of Protection test		No	No	
		Short circuit current capability	IEC-60146-2	No	Yes	



Sl No	Item	Test requirement	Standard	Test to be specifically conducted	Owner's approval req. On test certificate	Remarks
Col1	Col2	Col3	Col4	Col5	Col6	Col7
		Temp rise test without redundant fans	Approved procedure, IEC 60146-2	No	Yes	
		SWC test	Approved procedure	No	Yes	
		Burn-in-test	Approved procedure	No	Yes	
		Efficiency	IEC-60146-2	No	Yes	
		Audible Noise test	IEC-60146-2	No	Yes	
		Fuse Clearing capability	Approved Procedure	No	Yes	
		Relative harmonic content	Approved Procedure	No	Yes	
		ESD immunity test	IEC-61000-2 - 9(1)	No	Yes	
		Radio interference	IEC-60146-2	No	Yes	
		Over load test on Inverter & charger	Approved procedure	No	Yes	
		Restart test	IEC 60146-2	No	Yes	
		Output voltage Harmonic content	Approved procedure	No	Yes	
		Insulation test	IEC 60146	No	Yes	
		Load tests	Approved procedure	No	Yes	
		Preliminary light load test	IEC-60146	No	Yes	
		Current division / Voltage division	IEC-60146-2	No	Yes	
13	Battery	As per standard (Col.4)	IEC-623 / IS 10918 for Ni-Cd, IS-1652 for Plante Lead Acid	No	Yes	
14	Voltage	Over Load test	Approved procedure	No	Yes	



### 13.3.7 Factory Acceptance Tests for PLC

GENERAL	1	FACTORY ACCEPTANCE TEST (FAT): (NOTE:1)	✓
	2	FACTORY ACCEPTANCE TEST (FAT) PROCEDURE: (NOTE:1)	✓
TEST REQUIREMENTS	3	TEST SHALL BE PERFORMED WITH THE COMPLETELY ASSEMBLED SYSTEM	✓
	4	COMPLETE I&C SOFTWARE AND PERFORMING ALL FUNCTIONS EXPECTED OUT WHILE IN ACTUAL SERVICE AND WITH SYSTEM CONFIGURATION AS FINALISED.	✓
	5	PROCESS INPUT/OUTPUT CONDITIONS AND OTHER LOAD ON THE SYSTEM TO BE STIMULATED EITHER BY HARDWARE/SOFTWARE.	✓
	6	ALL SYSTEM SOFTWARE and APPLICATION SOFTWARE TO BE LOADED AND OPERATIONAL ON THE SYSTEM PRIOR TO FAT	✓
	7	FAT TO BE CONDUCTED AT ELEVATED TEMP. OF 45 DEG C FOR MINIMUM 48 HOURS	✓
	8	FAT UNDER FOUR CYCLES OF VOLTAGE FLUCATIONS VIZ NOMINAL AT 110 % OF RATED VOLTAGE	✓
	9	PERFORMANCE TEST:	✓
	10	TOTAL SYSTEM CONFIGURATION DRAWINGS	
	11	FAT PROCEDURE CONSISTING OF:	
TEST DOCUMENTS DRAWINGS	12	(i) TEST EQUIPMENT	
	13	(ii) TEST ENVIRONMENT	
	14	(iii) TEST CONFIGURATION	✓
	15	(iv) TEST PROCEDURE	
	16	(v) TEST SCHEDULE	
	17	(vi) TEST VENUE	
	18	(vii) TEST REPORTS- SPECIMEN COPIES	
	19	FUNCTION DESIGN SPECIFICATION FOR EACH EQUIPMENT / SYSTEM	
PRELIMINARY CHECKLISTS	24	GENERAL APPEARANCE CHECK AND BILL OF MATERIALS CHECK	✓
	25	CONSTRUCTION CHECK AS PER OVER ALL GENERAL ARRANGEMENT DRAWINGS	✓
	26	DIMENSIONAL CHECK	✓
	28	LABELLING, TERMINAL ARRANGEMENT AND EQUIPMENT IDENTIFICATION CHECK	✓
	29	POWER SUPPLY VOLTAGE LEVEL CHECK and POWER 'LEDs -ON CHECK	✓
	30	COOLING FAN OPERATION CHECK	✓
	31	GROUNDING NETWORK CHECK	✓



ITEM	1	POWER SUPPLY UNDER VOLTAGE AND OVER VOLTAGE CHECK ( $\pm 10\%$ )	✓
	2	PROCESSOR and MAIN DATA BUS NETWORK REDUNDANCY CHECK, IF APPLICABLE	✓
	3	COMMUNICATION COUPLER IF APPLICABLE REDUNDANCY CHECK	✓
	4	COMMUNICATION MODULE OF THE CONTROLLER TO NETWORK REDUNDANCY CHECK, IF APPLICABLE	✓
	5	POWER SUPPLY REDUNDANCY CHECK	✓
	6	HARDWARE ON-LINE MAINTAINABILITY CHECK,	✓
CONTROLLER ENGINEER	9	CLOSED LOOP CONTROL SIMULATION CHECK	✓
	10	OPEN LOOP CONTROL SIMULATION CHECK	✓
	11	CONTROL LOOP RESPONSE CHECK	✓
	12	BUMPLESS AUTO MANUAL TRANSFER CHECK	✓
	13	OPERATING STATION - GRAPHIC OVERVIEW CHECK	✓
	14	OPERATING STATION- TREND CHECK	✓
	15	OPERATING STATION- REAL TIME TREND CHECK	✓
	16	OPERATING STATION- MIMICS CHECK	✓
	17	OPERATING STATION- CHECK FOR OPERATING CONTROL DIRECTLY FROM MIMICS	✓
	18	OPERATING STATION- FUNCTION KEYS CHECK	✓
	19	OPERATING STATION- TOUCH SCREEN FUNCTION CHECK	✓
	20	OPERATING STATION- ANALOG CONTROL DISPLAY CHECK	✓
	21	OPERATING STATION- SEQUENCE CONTROL DISPLAY CHECK	✓
	22	OPERATING STATION- OPERATOR GUIDANCE MESSAGE CHECK	✓
	24	OPERATING STATION LOGGING FUNCTION CHECK	✓
	25	OPERATING STATION / RESPONSE / UPDATING CHECK	✓
	26	KEYBOARD LOCK FUNCTION CHECK	✓
	27	OPERATING STATION INTERCHANGEABILITY and ASSIGNABILITY CHECK	✓
	28	PRINTER ASSIGNABILITY and BACK-UP FUNCTION CHECK	✓
	29	FLOPPY DISK/ STD / OPTICAL DISK UNIT STORAGE and RETRIEVAL CHECK	✓
	30	OPERATING STATION ASSIGNABILITY CHECK FOR HARD COPIER FUNCTION	✓
	31	PLANT PERFORMANCE CALCULATION CHECK	✓
	32	COMMUNICATION INTERFACE TO OTHER'S SYSTEM SIMULATION CHECK	✓



	33	DATA BUS DISTANCE BUILDING CHECK (REFER NOTE- 3)	✓
	34	GRAPHIC DISPLAY BUILDING FUNCTION CHECK	✓
MAINTENANCE	35	CLOSED LOOP CONTROL SYSTEM MODIFICATION CHECK	✓
	36	OPEN LOOP CONTROL SYSTEM MODIFICATION CHECK	✓
	37	ALARM DISPLAY PRIORITISATION CHECK	✓
	38	SYSTEM SECURITY CHECK	✓
	39	SYSTEM ALARM CHECK	✓
	40	SYSTEM DIAGNOSTIC FUNCTION CHECK	✓
	41	POINT DETAIL CONFIGURATION CHECK	✓
	42	CONTROL LOOP TUNING CHECK	✓
	43	SYSTEM SELF DOCUMENTATION CHECK	✓
NOTES	1.	THE INTENT OF THE FAT IS TO DEMONSTRATE AND ENSURE THAT THE I&C SYSTEM MEETS ALL THE FUNCTIONAL REQUIREMENTS AS INTENDED IN THE SPECIFICATION / CONTRACT. A COMPLETED INTEGRATED TEST OF THE SYSTEM SHALL BE CARRIED OUT AT VENDOR'S WORKS IN THE PRESENCE OF OWNER, ON COMPLETION OF INTEGRATION/ MANUFACTURING OF THE SYSTEM. THE SHIPMENT OF I&C EQUIPMENT TO SITE WILL BE EFFECTED ONLY AFTER THE FAT HAS BEEN ACCEPTED BY THE OWNER.	
	2.	FAT PROCEDURE SHALL BE PREPARED BY VENDOR AND TO BE SUBMITTED FOR OWNER'S/ APPROVAL WELL IN ADVANCE PRIOR TO THE COMMENCEMENT OF FAT	
	3.	FAT SHALL BE CONDUCTED WITH THE DISTANCE BETWEEN THE PROCESSOR AND OTHER SUPPORTING PERIPHERIALS AS PER THE FINAL LAYOUT IN THE CONTROL ROOM.	
	4.	ALL THE RELEVANT APPROVED DOCUMENTS REQUIRED FOR FAT SHALL BE SUBMITTED BY THE BIDDER IN ADVANCE PRIOR TO COMMENCEMENT OF FAT.	

Copies of all test reports shall be submitted to the Owner as per procedure to be finalized during contract award. The owner reserves the right to witness all tests.

#### 13.4.0 Tests to be performed during FAT of PLC system

Following minimum tests shall be performed during FAT at manufacturer's place of PLC system:

- 1) Hardware Inspection of PLC Sub System
  - i) Heat run test
  - ii) Hardware check / physical software package check
  - iii) I/O loading specification



- iv) PLC start-up and power fail restart
  - v) PLC processor back-up function
  - vi) Communication redundancy
- 2) Application Inspection for Logic Functions
- i) Ladder logic functional check and graphic screen check
- 3) Application Inspection for PLC Panels
- i) General arrangement
  - ii) Appearance and construction
  - iii) Panel wiring
  - iv) Panel functional check
  - v) Power supply redundancy check
- 4) PLC System Checks
- i) PLC Scan time functional test
  - ii) PLC/I/O panel/Engineering station functions
  - iii) Diagnostic and process alarm test

In addition to above test, Bidder shall also perform other tests as per approved QAP & FAT procedure. Also bidder shall submit "Type Test" report as per IEC – 61131.2 along with FAT report for PLC.

#### **13.5.0 Performance and Guarantee Test and Acceptance of the System by Owner**

After successful trial operation the final test as to the performance and guarantees shall be conducted at site, by the Owner. The Bidder's commissioning and start-up engineers shall make the unit ready for such tests, assist the Owner in conducting such tests free of cost. Such tests will be commenced within a period of one month or less after the successful completion of Trial Operations. Any extension of time beyond the above- specified period shall be mutually agreed upon. Such test shall be for operation of 7 days out of which at least 72 hours shall be continuous operation on full load.

These tests shall be binding on both the parties of the Bidder to determine compliance of the equipment and the performance guarantees. Parameters for performance & Guarantee test shall be furnished by the bidder.

Any special equipment, tools and tackle required for the successful completion of the performance and Guarantee Tests shall be provided by the Bidder, free of cost.

The guaranteed performance figures of the equipment/systems shall be provided by the Bidder as per this specification. Should the results of these tests show any decrease from the guaranteed values, the Bidder shall modify the equipment as required to enable it to meet the guarantees. In such case, Performance and Guarantee Tests shall be repeated within one month from the date of equipment is ready for retest, and all cost for modifications including labour, materials and the cost of additional testing to prove that the equipment meets the guarantees shall be borne by the Bidder. If the Vendor is unable to meet the guarantees, even after the adjustments/calibration, the Owner retains the option



to reject the Equipment, and in the case of such option of rejection being exercised, the Vendor shall replace the entire equipment with the one, which shall meet the guaranteed values.

The above guarantees will be inclusive of the final control element responses. The bidder has the responsibility to commission the control loop inclusive of the final control element, some of which are supplied by others/Owner.

These tests shall be sufficiently detailed so as to fully satisfy the Owner that the equipment/systems furnished by the Bidder meet all requirements of this specification as well as the published specifications of the respective manufacturers.

### 13.6.0 Availability Guarantee Test

#### a) Availability Guarantee

The Bidder shall guarantee 99.7 per cent system availability for a continuous period of 365 days. An availability guarantee test shall be conducted to assure this level of availability. If the accrued downtime exceeds 0.3 per cent of 365 days, during a loss of availability, a new 365 days run shall start at the time when the system becomes available again. Loss of availability (unavailable system) shall be defined as the loss of the system's guaranteed accuracy and repeatability or of any system function; except, however, that the loss of a function for not more than five per cent of the points shall not be considered loss of availability. Loss of a function for not more than five per cent of the points shall be treated as partial unavailability and the corresponding outage time shall be weighed with respect to function and percentage of the points for which the function and percentage of the points for which the function is unavailable. Loss of each function shall have one weighing factor and unavailability of each equipment, peripheral device or process I/O card etc. shall have another weighing factor. The system shall be considered unavailable upon loss of functions or equipment such as loss of two control OWSs, all control room printers, all control room displays, control room operator keyboard, all alarming capability more than 5 percent of inputs or accuracy of more than 5 per cent of inputs, etc. The guaranteed accuracy and repeatability shall be maintained for the entire 365 days run without manual recalibration.

Downtime shall start upon loss of a system function and shall end upon restoration of all system functions. A minimum of one hour's down time shall be charged for each loss of availability in determining system availability.

If availability is lost due to Owner's error exclusive of any possible errors through misuse of the operator's console or engineer's/programmer's console while locked but inclusive of any possible errors through misuse of operator's or engineer's / programmer's console while unlocked, downtime will not be charged to the Bidder.

#### Test Dates

The availability test shall commence after the performance guarantee and acceptance tests.



### Test Duration and Definition

The availability test duration shall be 365 days of accumulated test duration time. Such duration time shall be continuous from the start of test except as declined hereinafter.

#### 13.7.0 Training

Bidder will be responsible for providing training to Owner's personnel on offered systems at Bidder's Works/Bidder's Associate's Work. It shall include training operators in the use of system, in the programming and hardware maintenance of the equipment to the extent that the Owner's personnel can make corrections and changes to the systems programs and maintain the system's hardware.

#### 13.8.0 Warranty

The Bidder shall provide an unlimited warranty on all equipment and software for three years after the start of the warranty period, i.e. after satisfactory completion of initial operations. This warranty shall include repair, replacement or correction of identified software or hardware discrepancies at no cost to OWNER.

No repairs/replacement shall normally be carried out by the Owner when the plant is under the supervision of Bidder's supervisory engineers. If in the event of any emergency, in the judgment of the Owner, delay would cause serious loss or damage, repairs may be made by the Owner or a third party chosen by the Owner without advance notice to the Bidder and the cost of such work shall be paid by the Bidder.

The Bidder shall provide warranty spares and an exhaustive list of warranty spares including components for system hardware and instrumentation and peripherals based on (and keeping adequate margin over) normally experienced failure rate shall be submitted by the Bidder for Owner's review regarding adequacy of the same. The Bidder must furnish the list before inviting OWNER personnel for ATS test. The warranty spares as per the list mentioned above will be dispatched by the Bidder along with the main equipment consignment. The Bidder shall also provide expandable items for the warranty period. This shall include printer ribbon, ink/toner cartridge print head etc. excluding paper.

In case of any hardware failure which hampers normal operation, the Bidder during the warranty period must provide on-site technical expertise to repair/rectify the problem within a week and if any component is not available at site, the Bidder must arrange to supply these components at site within additional 48 hours. If a software problem is identified, this problem shall be corrected within two weeks.

After six months of PLC operation, the Bidder shall provide the list of parts and expendables utilized for the period. The same information will be provided at the conclusion of the warranty.

In order to discharge the warranty responsibility, the bidder shall include in his proposal lumpsum price for the provisions of a team of service personnel at Site who will be fully qualified to perform the required duties throughout the warranty



period of one year. The Bidder shall deploy at least one engineer, two supervisors and four technicians in the team. The Owner shall approve the exact nos. & composition of team members. In case, the team is unable to rectify hardware or software problems, the Bidder shall depute and/or station additional specialist to rectify the problem to ensure 99.7% availability of system.

Bidder shall furnish the list of mandatory spares in separate sheet for all field instruments, control panel and UPS as per the list provided in the technical specification.

List of consumable items for the analyzer and other systems shall be furnished by the bidder.

In addition to the above the general contract conditions indicated in the Section-1 General technical specifications shall be considered by the bidder

#### **13.9.0 Annual Maintenance Contract (AMC)**

The Bidder shall provide maintenance services of complete PLC System and other critical control system under a comprehensive Annual Maintenance Contract (AMC) for period of Three years after Warranty period. Owner shall have the option of not renewing the AMC after end of each of first two years after giving a notice of one month.

The AMC shall cover total maintenance of all hardware & software coming under the scope of PLC and shall include free repair/replacement of all cards/modules/ peripherals/cables/components etc., correction of software problems and supply of expendable items. The Bidder shall ensure 99.7% availability of the system with the AMC. For the AMC the Bidder shall maintain the same staff as mentioned above for warranty period (i.e. at least one engineer, two supervisors and four technicians).

Further, Bidder may note that during the AMC he will be allowed to use Owner's mandatory spares and has to replenish the same within three months time or before completion of AMC period whichever is earlier.

However, if in the opinion of the Bidder, more spares than those included in the mandatory spare list are required to meet the availability requirement, then Bidder shall stock the same.

The Bidder shall prepare detailed list of faults corrected and parts, expendables utilized during AMC period and shall furnish the same to Owner, properly documented at the end of AMC period. Further, during AMC period the details as required by Owner/ Project Manager shall be made available by Bidder's personnel.

Annual maintenance contract services shall be optional. The bidder shall quote separate price for the same.

In addition to the above the general contract conditions indicated in the Section-1 General technical specifications shall be considered by the bidder.



### 13.10.0 ERP Requirements

Trouble shooting and maintenance requirements for the package shall be submitted by the vendor, the trouble shooting requirements shall be step by step procedure written to guide the maintenance personnel proceed easily.

Bidder shall note that the trouble shooting procedures shall be fed to Maintenance Software /ERP for easy operation, maintenance, inventory management, and efficiency calculation of the plant .Bidder considering these requirements shall provide operation and maintenance manual, troubleshooting techniques and methods for the packages. Bidder shall be bound to provide any other maintenance and operation procedures and manuals and information of any form or any format required to fulfill the ERP software Configuration and updation.

### 14.0.0 LIST OF MANDATORY SPARES

SI.No.	Item Description	Quantity / Unit
1.0	<b>Field Instruments / Elements / Equipment (Gauges, Switches, transmitters etc.)</b>	
1.1	Local Gauges	10% for each type, size and range or minimum 2 nos. whichever is higher.
1.2	Field switches	10% for each type, size and range or minimum 2 nos. whichever is higher.
1.3	Transmitter	10% for each type, size and range or minimum 2 nos. whichever is higher.
1.4	Temperature - Element RTD with Thermowell	10% for each type, size and range or minimum 2 nos. whichever is higher.
1.5	Temperature - Element T/C with Thermowell	10% for each type, size and range or minimum 2 nos. whichever is higher.
1.6	Air Filter Regulator	10% for each type, size and range or minimum 2 nos. whichever is higher.
1.7	Junction Box	10% for each type, size and range or minimum 2 nos. whichever is higher.
1.8	Flow Elements	10% for each type, size and range or minimum 2 nos. whichever is higher.
1.9	I/P Converter	10% for each type, size and range or minimum 2 nos. whichever is higher.
1.10	Position Transmitter	10% for each type, size and range or minimum 2 nos. whichever is higher.
1.11	Mass flow meter	10% for each type, size and range or minimum 2 nos. whichever is higher.



SI.No.	Item Description	Quantity / Unit
1.12	Positioner for control valves / pneumatic power cylinders	10% for each type, size and range or minimum 2 nos. whichever is higher.
1.13	Air lock relay for control valves / pneumatic power cylinders	10% for each type, size and range or minimum 2 nos. whichever is higher.
1.14	Solenoid valves for control valves / pneumatic power cylinders	10% for each type, size and range or minimum 2 nos. whichever is higher.
<b>2.0</b>	<b>DCS / PLC System</b>	
2.1	Power supply modules / cards	10% for each type and rating but minimum 1 no.
2.2	I/O Cards (Each type)	10% for each type and rating but minimum 2 no.
2.3	SER Cards	10% for each type and rating but minimum 1 no.
2.4	Electronic modules of each type for processor, controller, bus communication, operator station, memory module etc.	10% for each type but minimum 1 no.
2.5	Network cards / Switches	10% for each type but minimum 2 nos.
2.6	Communication Interface cards	10% for each type but minimum 1 no.
2.7	Optical Disk Drive	1 no.
2.8	Optical Disk	5 nos.
2.9	DVD (R&W)	50 nos.
2.10	Hard discs for servers & Work stations	10% of each type, size or minimum 2 nos.
2.11	Servers	1 No. of each type of server
2.12	Operator stations	2 nos.
2.13	Printer cartridges	5 nos. of each type
2.14	SMPS for Printers	1 no. of each type, rating.
2.15	SVGA Cards for Printers	1 no of each type
2.16	Data bus cable	1 no. full length
2.17	Data bus controller	1 no.
2.18	Fibre Optic cable converter / De-	2 nos.
<b>3.0</b>	<b>Panels, local panels, System / Marshalling cabinets</b>	
3.1	Fuses	50 nos. of each type and rating
3.2	Minature Ckt. Breaker (MCB)	10 nos of each type and rating

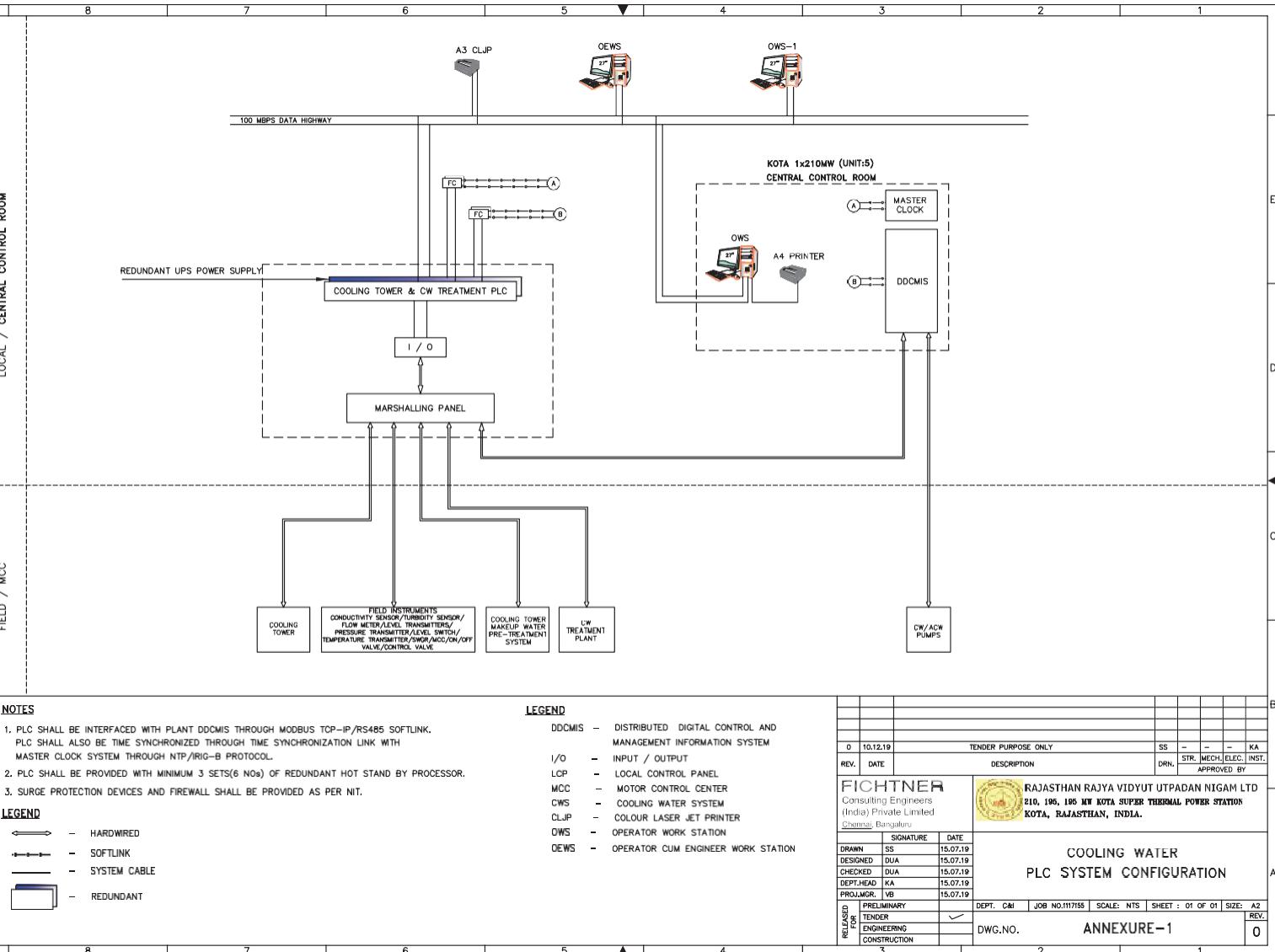


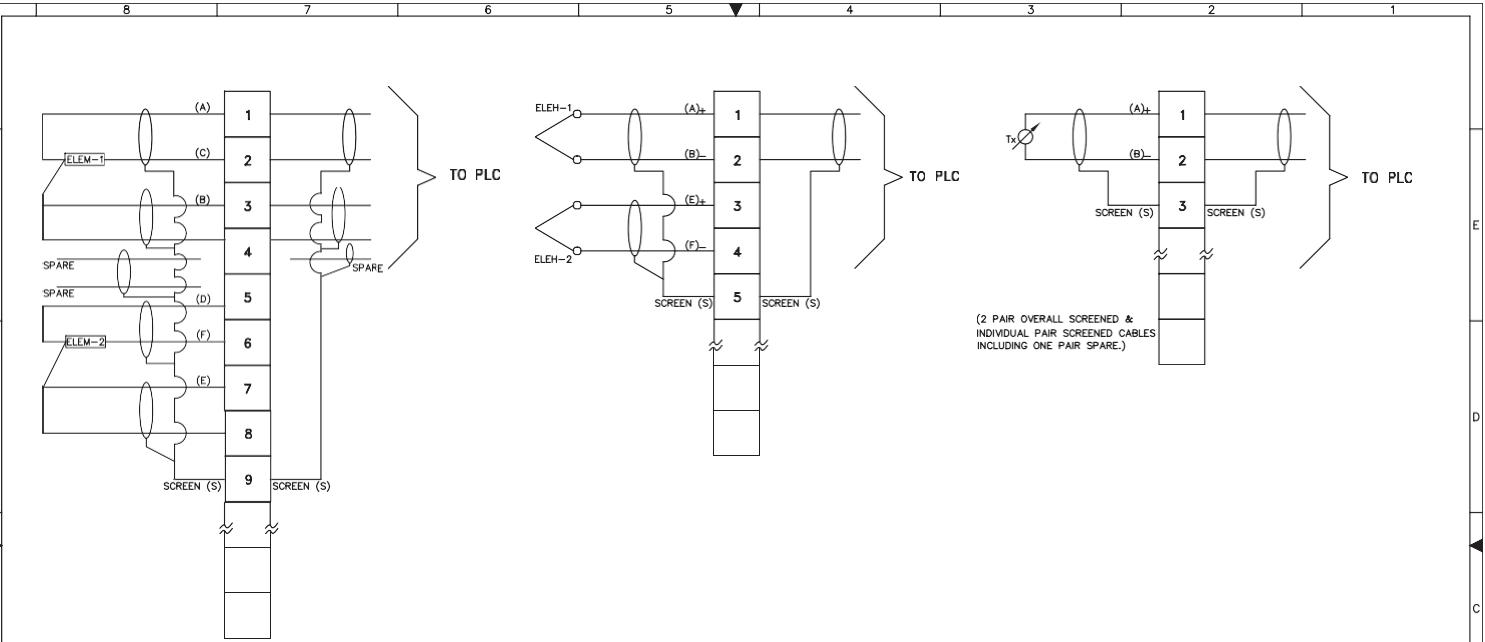
SI.No.	Item Description	Quantity / Unit
3.3	Male / female parts of pre-fabricated cables	6 nos. of each type
3.4	Space Heater	10% for each type, size and range or minimum 2 nos. whichever is higher
3.5	Smoke Detector	10% for each type, size and range or minimum 2 nos. whichever is higher
3.6	Terminal Blocks	20% of total quantity.
3.7	Terminal in Terminal blocks	10 Nos of each type
3.8	Cable clamps	5 Nos of each type
3.9	Blowers	1 no.
3.10	Cabinet cooling fans	4 nos. of each type rating.
4.0	<b>Control valves and Pneumatic Block Valves (for each type / model of valve)</b>	
4.1	Plug and steam assembly	1 no. of each type
4.2	Seat ring	1 no. of each type
4.3	Packing and gaskets	1 no. of each type
4.4	Pilot relay	1 no. of each type
4.5	Actuator diaphragm	1 no. of each type
4.6	O-rings	2 nos. of each size for positioner
4.7	Feedback linkage	1 no. of each type
4.8	Control valves (Electrical operated - if supplied) - Interfacing modules	1 no. or 10% of total quty whichever is higher.
5.0	<b>Solenoid valve</b>	
5.1	Solenoid valve coil	10% of each type and rating but minimum 1 no.
6.0	<b>Analyser</b>	
6.1	Electronic cards	1 no. for each type and range
6.2	pH cells & electrodes	1 no. for each type and range
6.3	Chemical Reagents	Suitable for 6 charges / usages
6.4	Resin column	2 nos.
6.5	Pressure control valve	Minimum 1 no. or 10% of total quantity whichever is higher for each type
6.6	Thermometer, temperature switch, pressure indicator, solenoid valve, Rotameter, flow switch	Minimum 1 no. or 10% of total quantity whichever is higher for each type



## 15.0.0 LIST OF ANNEXURES

S.NO	ANNEXURE	TITLE
1	ANNEXURE-1	PLC SYSTEM CONFIGURATION
2	ANNEXURE-2	TYPICAL WIRING ARRANGEMENT IN JUNCTION BOX
3	ANNEXURE-3	GA FOR OPERATOR WORK STATION
4	ANNEXURE-4	GA FOR PRINTER
5	ANNEXURE-5	GA FOR LOCAL INSTRUMENT ENCLOSURE
6	ANNEXURE-6	GA FOR LOCAL INSTRUMENT RACK
7	ANNEXURE-7	TYPICAL INSTRUMENT HOOKUP DIAGRAM
8	ANNEXURE-8	DRIVE CONTROL PHILOSOPHY
9	ANNEXURE-9	VENDOR LIST

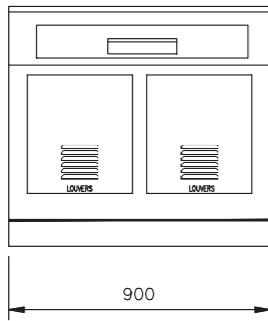




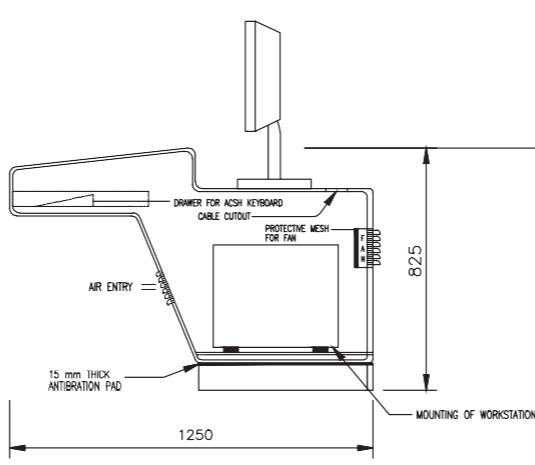
**B NOTES**

- SPLITTING OF CABLE MAY OCCUR WHEN TERMINALS REQUIRED FOR AN ELEMENT ARE LOCATED ON SEPARATE STRIPS. HENCE, NO. OF TBS ON A TERMINAL STRIP SHALL BE ADJUSTED TO PREVENT SPLITTING. 20% SPARE TB SHALL BE PROVIDED.
- SCREENS SHALL BE EARTHED AT DDCMIS/PLC END ONLY. NO EARTHING OF SCREEN TO BE DONE AT JB/INSTRUMENT END.
- OVERALL SCREEN OF OUTGOING AND ASSOCIATED INCOMING CABLE TO BE CONNECTED TOGETHER ON A SPARE TERMINAL AND THEN CONNECTED TO EARTH AT DDCMIS/PLC END.
- FOR SWITCH, BOTH CONTACTS SHALL BE WIRED TO JB WITH 2PAIR OVERALL SCREENED & INDIVIDUAL SCREENED PAIR CABLES.

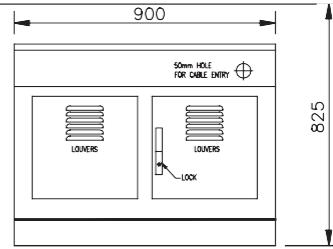
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REV.	DATE	DESCRIPTION	DRN.	STR.	MECH.	ELEC.
APPROVED BY						
<b>FICHTNER</b> Consulting Engineers (India) Private Limited Chennai, Bangalore			 RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD 210, 105, 106 MW KOTA SUPER THERMAL POWER STATION KOTA, RAJASTHAN, INDIA.			
<b>TYPICAL WIRING ARRANGEMENT IN JUNCTION BOX</b>						
<input checked="" type="checkbox"/> PRELIMINARY <input type="checkbox"/> TENDER <input type="checkbox"/> RELEASED <input type="checkbox"/> ENGINEERING <input type="checkbox"/> CONSTRUCTION		DEPT. C&I	JOB NO. 1117155	SCALE: NTS	SHEET : 01 OF 01	SIZE: A2
		DWG. NO.	ANNEXURE-2			
			REV. 0			



FRONT VIEW



SIDE VIEW



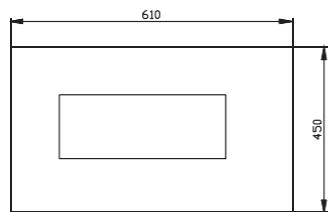
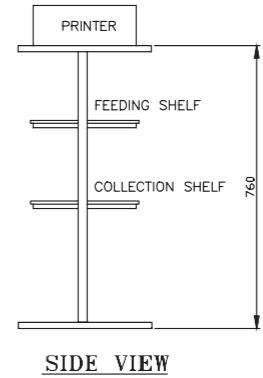
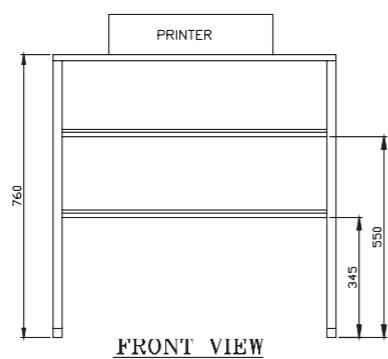
REAR VIEW

**NOTES**

1. DETAILS OF PANELS/CONSOLE SHALL BE AS PER SPECIFICATION.

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REV.	DATE	DESCRIPTION	DRN.	STR.	MECH.	ELEC.	INST.
							APPROVED BY
<b>FICHTNER</b> Consulting Engineers (India) Private Limited Chennai, Bangalore				 RAJASTHAN RVIDYUT UTPADAN NIGAM LTD 210, 185, 186 MW KUTA SUPER THERMAL POWER STATION KOTA, RAJASTHAN, INDIA			
RELEASED	PRELIMINARY	SIGNATURE	DATE	DEPT.	CAB	JOB NO.111715	SCALE: NTS SHEET : 01 OF 01 SIZE: A2
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	ENGINEERING						
	CONSTRUCTION						

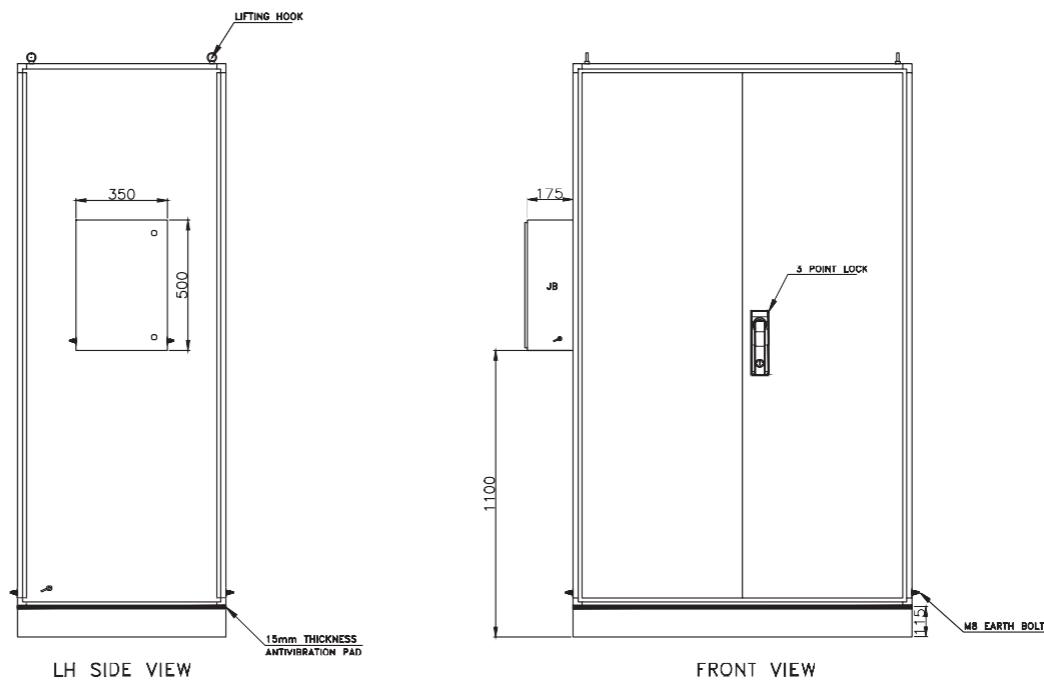
GA FOR  
OPERATOR WORK STATION TABLE



**NOTES**

1. DETAILS OF PANELS/CONSOLE SHALL BE AS PER SPECIFICATION.

0	28.05.15	TENDER PURPOSE ONLY	KK	-	-	-	KA
REV.	DATE	DESCRIPTION	DRN.	STR.	MECH.	ELEC.	INST.
				APPROVED BY			
<b>FICHTNER</b> Consulting Engineers (India) Private Limited <small>Chennai, Bangalore</small>				 RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD 210, 185, 195 MW KOTA SUPER THERMAL POWER STATION KOTA, RAJASTHAN, INDIA			
GA FOR PRINTER TABLE							
RELEASED	PRELIMINARY	✓	DEPT.	CAB	JOB NO.111715	SCALE:	NTS
	TENDER		SIZE:		01 OF 01	SHEET :	A2
	ENGINEERING		REV.				0
	CONSTRUCTION		DWG.NO.	ANNEXURE-4			



**B NOTES**

1. DETAILS OF PANELS/CONSOLE SHALL BE AS PER SPECIFICATION.

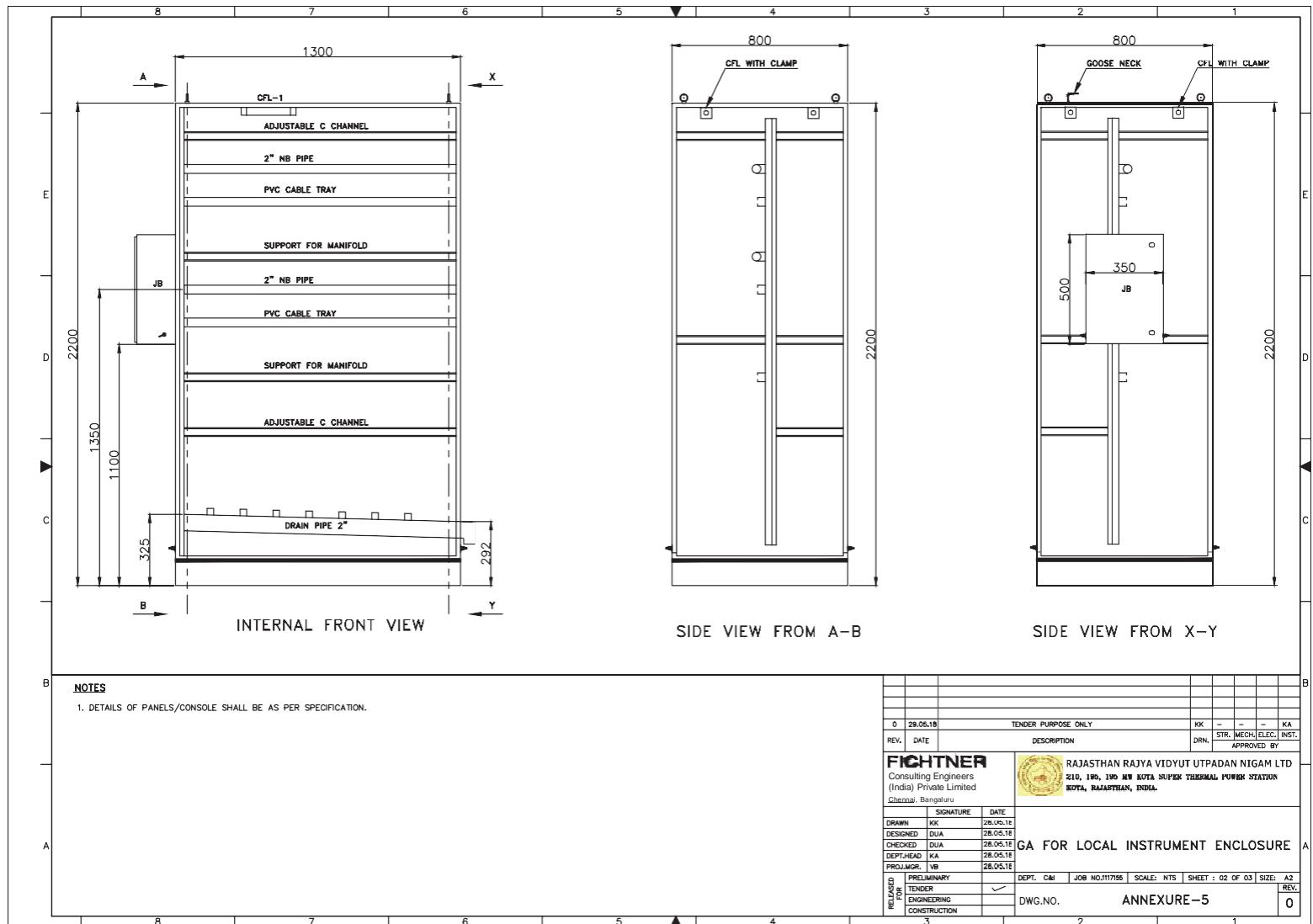
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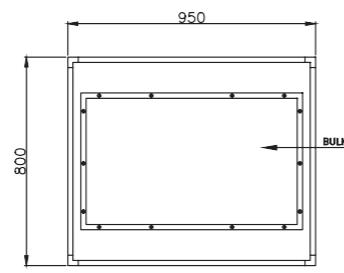
**FICHTNER**

Consulting Engineers  
(India) Private Limited  
Chennai, Bangalore

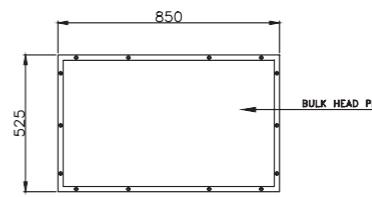
RAJASTHAN RAJYA VIDYUT UTTPADAN NIGAM LTD  
210, 180, 190 MW KOTA SUPER THERMAL POWER STATION  
KOTA, RAJASTHAN, INDIA

GA FOR LOCAL INSTRUMENT ENCLOSURE		DEPT.	CAB	JOB NO.111715	SCALE:	NTS	SHEET : 01 OF 03	SIZE:	A2
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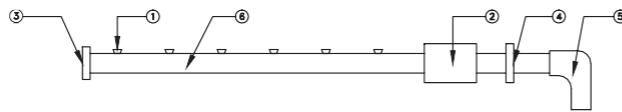




TOP VIEW



BULK HEAD PLATE



DRAIN PIPE

**NOTES**

1. DETAILS OF PANELS/CONSOLE SHALL BE AS PER SPECIFICATION.

S.NO	DESCRIPTION	QTY.
1	2" NB ASTM A-106 SDR-30/GR-C	AS REQD.
2	2" NBSW X 1" NPT(F) COUPLING CS ASTM A105	1 NO
3	2" SW CAP, CS ASTM A105	1 NO
4	1" NPT(M) X 1" BSP(M) HEX COUPLING CS ASTM A105	1 NO
5	1" BSP(M) ELBOW, CS ASTM A105	1 NO
6	HALF COUPLING 1/2" NB SW CS/AS	AS REQD.

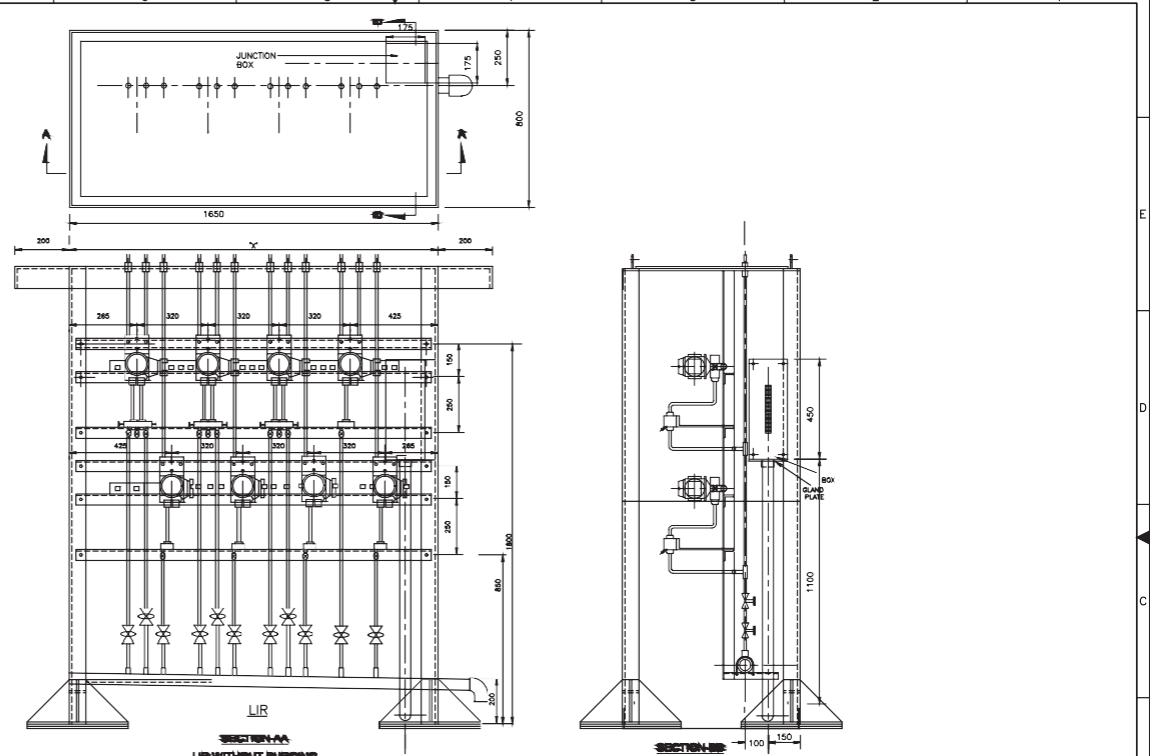
0 28.05.15	TENDER PURPOSE ONLY	KK	-	-	-	KA
REV. DATE	DESCRIPTION	STR.	MECH.	ELEC.	INST.	APPROVED BY
		DRN.				

**FICHTNER**Consulting Engineers  
(India) Private Limited

Chennai, Bangalore

RAJASTHAN RAJYA VIDYUT UTTPADAN NIGAM LTD  
210, 1st, 195 MW KOTA SUPER THERMAL POWER STATION  
KOTA, RAJASTHAN, INDIA

GA FOR LOCAL INSTRUMENT ENCLOSURE A	
DRAWN BY: MVR	SIGNATURE: [Signature]
DESIGNED BY: DUA	DATE: 28.05.15
CHECKED BY: DUA	28.05.15
DEPT.HEAD: KA	28.05.15
PROJ.MGR: VB	28.05.15
RELEASED FOR: PRELIMINARY ✓ TENDER ENGINEERING CONSTRUCTION	
DEPT. CAT: JOB NO.111715 SCALE: NTS SHEET : 03 OF 03 SIZE: A2	
DWG.NO. ANNEXURE-5 REV. 0	



**B NOTES**

1. DETAILS OF PANELS/CONSOLE SHALL BE AS PER SPECIFICATION.

REV.	DATE	TENDER PURPOSE ONLY	KK	-	-	KA
		DESCRIPTION	STR.	MECH.	ELEC.	INST.
			DRN.			APPROVED BY
<b>FICHTNER</b> Consulting Engineers (India) Private Limited Chennai, Bangalore						RAJASTHAN RAJYA VIDYUT UTTPADA NIGAM LTD 210, 1st, 195 MW KOTA SUPER THERMAL POWER STATION KOTA, RAJASTHAN, INDIA
DRAWN: MR. [Signature] 28.05.15 DESIGNED: DUA 28.05.15 CHECKED: DUA 28.05.15 DEPT. HEAD: KA 28.05.15 PROJ. MGR.: VB 28.05.15						GA FOR LOCAL INSTRUMENT RACK
RELEASED FOR: PRELIMINARY ✓ TENDER ENGINEERING CONSTRUCTION						DEPT. CAD JOB NO.111715 SCALE: NTS SHEET : 01 OF 01 SIZE: A2 DWG.NO. ANNEXURE-6 REV. 0

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## TYPICAL INSTRUMENT HOOK UP DIAGRAM

0 29.05.18	TENDER PURPOSE ONLY		KK	KA
REV. DATE	DESCRIPTION		DRN.	STR. MECH/ELEC/INST. APPROVED BY
<b>FICHTNER</b> Consulting Engineers (India) Private Limited Chennai, Bangalore		RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD 210, 195, 195 MW KOTA SUPER THERMAL POWER STATION KOTA, RAJASTHAN, INDIA		
DRAWN KK 28.05.18		HOOK UP DIAGRAM		
DESIGNED DUA 28.05.18				
CHECKED DUA 28.05.18				
DEPT-HEAD KA 28.05.18				
PROJ.MGR. VB 28.05.18				
LED FOR RELEASE FOR TENDER	PRELIMINARY	✓	DEPT. C&I	JOB NO. 1117155 SCALE: NTS SHEET 01 OF 15 REV. 0
ENGINEERING CONSTRUCTION		DWG.NO. ANNEXURE-7 0		

1 2 3 4 5 6 7 8

1	2	3	4	5	6	7	8
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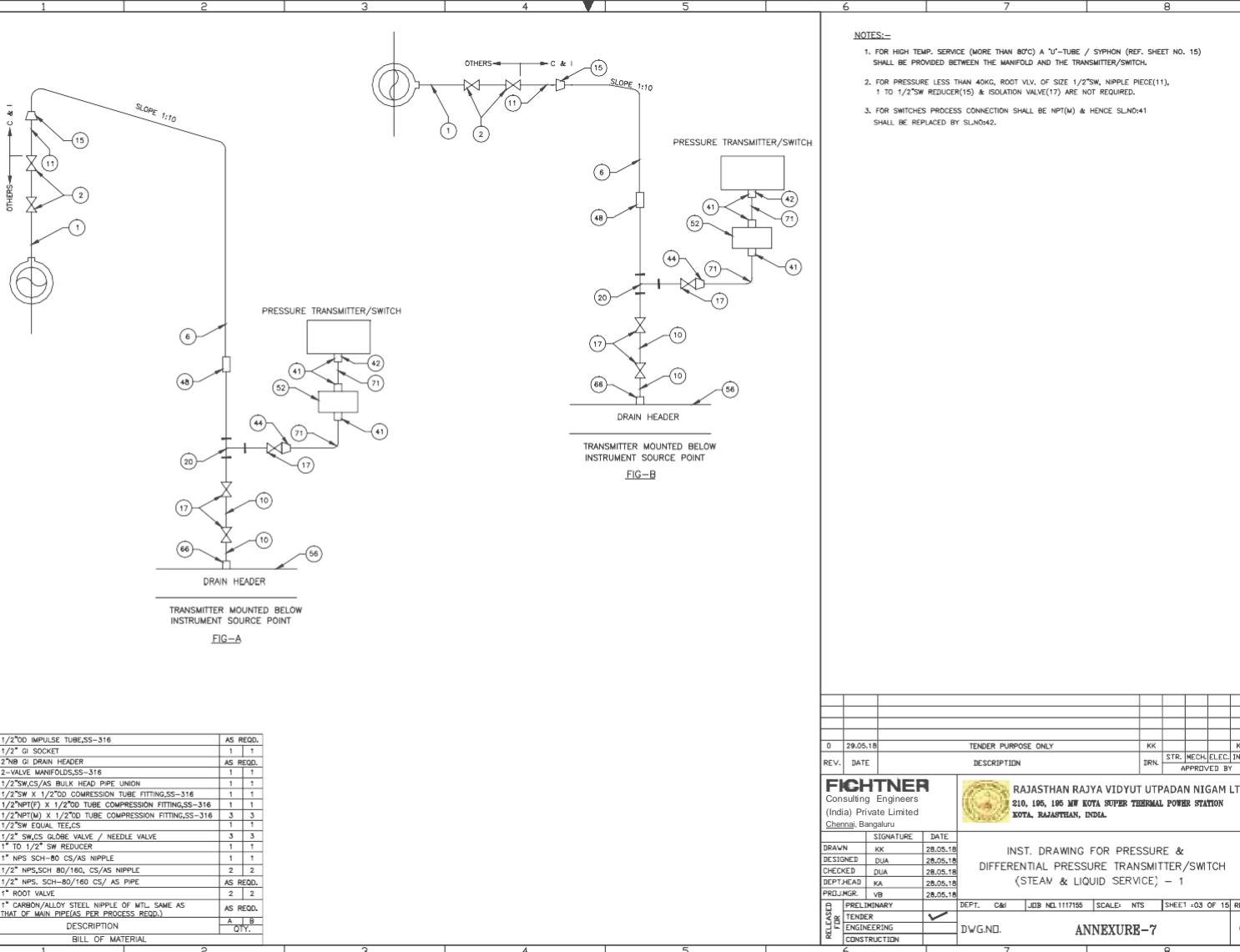
S.NO.	DESCRIPTION	SH.NO.	REV.
1.	COVER SHEET	01	00
2.	INDEX SHEET	02	00
3.	INST. DRAWING FOR PRESSURE & DIFFERENTIAL PRESSURE TRANSMITTER/SWITCH (STEAM & LIQUID SERVICE) – 1	03	00
4.	INST. DRAWING FOR PRESSURE & DIFFERENTIAL PRESSURE TRANSMITTER/SWITCH (STEAM & LIQUID SERVICE) – 2	04	00
5.	INST. DRAWING FOR PRESSURE & DIFFERENTIAL PRESSURE TRANSMITTERS (AIR SERVICE)	05	00
6.	INST. DRAWING FOR PRESSURE & DIFFERENTIAL PRESSURE TRANSMITTERS/SWITCH (OIL SERVICE)	06	00
7.	INST. DRAWING FOR LOCAL PRESSURE GAUGE	07	00
8.	INST. DRAWING FOR LOCAL PRESSURE & DIFFERENTIAL PRESSURE GAUGE/SWITCH	08	00
9.	INST. DRAWING FOR TEMP. STUB–1	09	00
10.	INST. DRAWING FOR TEMP. STUB–2	10	00
11.	INST. DRAWING FOR ULTRASONIC LEVEL TRANSMITTER	11	00
12.	INST. DRAWING FOR LEVEL SWITCHES	12	00
13.	INST. DRAWING FOR LEVEL SWITCH WITH FLANGED CONNECTION	13	00
14.	INST. DRAWING FOR FLOW MEASUREMENT	14	00
15.	INST. DRAWING FOR U-TUBE	15	00

NOTES:

1. FOR PROCESS PRESSURE UPTO 40Kg/sqcm, 1/2" PIPE WITH 1 ROOT VALVE SHALL BE PROVIDED.
2. FOR PROCESS PRESSURE MORE THAN 40Kg/sqcm, 1" PIPE WITH 2 ROOT VALVE SHALL BE PROVIDED.

1	2	3	4	5	6	7	8
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0 29.05.18	TENDER PURPOSE ONLY	KK	KA
REV. DATE	DESCRIPTION	DRN.	STR. MECH. ELEC. INST. APPROVED BY
<b>FICHTNER</b> Consulting Engineers (India) Private Limited Chennai, Bangalore		 RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD 210, 105, 195 MW KOTA SUPER THERMAL POWER STATION KOTA, RAJASTHAN, INDIA	
INDEX SHEET			
RELEASED FOR TENDER	PRELIMINARY	DEPT. C&I	JOB NO. 1117155 SCALE: NTS SHEET -02 OF 15 REV. 0
		DWG. NO.	ANNEXURE-7



1 2 3 4 5 6 7 8

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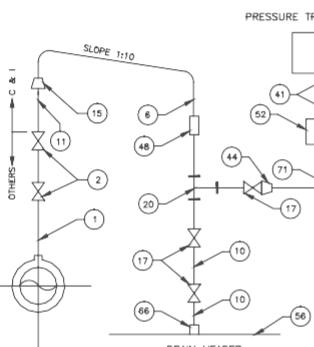


FIG-C

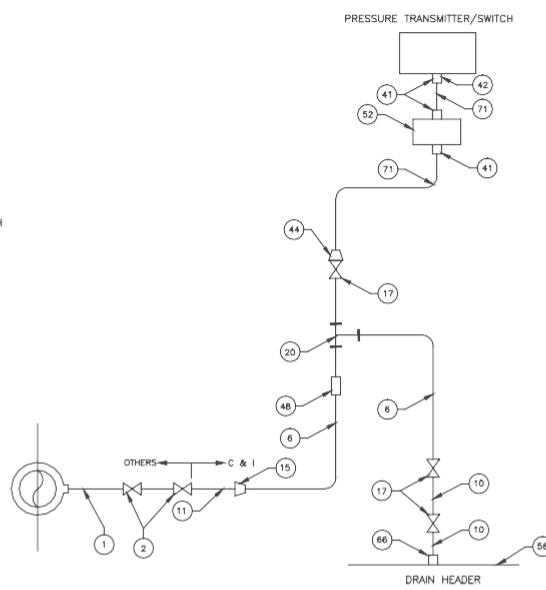


FIG-D

## NOTES:-

1. FOR HIGH TEMP. SERVICE (MORE THAN 80°C) A 'U'-TUBE / SYPHON (REF. SHEET NO. 15) SHALL BE PROVIDED BETWEEN THE MANIFOLD AND THE TRANSMITTER/SWITCH.

2. FOR PRESSURE LESS THAN 40KG, ROOT LV. OF SIZE 1/2"SW, NIPPLE PIECE(11), 1 TO 1/2"SW REDUCER(15) &amp; ISOLATION VALVE(17) ARE NOT REQUIRED.

3. FOR SWITCHES PROCESS CONNECTION SHALL BE NPT(M) &amp; HENCE SLN041 SHALL BE REPLACED BY SLN042.

71	1/2"OD IMPULSE TUBE,SS-316	AS REQD.
66	1/2" GI SODIUM LINE	1 1
56	1/2" GI DRAIN HEADER	AS REQD.
62	2-VALVE MANIFOLDS,SS-316	1 1
48	1/2"CHGS/AS BULK HEAD PIPE UNION	1 1
44	1/2"SW X 1/2"OD COMPRESSION TUBE FITTING,SS-316	1 1
42	1/2"NPT(F) X 1/2"OD TUBE COMPRESSION FITTING,SS-316	1 1
41	1/2"NPT(M) X 1/2"OD TUBE COMPRESSION FITTING,SS-316	3 3
20	1/2" EQUAL TEE,CS	1 1
15	1" TO 1/2" SW REDUCER	1 1
17	1/2" SWCS GLOBE VALVE / NEEDLE VALVE	3 3
11	1" NPS SCH-80 CS/AS NIPPLE	1 1
10	1/2" NPS,SCH 80/160, CS/AS NIPPLE	2 2
6	1/2" NPS, SCH-80/160 CS/ AS PIPE	AS REQD.
2	" ROOT VALVE	2 2
1	CARBON/ALLOY STEEL NIPPLE OF MIL SAME AS THAT OF MAIN PIPE AS PER PROCESS REQD.	AS REQD.
TAG NO.	DESCRIPTION	C I D QTY.
	BILL OF MATERIAL	

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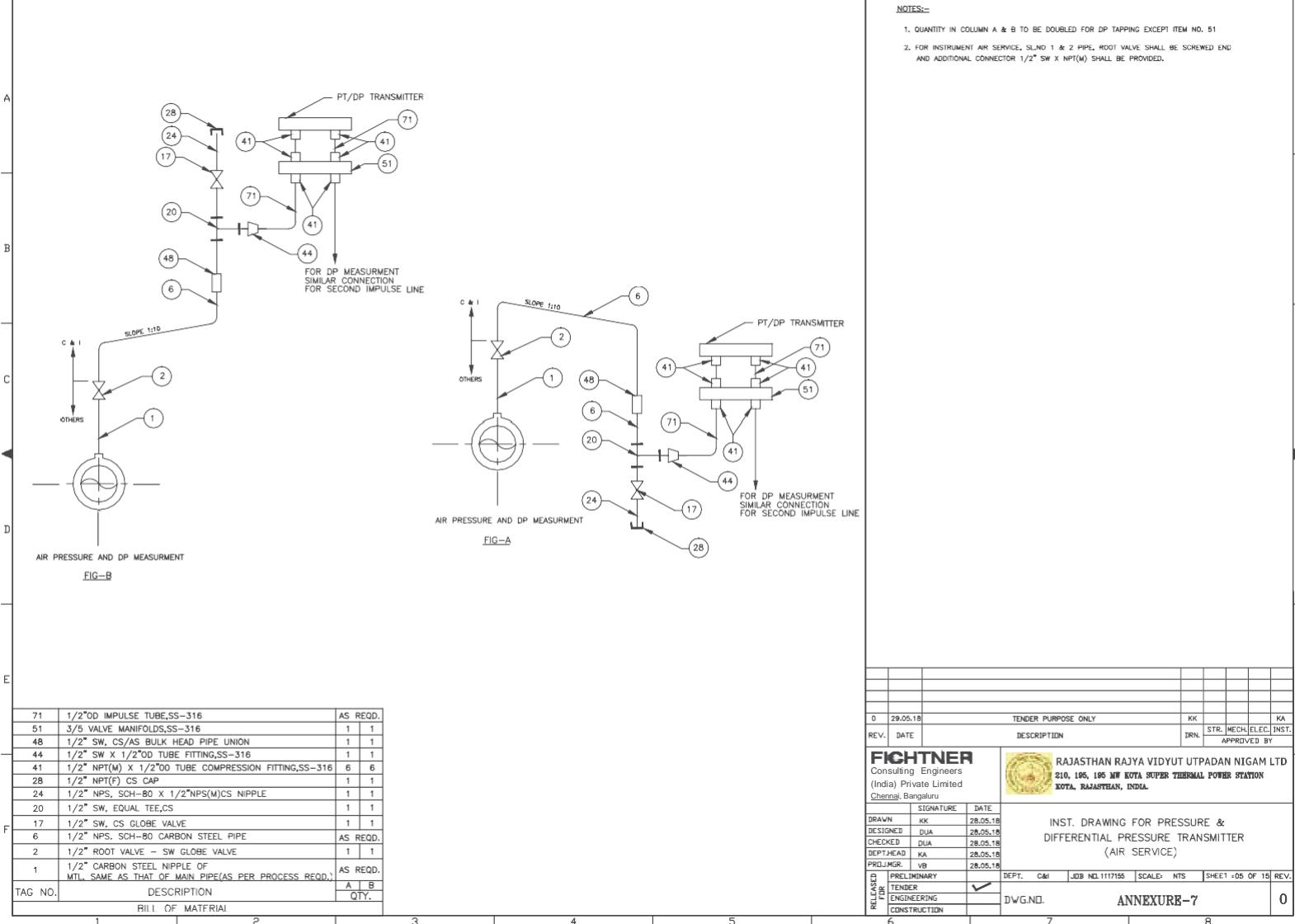
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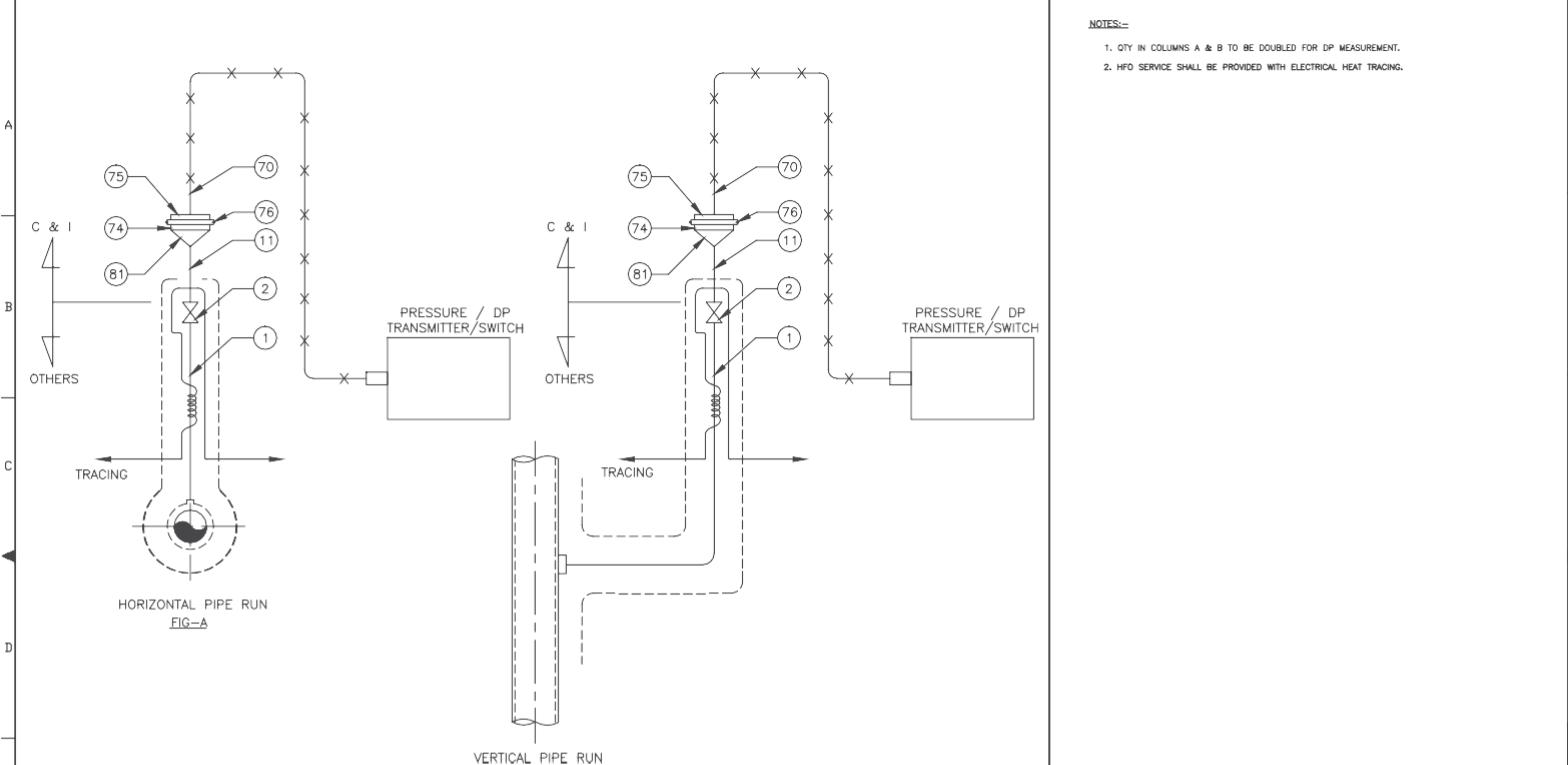
0	29.05.18	TENDER PURPOSE ONLY	KK	KA
REV.	DATE	DESCRIPTION	STR.	MECH,ELEC,INST.
APPROVED BY				
<b>FICHTNER</b> Consulting Engineers (India) Private Limited Chennai, Bangalore		 RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD 210, 105, 195 MW KOTA SUPER THERMAL POWER STATION KOTA, RAJASTHAN, INDIA		
INST. DRAWING FOR PRESSURE & DIFFERENTIAL PRESSURE TRANSMITTER/SWITCH (STEAM & LIQUID SERVICE) - 2				
RELEASED FOR	PRELIMINARY	DEPT. CAD	JOB NO. 1117155	SCALE: NTS SHEET - 04 OF 15 REV.
TENDER				
ENGINEERING				DWG.NO. ANNEXURE-7
CONSTRUCTION				0

1 2 3 4 5 6 7 8



0 29.05.18	TENDER PURPOSE ONLY		KK	KA
REV. DATE	DESCRIPTION		TRNL	STR. MECH. ELEC. INST.
				APPROVED BY
<b>FICHTNER</b> Consulting Engineers (India) Private Limited Chennai, Bangalore		RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD 210, 105, 195 MW KOTA SUPER THERMAL POWER STATION KOTA, RAJASTHAN, INDIA		
SIGNATURE	DATE			
DRAWN KK 28.05.18				
DESIGNED DUA 28.05.18				
CHECKED DUA 28.05.18				
DEPT/HEAD KA 28.05.18				
PROJ.MGR. VB 28.05.18				
RELEASED FOR TENDER	PRELIMINARY	DEPT. Cad	JOB NO. 1117155	SCALE: NTS SHEET -05 OF 15 REV.
ENGINEERING				
CONSTRUCTION				
DWG.NO.		ANNEXURE-7		
		0		

1 2 3 4 5 6 7 8

**NOTES:-**

1. QTY IN COLUMNS A & B TO BE DOUBLED FOR DP MEASUREMENT.
2. HFO SERVICE SHALL BE PROVIDED WITH ELECTRICAL HEAT TRACING.

81	1"x2" C.S. EXPANDER, SW	1	1
76	SEAL DIAPHRAGM	1	1
75	2" 300 LBS. ANSI FLANGE SUPPLIED ALONGWITH INSTRUMENT, BOLT HOLES- 8-190	-	-
74	2" 300 LBS. ANSI FLANGE BOLT HOLES 8-190	1	1
70	INSTRUMENT CAPILLARY TUBE SS-316	AS REQD.	
11	1" NPS SCH-80/160 CS/AS NIPPLE	1	1
2	1/2"/3/4"/1" ROOT VALVE	1	1
1	1/2"/3/4"/1" CARBON/ALLOY STEEL NIPPLE OF MTL SAMB AS THAT OF MAIN PIPE(AS PER PROCESS REQD.)	1	1
TAG NO.	DESCRIPTION	A	B
	BILL OF MATERIAL	QTY.	

1 2 3 4 5 6 7 8

0 29.05.18	TENDER PURPOSE ONLY		KK	KA
REV. DATE	DESCRIPTION		TRNL	STR. MECH. ELEC. INST. APPROVED BY
<b>FICHTNER</b> Consulting Engineers (India) Private Limited Chennai, Bangalore		RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD 210, 105, 195 MW KOTA SUPER THERMAL POWER STATION KOTA, RAJASTHAN, INDIA		
SIGNATURE DATE				
DRAWN	KK	28.05.18		
DESIGNED	DUA	28.05.18		
CHECKED	DUA	28.05.18		
DEPT/HEAD	KA	28.05.18		
PROJ.MGR.	VB	28.05.18		
RELEASED FOR	PRELIMINARY	TENDER	DEPT. CAD	JOB NO. 1117155 SCALE: NTS SHEET -06 OF 15 REV.
			DWG.NO.	ANNEXURE-7
				0

1 2 3 4 5 6 7 8

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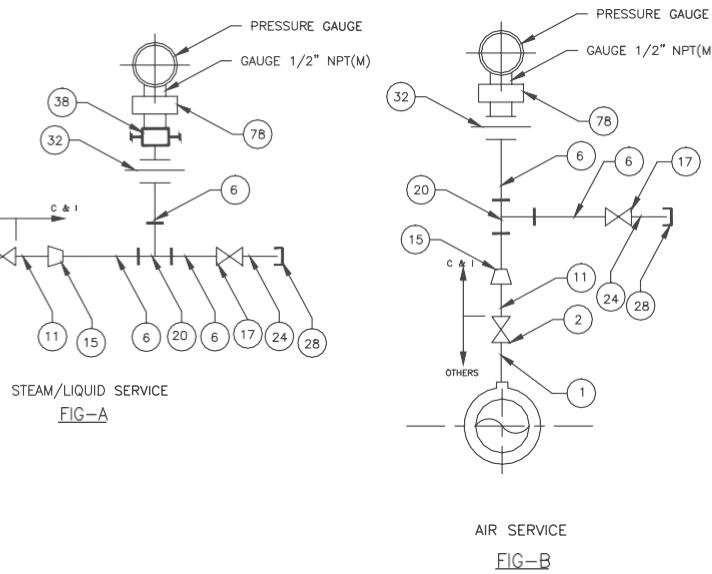
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## NOTE:-

1. FOR PRESSURE LESS THAN 40KG, ROOT VLV. OF SIZE 1/2"SW,  
NIPPLE PIECE(11) & 1 TO 1/2"SW REDUCER(15) ARE NOT REQUIRED.

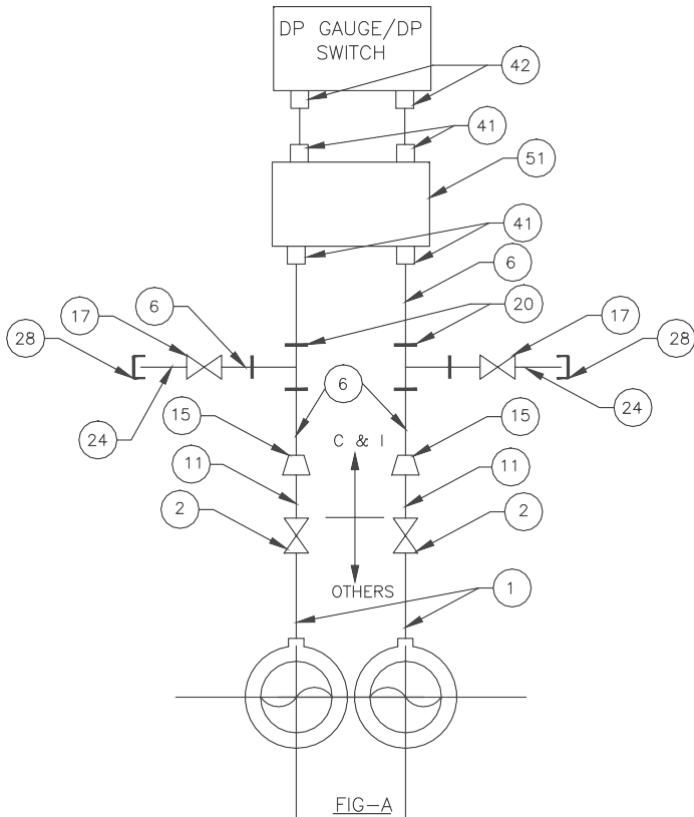
0	29.05.18	TENDER PURPOSE ONLY	KK	KA
REV.	DATE	DESCRIPTION	DRN.	STR. MECH. ELEC. INST. APPROVED BY

<b>FICHTNER</b> Consulting Engineers (India) Private Limited Chennai, Bangalore		RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD 210, 105, 195 MW KOTA SUPER THERMAL POWER STATION KOTA, RAJASTHAN, INDIA		
SIGNATURE	DATE	INST. DRAWING FOR LOCAL PRESSURE GAUGE		
DRAWN	KK 28.05.18			
DESIGNED	DUA 28.05.18			
CHECKED	DUA 28.05.18			
DEPT/HEAD	KA 28.05.18			
PROJ.MGR.	VB 28.05.18			
RELEASED FOR	PRELIMINARY TENDER	DEPT. C&I	JOB NO. 1117155	SCALE: NTS SHEET -07 OF 15 REV. 0
TAG NO. A B TAG NO.		DESCRIPTION	DWG.NO. ANNEXURE-7	
DESCRIPTION QTY.		BILL OF MATERIAL	0	

20	1/2"SW EQUAL TEE, CS/AS	1	1	78	1/2"NPT(F)X1/2"NPT(M) SNUBBER/PULSATION DAMPER AS APPLICABLE	1	1
17	1/2" SW CS/AS GLOBE VALVE	1	1	59	1/2"SW, STRAIGHT PIPE CONNECTOR, CS/AS	AS REQD.	
15	1" TO 1/2" SOCKET WELDED REDUCER	1	1	38	3 WAY GAUGE VALVE 1/2" NB SW	1	-
11	1" NPS SCH-80/160 CS/AS NIPPLE	1	1	37	6" COILED SYPHON SCH 80/160 1/2"NB CS/SS	AS REQD.	
6	1/2" NPS, SCH-80/160 CS/AS PIPE	AS REQD.		32	1/2"NPS,3PIECE PIPE UNION WITH 1/2"NPT(F) SCREWED	1	1
2	1/2"/4"1/4" ROOT VALVE-SW GLOBE VALVE	2	1	28	1/2"NPT (F) CS CAP	1	1
1	1/2"/4"1/4" CARBON/ALLOY STEEL NIPPLE OF BILL SAME AS THAT OF MAIN PIPES PER PROCESS REQD.)	AS REQD.		24	1/2"NPS,SCH-80/160X1/2"NPT(M)CS/AS NIPPLE	1	1
TAG NO.	DESCRIPTION	A B	QTY.		DESCRIPTION	A B	
	BILL OF MATERIAL				BILL OF MATERIAL		

1 2 3 4 5 6 7 8

1 2 3 4 5 6 7 8

**NOTE:-**

1. FOR PRESSURE LESS THAN 40KG, ROOT VALV. OF SIZE 1/2"SW,  
NIPPLE PIECE(11) & 1 TO 1/2"SW REDUCER(15) ARE NOT REQUIRED.

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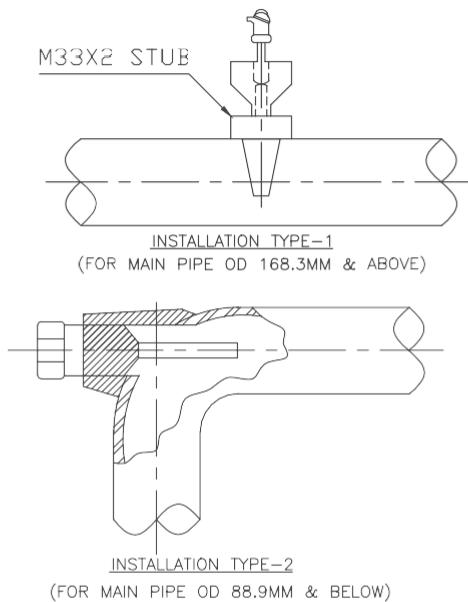
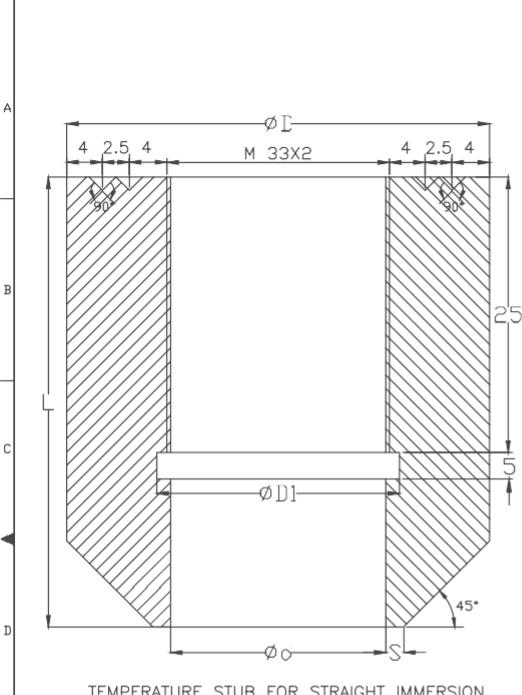
E

51	3/8" VALVE MANIFOLDS, SS-316	1
42	1/2" NPT(F) X 1/2" OD TUBE COMPRESSION FITTING,SS-316	2
41	1/2" NPT(M) X 1/2" OD TUBE COMPRESSION FITTING,SS-316	4
28	1/2" NPT(F) CS. CAP	2
24	1/2" NPS SCH 80/160 X 1/2" NPT(M) CS/AS NIPPLE	2
20	1/2" SW EQUAL TEE CS/AS	2
17	1/2" SW,CS,AS, GLOBE VALVE	2
15	1/2" TO 1/2" SW,CS,AS REDUCER	2
11	1/2" NPS SCH 80/160 CS/AS NIPPLE	2
6	1/2"NPS SCH 80/160 CARBON/ALLOY STEEL PIPE AS RECD.	
2	1/2"3/4"1" ROOT VALVE - SW GLOBE VALVE	2
1	1/2"3/4"1" CARBON/ALLOY STEEL NIPPLE OF MTL SAME AS THAT OF MAIN PIPE (AS PER PROCESS RECD.)	AS RECD.
TAG NO.	DESCRIPTION	A
	QTY.	

0 29.05.18	TENDER PURPOSE ONLY	KK	KA
REV. DATE	DESCRIPTION	DRN.	STR. MECH,ELEC,INST. APPROVED BY

FICHTNER		RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD 210, 105, 106 KOTA SUPER THERMAL POWER STATION KOTA, RAJASTHAN, INDIA.		
SIGNATURE	DATE			
DRAWN	KK 28.05.18			
DESIGNED	DUA 28.05.18			
CHECKED	DUA 28.05.18			
DEPT/HEAD	KA 28.05.18			
PROJ.MGR.	VB 28.05.18			
RELEASED FOR	PRELIMINARY	DEPT.	C&I	JOB NO. 1117155
	TENDER			SCALE: NTS SHEET 08 OF 15 REV.
	ENGINEERING			DWG.NO. ANNEXURE-7
	CONSTRUCTION			0

1 2 3 4 5 6 7 8



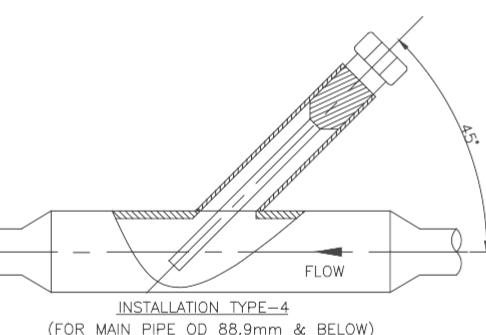
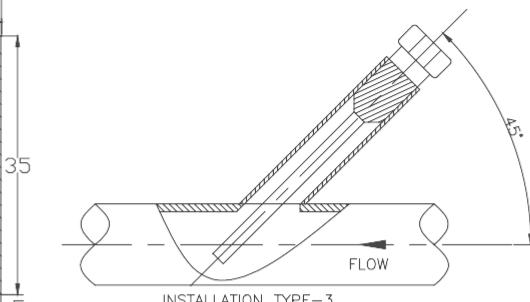
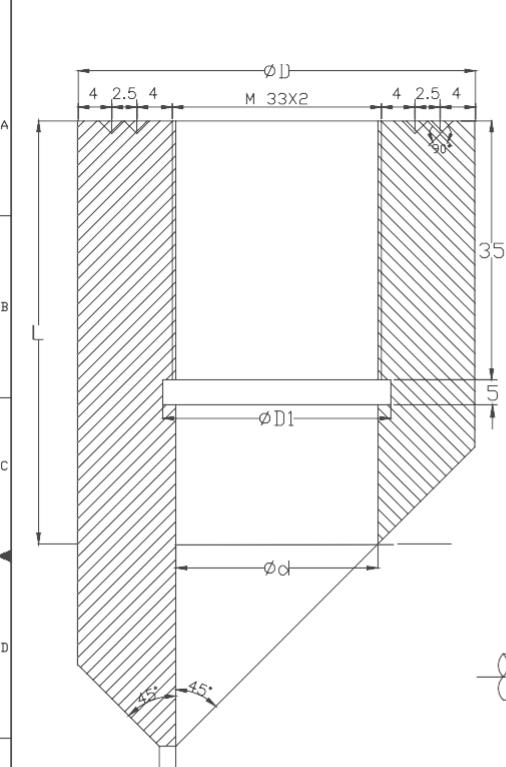
NOTES:-

1. MATERIAL OF THE BOSS SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED.
2. STRAIGHT IMMERSION STUBS SHALL BE USED FOR PIPE OD'S 168.3mm AND ABOVE. THE STUB HEIGHT FOR PIPE OD,168.3mm TO <219.1mm SHALL BE 65mm.
3. SLANT IMMERSION STUBS SHALL BE USED FOR PIPE OD'S 88.9mm TO 159mm.
4. FOR MAIN PIPE OD'S 88.9mm & BELOW SUITABLE EXPANDER SHALL BE USED.

FOR PIPE OD BELOW 219.1mm	29	55	33.5	1.5	65
FOR PIPE OD 219.1mm & ABOVE	29	55	33.5	1.5	45
MAIN PIPE SIZES	d	D	D1	S	L

0 29.05.18	TENDER PURPOSE ONLY	KK	KA
REV. DATE	DESCRIPTION	TRNL	STR. MECH. ELEC. INST. APPROVED BY
<b>FICHTNER</b> Consulting Engineers (India) Private Limited Chennai, Bangalore		 RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD 210, 105, 195 MW KOTA SUPER THERMAL POWER STATION KOTA, RAJASTHAN, INDIA	
INST. DRAWING FOR TEMP. STUB-1			
RELEASED FOR TENDER	PRELIMINARY	DEPT. C&I	JOB NO. 1117155 SCALE: NTS SHEET -09 OF 15 REV. 0
		DWG. NO.	ANNEXURE-7

1 2 3 4 5 6 7 8

**NOTES:-**

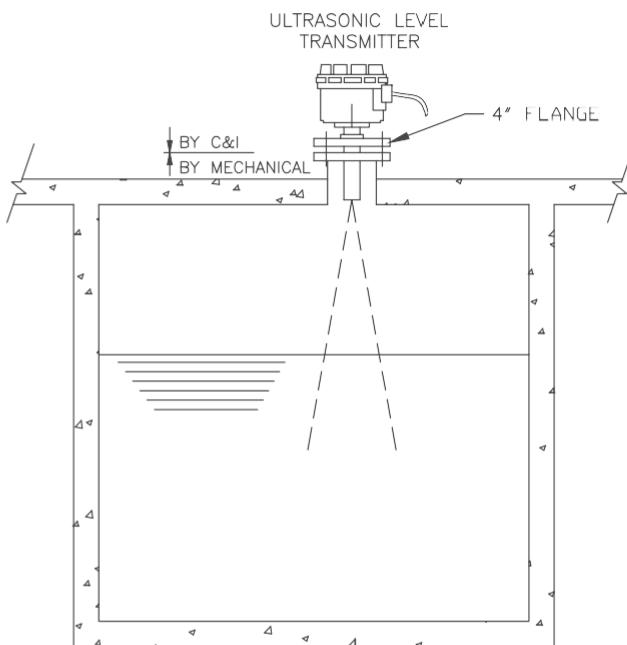
1. MATERIAL OF THE BOSS SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED.
2. STRAIGHT IMMERSION STUBS SHALL BE USED FOR PIPE OD'S 168.3mm AND ABOVE. THE STUB HEIGHT FOR PIPE OD 168.3mm TO 219.1mm SHALL BE 65mm.
3. SLANT IMMERSION STUBS SHALL BE USED FOR PIPE OD'S 88.9mm TO 159mm.
4. FOR MAIN PIPE OD'S 88.9mm & BELOW SUITABLE EXPANDER SHALL BE USED.

FOR PIPE OD BELOW 219.1mm	29	55	33.5	1.5	65
FOR PIPE OD 219.1mm & ABOVE	29	55	33.5	1.5	45
MAIN PIPE SIZES	d	D	D1	S	L

0 29.05.18	TENDER PURPOSE ONLY	KK	KA
REV. DATE	DESCRIPTION	TRNL	STR. MECH. ELEC. INST. APPROVED BY
<b>FICHTNER</b> Consulting Engineers (India) Private Limited Chennai, Bangalore		 RAJASTHAN RAJYA VIDYUT UTUPADAN NIGAM LTD 210, 105, 195 MW KOTA SUPER THERMAL POWER STATION KOTA, RAJASTHAN, INDIA	
INST. DRAWING FOR TEMP. STUB-2			
RELEASED FOR Preliminary Tender	DEPT. Cad	JOB NO. 1117155	SCALE: NTS
FOR Engineering Construction			REV. SHEET 1 OF 15
DWG. NO.	ANNEXURE-7		
	0		

1 2 3 4 ▼ 5 6 7 8

A



B

C

D

E

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A

B

C

D

E

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0 29.05.18	TENDER PURPOSE ONLY	KK KA
REV. DATE	DESCRIPTION	TRNL STR. MECH. ELEC. INST. APPROVED BY
<b>FICHTNER</b> Consulting Engineers (India) Private Limited Chennai, Bangalore		RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD 210, 105, 195 MW KOTA SUPER THERMAL POWER STATION KOTA, RAJASTHAN, INDIA
INST. DRAWING FOR ULTRASONIC LEVEL TRANSMITTER		
RELEASED FOR Preliminary Tender	DEPT. C&I JOB NO. 1117155 SCALE: NTS	SHEET 1 OF 15 REV.
	DWG. NO.	ANNEXURE-7 0

1 2 3 4 5 6 7 8

1 2 3 4 5 6 7 8

A

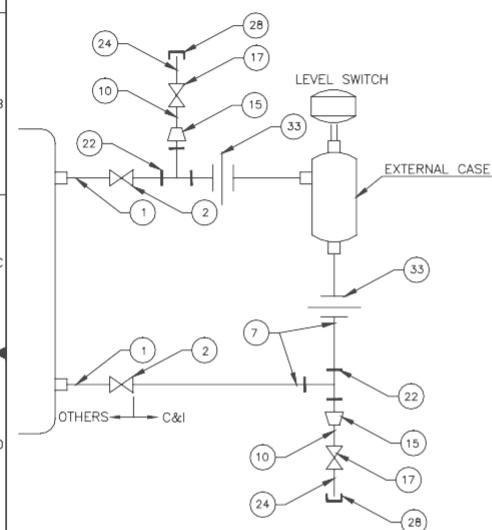
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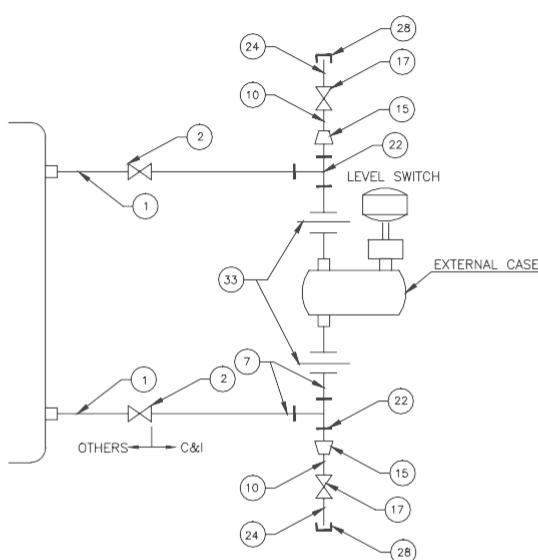
D

E

**FIG-A**



**FIG-B**



NOTE:-  
1. WITH VALVE OF SIZE 1/2" SW NIPPLE PIECE IS NOT REQUIRED.

1. WITH VALVE OF SIZE 1/2" SW NIPPLE PIECE IS NOT REQUIRED.

0	29.05.18	TENDER PURPOSE ONLY	KK	KA
REV.	DATE	DESCRIPTION	TRNL	STR. MECH. ELEC. INST.
APPROVED BY				

<b>FICHTNER</b> Consulting Engineers (India) Private Limited Chennai, Bangalore		RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD 210, 105, 195 MW KOTA SUPER THERMAL POWER STATION KOTA, RAJASTHAN, INDIA		
SIGNATURE	DATE			
DRAWN	KK	28.05.18		
DESIGNED	DUA	28.05.18		
CHECKED	DUA	28.05.18		
DEPT/HEAD	KA	28.05.18		
PROJ.MGR.	VB	28.05.18		
RELEASED FOR	PRELIMINARY	DEPT.	Cd	JOB NO. 1117155 SCALE: NTS SHEET 1 OF 15 REV.
TENDER		<input checked="" type="checkbox"/>		DWG.NO. ANNEXURE-7 0
ENGINEERING				
CONSTRUCTION				

33	1" EW EQUAL PIPE UNION	2	2
28	1/2" NPT(F) CS. CAP	2	2
24	1/2" NPS SCH 80/160 X 1/2" NPT(M) CS/AS NIPPLE	2	2
22	1" SW EQUAL TEE CS/AS	2	2
17	1/2" SWCS/AS, GLOBE VALVE	2	2
15	1/2" NPT(F) CS. CAP/REDUCER	2	2
10	1/2" NPT(F) CS. CAP/AS NIPPLE	2	2
7	1" NPS SCH 80/160 CS/AS STEEL PIPE AS RECD.	2	2
2	1" ROOT VALVE - SW GLOBE VALVE	2	2
1	1" CARBON/ALLOY STEEL NIPPLE OF MTL SAME AS THAT OF MAIN PIPE (AS PER PROCESS RECD.)	AS RECD.	
TAG NO.	DESCRIPTION	A   B	
		CITY:	

1 2 3 4 5 6 7 8

1 2 3 4 5 6 7 8

A

B

C  
STAND PIPE

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F

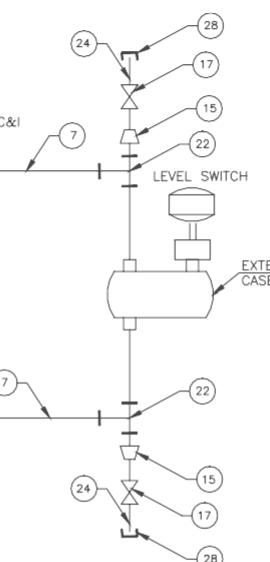


FIG-A

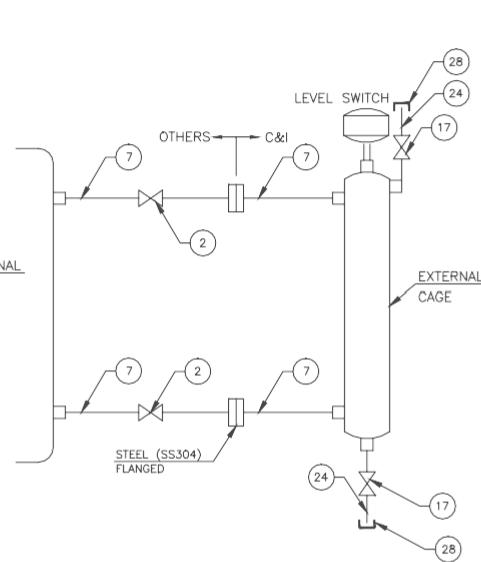
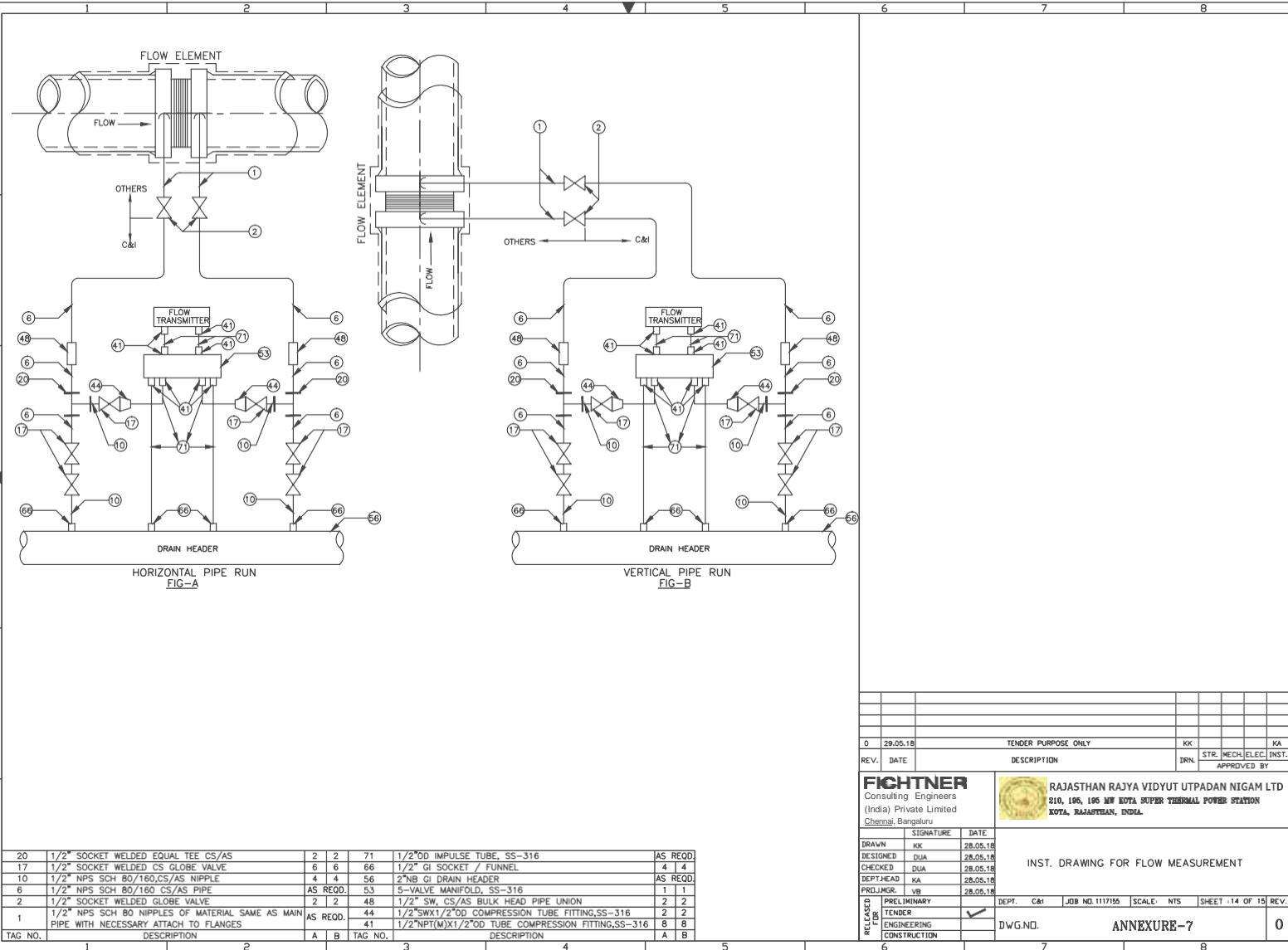


FIG-B

28	1/2" NPT (F) CS CAP	2	2
24	1/2" NPS SCH 80/160 X 1/2" NPT(M) CS/AS NIPPLE	2	2
22	1" SW EQUAL TEE CS/AS	2	2
17	1/2" SOCKET WELDED GLOBE VLV/ROOT VLV.	2	2
15	1" TO 1/2" SOCKET WELD REDUCER	2	2
7	1" NPS SCH 80/160 CS/AS STEEL PIPE AS REQD.	2	2
2	1" ROOT VALVE - SW GLOBE VALVE	2	2
TAG NO.	DESCRIPTION	A	B
	BILL OF MATERIAL	QTY.	

1 2 3 4 5 6 7 8

0 29.05.18	TENDER PURPOSE ONLY		KK	KA
REV. DATE	DESCRIPTION		TRNL	STR. MECH. ELEC. INST. APPROVED BY
<b>FICHTNER</b> Consulting Engineers (India) Private Limited Chennai, Bangalore		 RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD 210, 105, 195 MW KOTA SUPER THERMAL POWER STATION KOTA, RAJASTHAN, INDIA		
INST. DRAWING FOR LEVEL SWITCH WITH FLANGED CONNECTION				
RELEASED FOR TENDER	PRELIMINARY	DEPT. C&I	JOB NO. 1117155	SCALE: NTS SHEET 13 OF 15 REV. 0
			DWG. NO.	ANNEXURE-7



0 29.05.18	TENDER PURPOSE ONLY		KK	KA
REV. DATE	DESCRIPTION		DRN.	STR. MECH.ELEC.INST.
				APPROVED BY
<b>FICHTNER</b> Consulting Engineers (India) Private Limited Chennai, Bangalore		RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD 210, 105, 195 MW KOTA SUPER THERMAL POWER STATION KOTA, RAJASTHAN, INDIA		
SIGNATURE	DATE			
DRAWN KK	28.05.18			
DESIGNED DUA	28.05.18			
CHECKED DUA	28.05.18			
DEPT:HEAD KA	28.05.18			
PROJ.MGR. VB	28.05.18			
INST. DRAWING FOR FLOW MEASUREMENT				
RELEASED PRELIMINARY	DEPT. C&I	JOB NO. 1117155	SCALE: NTS	SHEET 14 OF 15 REV.
FOR TENDER	<input checked="" type="checkbox"/>			
ENGINEERING				
CONSTRUCTION				
DWG.NO. ANNEXURE-7 0				

1 2 3 4 5 6 7 8

A

B

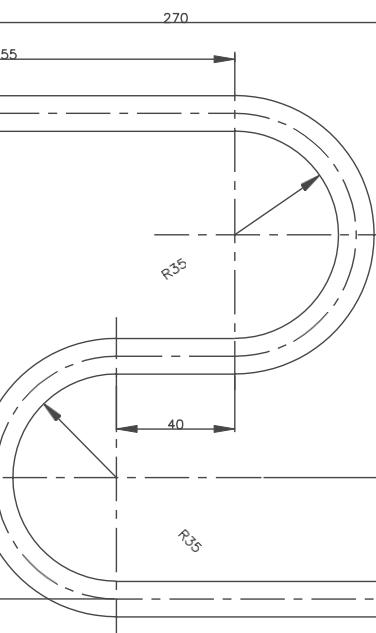
C

D

E

F

164



0	29.05.18	TENDER PURPOSE ONLY	KK	KA
REV.	DATE	DESCRIPTION	DRN.	STR. MECH.ELEC.INST. APPROVED BY
FICHTNER Consulting Engineers (India) Private Limited Chennai, Bangalore		RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD 210, 105, 195 MW KOTA SUPER THERMAL POWER STATION KOTA, RAJASTHAN, INDIA		
SIGNATURE	DATE	INST. DRAWING FOR U-TUBE		
DRAWN KK	28.05.18			
DESIGNED DUA	28.05.18			
CHECKED DUA	28.05.18			
DEPT:HEAD KA	28.05.18			
PROJ.MGR. VB	28.05.18			
RELEASED FOR TENDER	PRELIMINARY	DEPT. C&I	JOB NO. 1117155	SCALE: NTS SHEET -15 OF 15 REV. 0
ENGINEERING CONSTRUCTION		DWG.NO.	ANNEXURE-7	

1 2 3 4 5 6 7 8

## ANNEXURE – 8

### DRIVE CONTROL PHILOSOPHY

SL. NO.	DESCRIPTION	Type of I/O
<b>1</b>	<b>PLC INTERFACE FOR UNIDIRECTIONAL HTDRIVE / LT BREAKER CONTROL DRIVE (Signal Exchange has been envisaged between PLC and Switchgear/Drives)</b>	
a.	Start Command	DO
b.	Stop Command	DO
c.	ON Feedback	DI
d.	OFF Feedback	DI
e.	Swgr Disturbance (Overload relay operated/ control supply fail)	DI
f.	Emergency LPBS stop	DI
g.	Electrical Trip (Motor Protection Relay)	DI
h.	Switchgear Available (breaker in service position, switchgear in remote & breaker spring charged)	DI
i.	Pump / Fan bearing (DE & NDE) temperature measurement	RTD
j.	Motor Bearing (DE & NDE) temperature measurement	RTD
k.	Motor Winding temperature measurement	RTD
l.	Pump / Fan bearing Vibration measurement – DE & NDE (X & Y direction)	AI
m.	Motor Bearing Vibration measurement– DE & NDE (X & Y direction)	AI
n.	Speed input (For VFD Drives)	AI
o.	Speed output (For VFD Drives)	AO
p.	VFD mode/Bypass Mode selection (For VFD Drives)	DI
q.	VFD mode/Bypass Mode command (For VFD Drives)	DO
r.	Current Transducer input (> 30 KW rating)	AI
<b>2</b>	<b>PLC INTERFACE FOR UNIDIRECTIONAL LT DRIVE (Signal Exchange has been envisaged between PLC and PMCC/MCC/Drive related equipments)</b>	
a.	Start Command	DO
b.	Stop Command	DO
c.	ON Feedback	DI
d.	OFF Feedback	DI
e.	Swgr/MCC Disturbance (Overload relay operated/ control supply fail)	DI
f.	Emergency LPBS stop	DI
g.	Switchgear/MCC Available (switchgear/MCC in remote)	DI

SL. NO.	DESCRIPTION	Type of I/O
h.	Current Transducer input (> 30 KW rating)	AI
<b>3</b>	<b>PLC INTERFACE FOR BIDIRECTIONAL LT DRIVE- For Integral starters (Signal Exchange has been envisaged between Actuator and PLC)</b>	
a.	Open Command	DO
b.	Close Command	DO
c.	Integral starters Fault (Control supply fail/ O/L relay operated/L/R selector switch selected in local / Phase loss).	DI
d.	Open limit switch feedback	DI
e.	Close limit switch feedback	DI
f.	Open / close torque switch operated feedback	DI
g.	Position Transmitter (For inching type Drive)	AI
h.	Current input (> 30 KW rating)	AI
<b>4</b>	<b>PLC INTERFACE FOR BIDIRECTIONAL LT DRIVE-For Non-Integral starters (Signal Exchange has been envisaged between Actuator and PLC)</b>	
a.	Open Command	DO
b.	Close Command	DO
c.	Swgr/MCC Disturbance (Overload relay operated/ control supply fail/Emergency LPBS stop)	DI
d.	Switchgear/MCC Available (switchgear/MCC in remote)	DI
e.	Open limit switch feedback	DI
f.	Close limit switch feedback	DI
g.	Open Torque switch feedback	DI
h.	Close Torque switch feedback	DI
i.	Position Transmitter (For inching type Drive)	AI
j.	Current input (> 30 KW rating)	AI
<b>5</b>	<b>PLC INTERFACE FOR SOLENOID DRIVE (Single coil)</b>	
a.	Energize or DeEnergize	DO
b.	Open limit switch feedback	DI
c.	Close limit switch feedback	DI
<b>6</b>	<b>PLC INTERFACE FOR SOLENOID DRIVE (Double coil)</b>	
a.	Energise	DO
b.	DeEnergise	DO
c.	Open limit switch feedback	DI

SL. NO.	DESCRIPTION	Type of I/O
d.	Close limit switch feedback	DI
<b>7</b>	<b>PLC INTERFACE FOR PNEUMATIC DRIVE</b>	
a.	Command to I/P converter (Smart Positioner)	AO
b.	Position Transmitter (Smart Positioner)	AI

**Note:**

1. This is a minimum requirement, however the Drive control philosophy shall be as per Owner's main plant equipment Drive control philosophy and the redundancy of I/O cards for PLC I/Os shall be inline with main plant redundancy philosophy.
2. RTDs mentioned are duplex RTDs.
3. In addition to above Vibration measurement signals, Key Phasor signal shall also be provided
4. Local start pushbuttons (for pump/fan etc.) commands shall be connected to the control system to ensure interlock/protection requirement. The Drives, Critical Valves/Dampers shall be decided during detailed engineering

**ANNEXURE – 9**

**VENDOR LIST**

<b>SR. NO.</b>	<b>EQUIPMENT / SYSTEM</b>	<b>VENDOR</b>
1.	PRESSURE GAUGES	1. ALTOP 2. GENERAL INSTRUMENTS 3. WIKA 4. PRECISION INSTRUMENT 5. WAAREE 6. PYRO ELECTRIC 7. FOBES MARSHALL
2.	TEMPERATURE GAUGES	1. WAAREE INSTRUMENTS 2. GENERAL INSTRUMENTS 3. PYRO ELECTRIC 4. ALTOP 5. WIKA 6. TOSHNIWAL BROTHERS. 7. TEMPSENS.
3.	DIFFERENTIAL PRESSURE GAUGE	1. SWITZER 2. ALTOP 3. PREMIER INSTRUMENTS 4. A.N.INSTRUMENTS 5. CHEMTROL.
4.	RTD AND THERMOCOUPLES	1. GENERAL INSTRUMENTS 2. ALTOP INDUSTRIES 3. PYRO ELECTRIC 4. WAAREE INSTRUMENTS. 5. WIKA TEMPSENS.
5.	LEVEL GAUGES	1. CHEMTROLS 2. LEVCON 3. V. AUTOMAT 4. PUNE TECHTROL 5. YARWAY/TYCO 6. SBEM
6.	ELECTRONIC TRANSMITTERS (SMART)	1. ROSEMOUNT 2. YOKOGAWA 3. ABB 4. HONEYWELL 5. FOXBORO/INVENSYS 6. SIEMENS
7.	CONTROL VALVES	1. INSTRUMENTATION LTD 2. DRESSER/MASONEILAN 3. FISHER XOMOX 4. MIL 5. CCI
8.	PRESSURE RELIEF VALVE	1. TYCO VALVES & CONTROLS 2. FAINGER LESER VALVES (P.) LTD 3. DRESSER VALVES
9.	SAFETY VALVES	1. TYCO 2. IL 3. BHEL 4. DRESSER 5. FAINGER LASER
10.	FLOW ORIFICES	1. MICRO PRECISION 2. HYDRO PNEUMATICS 3. INSTRUMENTATION LTD., PALGHAT 4. GENERAL INSTRUMENTS

SR. NO.	EQUIPMENT / SYSTEM	VENDOR
		5. BALIGA
11.	FLOW NOZZLES / VENTURI	1. MICRO PRECISION 2. STAR MECH 3. GIC 4. HYDRO PNEUMATICS 5. INSTRUMENTATION LTD., PALGHAT 6. BALIGA
12.	ROTAMETERS	1. WAAREE INSTRUMENTS 2. SCIENTIFIC DEVICES 3. EUREKA
13.	FLOW SWITCHES	1. SWITZER 2. S.B.ELECTROMECHANICALS 3. SCIENTIFIC DEVICES 4. V.AUTOMAT 5. P&F
14.	VORTEX FLOW METER	1. YOKOGAWA 2. ROSEMOUNT 3. FOXBORO
15.	CORIOLISIS MASS FLOWMETER	1. YOKOGAWA 2. ROSEMOUNT 3. FOXBORO
16.	FLOAT & BOARD TYPE LEVEL INDICATOR	1. MICROPRECISION 2. LEVCON INSTRUMENTS (P) LTD., CHENNAI 3. V.AUTOMAT & CONTROL PVT. LTD. 4. FLOW STAR. 5. Emerson 6. EH 7. ABB
17.	CONTROL PANEL	1. JAISUN & HUTCHISON 2. RITTAL 3. PYROTECH 4. INDUSTRIAL CONTROLS & APPLIANCES 5. IND SWITCHGEAR & CONTROLS
18.	SOLENOID VALVES	1. ASCO 2. ROTEX 3. BLUE STAR 4. AVCON 5. FESTO
19.	PH/CONDUCTIVITY ANALYSERS	1. ROSEMOUNT 2. ABB 3. FORBES MARSHALL 4. YOKOGAWA
20.	E/ P CONVERTERS (SMART)	1. ROSEMOUNT 2. WATSON SMITH
21.	INSTRUMENT CABLES	1. ASSOCIATED CABLES 2. DELTON 3. UNIVERSAL CABLE 4. ASIAN CABLES 5. ELKAY TELELINKS 6. THERMOPAD CABLES 7. TCL 8. CORDS 9. RASHI CABLES.
22.	ANNUNCIATORS	1. IIC 2. ICA

SR. NO.	EQUIPMENT / SYSTEM	VENDOR
		3. MINILEC 4. PROCON
23.	AIR FILTER REGULATOR	1. SHAVO NORGREN 2. PLACKA 3. LEGRIS FRANCE 4. ABB 5. PARKAR
24.	RELAYS	1. OEN 2. L&T 3. SIEMENS 4. GEC ALSTHOM 5. OMRON
25.	SELECTOR SWITCHES	1. KAYCEE 2. L & T 3. GEC ALSTHOM
26.	PROGRAMMABLE LOGIC CONTROLLER (PLC)	1. ROCKWELL. 2. SIEMENS 3. ABB 4. GE FANUC.
27.	PRESSURE SWITCH / TEMPERATURE SWITCH	1. SWITZER 2. GIC 3. CHEMTROL 4. SOR
28.	LIMIT SWITCHES / PROXIMITY SWITCHES	1. HONEYWELL 2. BCH 3. P & F 4. SIEMENS
29.	DISPLACER TYPE LEVEL TRANSMITTER	1. MASONEILAN 2. CHEMTROL 3. YARWAY/TYCO 4. V. AUTOMAT
30.	STAINLESS STEEL TUBES	1. MITAL INDIA 2. CHOKSI 3. EXCEL HYDRO PNEUMATICS 4. CHAMP 5. WESMEC 6. V S METAL 7. SWAGELOK
31.	COPPER TUBES (BARE & PVC SHEATHED)	1. PLACKA INSTRUMENTS & CONTROLS 2. RELIANCE ENGINEERING & ELECTRICAL CORPORATION 3. MULTIMETAL LIMITED 4. V. S. METAL 5. INVENTUM
32.	COMPRESSION FITTINGS (BRASS & STAINLESS STEEL)	1. PLACKA INSTRUMENTS / VALTEX 2. SWAGELOK 3. PARKER 4. CHAMP 5. EXCEL HYDRO PNEUMATICS 6. WESMEC 7. TRUEWAY CORPORATION 8. VS METAL 9. INVENTUM
33.	FLAME PROOF / WEATHER PROOF CABLE GLANDS	1. BALIGA 2. FLEXPRO 3. FCC 4. COMET

SR. NO.	EQUIPMENT / SYSTEM	VENDOR
34.	FLAME PROOF / WEATHER PROOF JUNCTION BOXES	1. BALIGA 2. STERLING SWITCH GEARS 3. EX-PROTECTA 4. SUMIP PUSTRON (FOR FRP)
35.	TERMINAL BLOCKS	1. PHEONIX 2. CONNECT WELL 3. WAGO
36.	PNEUMATIC HEADER	1. EXCELSIOR 2. BALIGA 3. EXCEL HYDROPNEUMATICS 4. CHAMP 5. SWAGELOK 6. PARKER 7. WESMEC 8. INVENTUM.
37.	ISOLATION VALVES	1. BDK 2. DEWRANCE MCNEII 3. L & T 4. MICROPRECISION 5. EL O MATIC
38.	TEMPERATURE SCANNERS	1. RADIX 2. NISHKO 3. LECTROTEK 4. BENTLY NEVEDA, USA 5. ROCHESTER INSTRUMENTS SYSTEM LTD. UK
39.	DESUPERHEATER NOZZLES	1. INSTRUMENTATION LTD., PALGHAT 2. ARCA CONTROLS INDIA PVT. LTD., MUMBAI 3. FISHER XOMOX, CHENNAI 4. VALFLO 5. DRESSER/MASONEILAN 6. YARWAY/TYCO
40.	LEVEL TRANSMITTERS	1. V AUTOMAT & CONTROLS PVT. LTD., NEW DELHI (ONLY UPTO 300 CLASS) 2. CHEMTROLS ENGG. PVT. LTD., MUMBAI 3. DRESSER INDIA 4. MAGNETROL, INDIA 5. FISHER XOMOX, INDIA 6. YOKOGAWA 7. ROSEMOUNT 8. YARWAY/TYCO 9. AMETEK
41.	TRIP SOLENOID VALVES	1. IMI NORGREN, GERMANY 2. ASCO
42.	MERCURY IN STEEL DIAL THERMOMETERS	1. ALTOP 2. GENERAL INSTRUMENTS CONSORTIUM, CHENNAI 3. BELLS CONTROLS LTD., CHENNAI 4. A.N. INSTRUMENTS, CHENNAI. 5. WAAREE INSTRUMENTS
43.	BIMETALLIC THERMOMETERS	1. GENERAL INSTRUMENTS CONSORTIUM, CHENNAI 2. NUOVOFINA,ITALY
44.	LIQUID LEVEL SWITCHES	1. LEVECON 2. CHEMTROL, MUMBAI

SR. NO.	EQUIPMENT / SYSTEM	VENDOR
		3. V. AUTOMAT.
45.	DISSOLVED OXYGEN ANALYZER	1. ROSEMOUNT 2. YOKOGAWA 3. KENT 4. ABB 5. GLI 6. FORBES MARSHALL
46.	ULTRASONIC LEVEL TRANSMITTER	1. SIEMENS 2. YOKOGAWA 3. CHEMTROLS 4. AMETEK 5. ROSEMOUNT
47.	MAGNETIC FLOW METERS	1. ABB 2. E&H 3. FORBES MARSHALL 4. YOKOGAWA
48.	ORP ANALYSER	1. HACH ULTRA 2. YOKOGAWA 3. HONEYWELL 4. EMERSON 5. ABB
49.	O2 ANALYSER	1. CHEMTROLS ENGG. PVT LTD 2. EMERSON PROCESS MANAGEMENT 3. FORBES MARSHALL ARCA PVT. LTD. 4. AMETEK 5. YIL
50.	pH ANALYSER	1. ABB 2. HACH ULTRA 3. POLYMETRON 4. YOKOGAWA 5. FORBES MARSHALL 6. EMERSON PROCESS MANAGEMENT
51.	SODIUM ANALYSER	1. HACH ULTRA 2. FORBES MARSHALL 3. ABB 4. YBL
52.	CONDUCTIVITY ANALYSER	1. ABB 2. HACH ULTRA 3. POLYMETRON 4. YOKOGAWA 5. FORBES MARSHALL 6. EMERSON PROCESS MANAGEMENT
53.	PNEUMATIC CYLINDER	1. FESTO 2. EXCEL HYDRO PNEUMATIC 3. IL 4. KELTRON
54.	CONTROL DESK	1. PYROTECH 2. RITTAL
55.	INDICATING LAMPS	1. SIEMENS 2. TEKNIK
56.	CONDENSATE POTS	1. MICROPRECISION 2. EXCEL HYDRO PNEUMATIC

SR. NO.	EQUIPMENT / SYSTEM	VENDOR
57.	LED MONITORS	1. DELL 2. HP 3. VEIWSOMIC 4. SONY 5. SAMSUNG
58.	BULK POWER SUPPLY	1. PHOENIX 2. COSEL 3. APLAB
59.	MANAGED ETHERNET SWITCH	1. CISCO 2. HIRSCHMANN. 3. ALLIED TELE 4. RUGGEDCOM
60.	SIGNAL ISOLATORS	1. MTL 2. PHOENIX 3. TURCK 4. STAHL
61.	LVS	1. BARCO 2. DELTA. 3. SONY, 4. PYROTECH
62.	MCB	1. ABB, 2. GE, 3. ALSTOM, 4. L&T, 5. SIEMENS



# **RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD**

## **Cooling Water System Package for Kota Super Thermal Power Station Unit # 5 (1 x 210 MW) Kota, Rajasthan, India**

[DOC. No. FCE-1117155-ME-DOC-SPC-3000-033]

### **VOLUME II SECTION 5 DETAILED TECHNICAL SPECIFICATION - CIVIL**

**FICHTNER Consulting Engineers (India) Private Limited**  
Chennai-Bengaluru, India



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**VOLUME II**  
**SECTION 5**  
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## VOLUME - II

### SECTION 5

#### DETAILED TECHNICAL SPECIFICATION – CIVIL

##### 1.0.0 GENERAL

1.1.0 This specification covers design, preparation of general arrangement drawings, construction and fabrication drawings, supply of labour, materials and construction of all civil, structural and architectural works.

Description of various items of work under this specification and nature of work in detail are given hereinafter. The complete work under this scope is referred to as Civil Works. Various buildings, structures, plant and systems, facilities, etc., covered under the Civil, Structural and Architectural works irrespective of what is stated in this document, to complete the entire scope of work specified elsewhere within the battery limits (terminal points) in the bid documents shall be deemed to be in the scope of this contract.

The scope shall include dismantling, rerouting & restoration of existing underground and over ground structures or any obstructions which are necessary for the execution of work.

The work to be performed under this specification consists of design, engineering and providing all labour, materials, consumables, equipment, temporary works, temporary storage sheds, temporary colony for labour and staff, temporary site offices, constructional plants, fuel supply, transportation and all incidental items not shown or specified but reasonably implied or necessary for the completion and proper functioning of the plant, all in strict accordance with the specifications including revisions and amendments thereto as may be required during the execution of work.

All materials including cement, reinforcement steel and structural steel, etc., shall be provided by the Contractor.

The scope shall also include setting up by the Contractor a complete testing laboratory in the field to carry out all relevant tests required for the Civil Works.

The work shall be carried out according to the design / drawings to be developed by the Contractor and approved by the Owner / Engineer. For all buildings, facilities, systems, structures, etc., necessary layout and details are to be developed by the Contractor keeping in view the statutory and functional requirements and providing enough space and access for operation, use and maintenance. The Contractor's work shall cover complete requirements as per IS codes, fire safety norms, requirements of various statutory bodies, International Standards, best prevailing practices and to the complete satisfaction of the Owner / Engineer.



Site grading and leveling is in the scope of Contractor. The Contractor shall reinstate the finished ground level to the same conditions as was handed over at the end of all construction works undertaken to fulfill the requirements of this specification.

The Contractor shall make the layout and levels of all structures from the general grid of the plot and the nearest GSI benchmark or other acceptable benchmark of Govt. dept. as per the directions of the Owner / Engineer. The Contractor shall be solely responsible for the correctness of the layout and levels and shall also provide necessary instruments, materials, access to works, etc., to the Owner / Engineer for general checking of the correctness of the civil works.

All the quality standards, tolerances, welding standards and other technical requirements shall be strictly adhered to.

The Contractor shall fully apprise himself of the prevailing conditions at the proposed site, climatic conditions including monsoon pattern, soil conditions, local conditions and site specific parameters and shall include for all such conditions and contingent measures in the bid, including those which may not have been specifically brought out in the specifications.

In case of any conflict between stipulations in various portions of the specification, most stringent stipulation would be applicable for implementation by the Contractor without any extra cost to the Owner.

#### **1.2.0 Scope of Works**

Refer to Section 1, General Technical Specification

#### **2.0.0 SUBMISSIONS**

Refer to Section 1, General Technical Specification

#### **3.0.0 LOADS**

##### **3.1.0 General**

All structures shall be designed for the most critical combinations of dead loads, imposed loads, equipment loads, crane loads, steam piping (static & dynamic) and other piping loads, wind loads, seismic loads, temperature loads, loads and any other loading conditions which can occur during the design life of the facility.

##### **3.2.0 Loading**

###### **3.2.1 Dead Loads (DL)**

Dead loads consist of the weights of the structure complete with finishes, fixtures, partitions, wall panels and all equipment of semi-permanent nature including tanks, silos, bins, partitions, roofing, piping, cable trays, bus ducts etc. The content of tanks, silos, bins and hoppers etc. shall be measured at full capacity for this purpose.



The piping loads, cable tray loads and the contents of the tanks shall be listed separately so that they can be excluded from dead load when dead loads are acting as stabilising load for uplift.

### 3.2.2 Equipment Loads (EL)

Loads of all equipment Pumps, Monorails, Electrical control and relay panels, Cable load, Pipe load (static and dynamic), Tanks, Batteries, etc. shall be considered over and above the imposed loads. Equipment loads shall be considered as given by equipment supplier. Equipment loads which are of permanent nature shall be treated as dead loads. Static and dynamic loads of major equipment shall be based on the manufacturer's data of the specified equipment. However, where the uniform floor live load adequately accounts for the equipment moving weight, the weight of such equipment as a dead load shall not be considered e.g. switchgear and control room floors are usually designed for a live load that includes the equipment weight.

All equipment, tank and piping design loading shall include hydraulic testing loads. Weight of equipment, tanks, pipes, conduits etc. supported by structure shall include maximum possible loading conditions i.e. flooded material contents and associated impacts, test loading, anchorage and constraint effects.

### 3.2.3 Crane Load (CRL)

For crane loads, an impact factor of 25% and lateral crane surge of 10% (of lifted weight + trolley weight) shall be considered in the analysis of frame according to the provisions of IS: 875. The longitudinal crane surge shall be 5% of the static wheel load. Longitudinal surge and lateral surge shall not be considered to act simultaneously.

### 3.2.4 Imposed Loads (LL)

Imposed loads in different areas shall include live loads, minor equipment loads, cable trays, small pipe racks / hangers, erection loads, operation / maintenance loads etc. The loads considered shall not be less than that specified in IS: 875 (Part II).

The loads listed hereunder are minimum live loads for the areas involved. Special use areas shall be investigated and loads revised upward as necessary. Floors and supporting members which may be subjected to heavy equipment live loads shall be designed on the basis of the weight of equipment or specifically defined live loads, whichever is greater.

#### 3.2.4.1 Roofs

- |                |  |
|----------------|--|
| a. Flat Roof   | - 1.5 kN/sq.m for accessible roofs<br>- 0.75 kN/sqm for non-accessible roofs<br>- 5.0 kN/sqm for accessible roofs with HVAC equipment etc. |
| b. Sloped Roof | - As per IS: 875   |



### 3.2.4.2 Electrical Bay and other electrical buildings

- |                      |                     |
|----------------------|---------------------|
| a. MCC Room          | - 12 kN/sqm         |
| b. Cable Vault Floor | - 5 kN/sqm          |
| c. Battery Rooms     | - 10 kN/sqm         |
| d. Cable tray loads  | - 1.0 kN/m per tray |
| e. Minimum live load | - 5 kN/sqm          |

### 3.2.4.3 Other Areas

- |                               |  |
|-------------------------------|--|
| a. RCC Floors                 | - 5 kN/sqm for offices, laboratories, conference rooms and general floors  |
| b. Stairs and balconies       | - 5 kN/sqm   |
| c. Chequered Plate / gratings | - The gratings / chequered plates shall be designed for minimum live load of 7.5kN/sq.m for minimizing deflection. However, the supporting member shall be designed for a live load of 5 kN/sq.m |
| d. Walkways                   | - 3 kN/sqm   |
| e. Toilet rooms               | - 2 kN/sqm   |

3.2.4.4 Culverts and allied structures including buried RCC Pipes shall be designed for Class "AA" loading as per IRC-6

3.2.4.5 Covers for trenches & channels that are not exposed to vehicular traffic shall be designed for Live Load of adjoining areas or 5 kN/sqm whichever is higher. Where channels are likely to be exposed to vehicular traffic, the requirements of Code of Practice for road bridges shall be adhered to

### 3.2.5 Piping Anchor and Restraint Loads

Piping load shall be as per load plan drawings unless otherwise mentioned.

Piping anchor and restraint forces of major piping shall be obtained from piping analysis results, and be considered as live load in the structure design.

3.2.6 Ponding effects due to framing deflections for roofs, if any, shall be considered.

3.2.7 In addition to live loads, a minimum of 1.5 kN/sqm shall be considered as Hung loads for electrical, ventilation & air conditioning for applicable floors unless otherwise mentioned. A load of 2.0 kN/sqm shall be considered as Hung Loads for piping unless otherwise mentioned.

3.2.8 Live Loads reduction shall be in accordance with the provisions of IS: 875 & IS: 1893.



### 3.3.0 Seismic Load (SL)

Seismic forces shall be considered as per the criteria specified in Project Information attached in this specification. Response spectrum method shall be used for the seismic analysis using at least five modes of vibration.

Seismic forces shall be as per IS: 1893-2005. As per IS: 1893, the site falls in Zone III.

Zone Factor (Z) = 0.16

For the following structures, the design methods listed below shall be used:

- a. For all buildings / structures Response Reduction factor shall be as per Table 3 of IS: 1893 (Part 4).
- b. The importance factor for each structure shall be as per Table 2 of IS: 1893 (Part 4).
- c. Ductile detailing as per IS: 13920 shall be adopted for all RCC structures.

### 3.4.0 Wind Load (WL)

Wind loads on structures shall be calculated as per provisions of IS: 875 (Part 3): 2015. The wind shall be assumed to blow in any direction and most unfavorable condition shall be considered.

Basic Wind Speed	= 47 m/s
K1 factor	= 1.07
K2 factor shall be	= corresponding to Terrain Category 2
K3 factor	= 1.0

In design of structures, wind force on equipment supported on frame including all fixtures, piping, staircases, ladders, handrails etc. shall also be considered.

### 3.5.0 Temperature Load (TL)

Expansion and contraction due to changes of temperatures of materials of a structure shall be considered and adequate provisions shall be made for the effects produced (as per provision in relevant IS codes). The maximum distance of the expansion joint shall be as per the provisions of IS: 800 and IS: 456 for steel and concrete structures respectively.

Analysis shall be carried out for ambient temperature variation. The temperature variation shall be considered as 2/3 of the average maximum annual variation in temperature. The average maximum annual variation in temperature for this purpose shall be taken as the difference between the mean of the daily minimum temperature during the coldest month of the year and mean of daily maximum temperature during the hottest month of the year. The structure shall be designed to withstand thermal stresses due to 50% of the total temperature variation.



Coefficient of thermal expansion of steel shall be taken as per IS:800. Coefficient of thermal expansion for concrete shall be taken as per IS:456

### 3.6.0 Earth Pressure Load (SP & SCL)

Earth pressure for all underground structures shall be calculated using coefficient of earth pressure at rest, co-efficient of active or passive earth pressure (whichever is applicable). However, for the design of substructure of pump houses, earth pressure at rest shall be considered.

In addition to earth pressure and ground water pressure etc. a minimum surcharge load of 15 kN/m<sup>2</sup> shall also be considered for the design of all underground structures including channels, sumps, cable & pipe trenches etc. for the vehicular traffic in the vicinity of the structure.

### 3.7.0 Hydrostatic Pressure Load (HP)

Ground water level for calculation of shall be considered at 1.0 m below finished grade level.

## 4.0.0 LOAD COMBINATIONS

Structures shall be analyzed and designed for the most critical combinations of dead loads, imposed loads, equipment loads, crane loads, piping loads (static, friction and dynamic), wind loads, seismic loads and temperature loads. In addition, Erection loads, loads and forces developed due to differential settlement shall also be considered.

### 4.1.0 Building / Structures

The individual members of the frame shall be designed for worst combination of forces such as bending moment, axial force, shear force and torsion. Wind and seismic forces shall not be considered to act simultaneously.

The following are the general load combinations to be considered for analysis of buildings / structures.

DL + EL ± TL  
DL + EL + LL ± TL  
DL + EL + CRL ± TL  
DL + EL + LL + CRL ± TL  
DL ± WL ± TL  
DL + EL ± WL ± TL  
DL + EL + CRL ± WL ± TL  
DL + EL + LL + CRL ± WL ± TL  
DL ± SL ± TL  
DL + EL ± SL ± TL  
DL + EL + CRL(E) ± SL ± TL  
DL + EL + LL + CRL(E) ± SL ± TL



For stability check

$$0.9DL \pm SL$$
$$0.9DL \pm WL$$

While considering seismic nodal masses, live load reduction factors shall be as per the IS 1893:2002 Cl 7.3 Table 8. For imposed loads,

Up to 3 kN/Sq.m - 25%,  
Above 3 kN/Sq.m - 50%,  
For Roofs - 0%.

Wind and Seismic loads acting in the transverse and longitudinal direction shall be considered independently as separate load cases .

## 5.0.0 CONSTRUCTION LOAD

For large structure design, construction loading depending on methodology of construction shall be considered. Temporary loadings likely to be imposed are due to handling of concrete, formwork, hoist fixing, storage of materials, temporary access etc. Loads due to foundation settlement shall also be considered.

For large structures the method of construction and the type of formwork to be used shall be decided by the Contractor in advance and should be enclosed in the bids submitted. Construction loadings that may occur during execution of work shall be considered in the design of the structure. Factors causing temporary loading may include the following depending upon the method construction.

- a. Barrowing of concrete
- b. Scaffolding and formwork
- c. Loads produced by anchoring devices of climbing scaffolds
- d. Hoist fixings
- e. Storage of materials on scaffolding
- f. Temporary access
- g. Tower crane fixing
- h. Works temporary omitted for access purpose.

## 6.0.0 GENERAL DESIGN CONCEPTS

- 6.1.0
  - i) All buildings shall have framed super structure.
  - ii) Unless specified otherwise, all buildings shall have minimum 230 mm thick brick masonry on exterior face.
- 6.2.0 Individual members of the frame shall be designed for the worst combination of forces such as bending moment, axial force, shear force, torsion, etc.



- 6.3.0 Different load combinations shall be taken as per IS:875 and other relevant IS Codes.
- Wind and seismic forces shall not be considered to act simultaneously.
  - 'Lifted load' of crane shall not be considered during seismic condition.
  - Permissible stresses for different load combinations shall be taken as per relevant IS codes.
  - For the design of pipe / cable supporting structure, the soil weight shall be considered as backfilled upto grade level for the condition of pipe running full / cables in position.
  - Frictional forces between the pipes and supporting structure in longitudinal direction need not be considered along with seismic or wind forces.
- 6.4.0 Design detailing and fabrication of steel structures shall be as per provisions of IS: 800
- 6.5.0 Welding shall be used for fabrication and erection. Site connections shall generally be with welding / bolts. For bolted connection, IS: 4000, IS: 3757, IS: 6623 and IS: 6649 shall be followed. IS: 814, IS: 816, IS: 1024, IS: 4353 and IS: 9595 shall be followed for welding of structures.
- 6.6.0
- Dispersion of load in any direction through soil shall be as per IS: 8009 (relevant part).
  - Dispersion of load through concrete shall be considered at an angle of 45 degrees with horizontal from the edge of contact area.
- 6.7.0
- Permissible deflection (unless specified otherwise in this specification) for latticed framework and beams of floors other than drive floor shall be span/325.
  - The allowable deflection for beams directly supporting drive machinery shall be restricted to span/500 unless specified otherwise in this specification.
- 6.8.0
- The design and construction of RCC structures shall be carried out as per IS: 456. Working stress method shall be adopted for the design wherever specifically mentioned in this specification.
  - For design and construction of steel-concrete composite members, IS: 11384 shall be followed.
  - For reinforcement detailing, IS: 5525, IS 13920 and SP: 34 shall be followed.
  - Two layers of reinforcement (on both inner and outer faces) shall be provided for RCC wall sections having thickness 150 mm or more.



- 6.9.0
- a) All RCC liquid retaining / conveying structure (except water storage tanks) shall be designed in accordance with IS: 3370 by the working stress method, using limited steel stress. However, water storage tanks shall be designed as an uncracked section as per IS: 3370 by working stress method. Grade of concrete for the above structures shall be M-25 as per IS: 456.
  - b) Water proofing treatment shall be provided for liquid retaining / carrying structures and basement type structures (requiring dry working condition). Dense and durable concrete with water cement ratio not more than 0.45 shall be used. Plasticiser / super-plasticiser cum water proofing compound shall be added to the concrete. All the construction / expansion joints shall be properly treated with PVC water bar and / or chemical injection grouting as per IS: 6494. For basement type of structures, internal / external surface shall be provided with acrylic based polymer modified cementitious composite coating system for critical structures. For external application wherever the surface is in contact with the earth, fine silica / quartz sand of 0.6 mm nominal size shall be added in the coating mix for better abrasion resistance and total nominal thickness of such coating shall be minimum 1.5 mm. For non-critical structures minimum two coats of bitumen grade 85/25 as per IS: 702, mixed with 1% of anti-stripping compound meeting the requirement of IS: 6241, shall be applied. The total application of bitumen shall not be less than 1.7kg/sq.m.

Contractor shall submit a comprehensive scheme for water proofing treatment based on above or any other alternative scheme, internationally accepted for Owner / Engineer approval prior to commencement of work.

- c) All liquid retaining / carrying structures shall be tested for water tightness as per the provisions of IS: 3370 and IS: 6494 and in case of leakage, the same shall be rectified by chemical injection grouting through nozzles.

#### 6.10.0 Underground Structures

- a) Following loading conditions shall be considered in addition to the loading from super structure for the design of substructure of pump house, channels, sumps, tanks, trenches and other underground structures.
  - i) Liquid pressure from inside and no outside pressure, like earth pressure, ground water and surcharge pressure (applicable only to structures, which are liable to be filled up with water or any other liquid.)
  - ii) Earth pressure, surcharge pressure and ground water pressure from outside and no Liquid pressure from inside.
  - iii) Design shall also be checked against buoyancy due to the ground water during construction as well as after construction stages. Minimum factor of safety against buoyancy shall be ensured



considering empty condition inside and ignoring the superimposed loadings. Provision of pressure relief valves / flap valves, etc., shall not be permitted to counter the buoyancy in pump sumps.

- iv) Base slab and piers of the pump houses shall also be designed for the condition of different combination of pump sumps being empty during maintenance stages with maximum ground water level
- b) Intermediate dividing pier of pump sumps and partition wall (if applicable) in channel shall be designed considering water on one side only and other side being empty for maintenance.
- c) All pump houses and other substructures (wherever applicable) shall be checked for stability against sliding and overturning during construction as well as operating conditions for various combinations of loads.

#### 6.11.0 Deflection Criteria

The max. deflection for various structures shall not exceed and be limited to the following:

S.No.	Description	Max. Value of
1.	For all structures	Span/325 or Height/325 as the case be unless noted otherwise.
2.	For all beams directly supporting equipment	Span/500
3.	For all roof purlins	Span/250
4.	For all grating / chequered plates	Span/250 (However, the min. vertical deflection grating / chequered plate shall be limited to 6 mm.)
5.	For cladding runners, roofing / cladding sheets	Span /250

However, the max. Vertical deflection of Grating / chequered plate shall be limited to 6mm).

#### 6.12.0 Equipment Foundations

All block foundations supporting rotating equipment resting on soil shall be designed using the elastic half space theory. The mass of the RCC block shall not be less than three times the mass of the machine. Dynamic analysis shall be carried out to calculate natural frequencies in all the modes including coupled modes and to calculate vibration amplitudes. Frequency and amplitude criteria as laid down in the relevant codes and / or by machine manufacturer, whichever, is more stringent shall be satisfied. Minimum reinforcement shall be governed by IS: 2974 and IS: 456.



For the foundations supporting minor rotating equipment weighing less than one tonne or if the mass of the rotating parts is less than one hundredth of the mass of the foundation, no dynamic analysis is necessary. However, if such minor equipment is to be supported on building structure, floors, etc., suitable vibration isolation shall be provided by means of springs, neoprene pads, etc., and such vibration isolation system shall be designed suitably.

- 6.13.0 a) No cable / pipe trench is envisaged in outdoor areas of the plant.  
b) All pipes and cable shall generally be routed above ground on structural steel trestles having minimum clear height of 3.0m.  
c) A minimum clearance (clear headroom) of 7 m shall be kept for all over-ground pipe / cable trestles for all road / rail crossings. For other areas, the requirement of trestle height is specified elsewhere in the specifications. All trestles shall be provided with continuous walkway of minimum 750mm width with handrails and toe-guards all along the length of the trestle along with approach ladders near roads, passageways, etc. Before and after the road / rail crossings, a barrier of suitable height shall be constructed so as to prevent the approach of cranes (having height more than 7 m) etc, upto the pipe / cable trestles.

- 6.14.0 Sewers shall be designed for a minimum self-cleansing velocity of 0.75m/sec and the maximum velocity shall not exceed 2.4m/sec. and shall be connected by gravity or by pumping, to the sewage treatment plant to be constructed by Contractor.

Manual on Sewerage and Sewage treatment (published by Central Public Health Environment Engineering Organization, Government of India) shall be followed for design purpose.

- 6.15.0 Roof decking sheets shall be designed as per IS: 801 to carry the self load, dead load due to RCC slab and finishes and imposed load.

- 6.16.0 Plant effluents shall be handled in separate drains / pipes. The plant effluent drain shall not be mixed with storm water drain or sewer lines.

- 6.17.0 Foundations for all steel tanks shall be designed as per IS: 803.

- 6.18.0 Footings shall be so proportioned to as to minimize the differential settlement.

- 6.19.0 Plinth level of all buildings shall be kept at least 500 mm above the finished grade/ formation level.

#### **6.20.0 Joints / Connections in steel structures**

Steel structures shall be detailed and connection and joints provided as per the provisions of IS:800, IS:816, IS:9595, IS:1367, and IS:9178 and as per following requirements.



- a) Connection of vertical bracings and diagonals of truss members shall be designed for full tensile capacity of the bracings unless actual loads are indicated on the drawings.
- b) Size of fillet weld for flange to web connection for built up section shall be as follows:
  - i) For box section weld size shall be designed for 60% of full shear capacity or actual shear whichever is more. Where fillet weld is not possible, full penetration butt weld shall be provided.
  - ii) For built up I section, weld size shall be designed for 80% of full shear capacity or actual shear, (if indicated, in drawings) whichever is more. However, weld size shall not be less than 0.5 times the web thickness. Weld shall be double fillet.
  - iii) All welds shall be continuous unless otherwise specifically approved. The minimum size of the fillet weld shall be 6mm.
- c) Shear connections shall be designed for 60% of section strength for rolled sections and 80% of section strength for built up section or rolled section with cover plates. However, if load is more than above, the connection shall be designed for actual load.
- d) Moment connections between beam and column shall be designed for 100% of moment capacity of the beam section. This can be achieved either by direct butt welding of the top flange of beam with column flange or by providing top moment plate with suitable notch for additional weld length.
- e) All butt welds shall be full penetration butt welds.
- f) The connection between top flange and web of crane girder shall be full penetration butt weld. Bottom flange, connection with web can be fillet weld or butt weld as directed by Owner / Engineer.
- g) Connection of base plate and associated stiffeners with the columns shall be designed considering the total load transferred through welds. However, minimum weld size (double fillet) shall not be less than 0.6 times the thickness of stiffeners.
- h) Splicing: All splicing work shall be of full strength. Field splicing shall be done with web and flange cover plates for full strength. Shop splicing for all sections other than rolled shall be carried out by full penetration butt welds with no cover plates. Splicing for all rolled sections shall be carried out using web and flange cover plate.



## 7.0.0 ARCHITECTURAL CONCEPTS AND DESIGN

### 7.1.0 Architectural Concepts

- a) All buildings and structures shall be architecturally treated in such a way so as to be in complete harmony with the main plant, surrounding structures and environment. Local architectural characters and materials may be judiciously imbibed. The building shall be designed initiating an architectural control common to all buildings. The architectural control shall be clearly spelt out in terms of scale, man and form.
- b) Overall colour scheme of the plant and other buildings shall be designed judiciously and in a comprehensive manner taking into account the mass and void of buildings, its facade, equipment, exposed structural elements, piping, trestles, bus ducts and other service elements.
- c) Overall emphasis shall be on developing an eco-friendly architecture, merging with the nature. The scheme shall be conceptually finalised in totality including that of equipment so that the proper coordination with other agencies can be taken up at appropriate time.

### 7.2.0 Architectural Design

- a) Natural light shall be used to the maximum extent, especially in the form of north light / sky light. For adequate light and ventilation, National Building code recommendations shall be followed.
- b) Entrance canopies chajjas (projections, recesses) over openable windows and door openings on exterior facades shall be provided.
- c) All the buildings shall be architecturally designed to meet the National Building Code (SP: 7) norms and local building bye laws, wherever applicable.
- d) Architectural design and detailing aspects of all the buildings shall be rendered through professional services of an Architect. Statutory requirements may be required to be met with, wherever essential.

## 8.0.0 SITE LEVELING

Site levelling & grading shall be in the scope of Contractor.

## 9.0.0 GEOTECHNICAL INVESTIGATION

The Contractor shall carry out his own geotechnical investigation in all work areas under Contractor's scope for establishing the sub-surface conditions and to decide type of foundations for the structures envisaged, construction methods, any special requirements / treatment called for remedial measures for sub-soil / foundations etc. in view of soft sub-soils, aggressive sub-soils and water,



expansive / swelling soils etc. prior to commencement of detailed design / drawings. The Contractor shall obtain the approval for the field and laboratory testing scheme proposed by him from the Owner before undertaking the geotechnical investigation work.

**9.1.0 Field test shall include but not be limited to the following:**

Boreholes, Standard Penetration Test (SPT), collection of disturbed and undisturbed soil samples (UDS), Trial Pits (TP), collection of water samples, Static Cone Penetration Test (SCPT), of 20T capacity, Electrical Resistivity Test (ERT) etc.

**9.2.0 Scheme of Soil Investigation**

The diameter of borehole shall be minimum 150 mm in soil and 76 mm in rock. The diameter of UDS sampler shall be 90 mm minimum. Drilling in rock shall be done by means of rotary drilling rig using double tube core barrel with diamond bit attachment.

Field investigations shall be done in sufficient numbers.

**10.0.0 FOUNDATIONS**

**10.1.0 Foundation System**

**10.1.1 General Requirements**

- (a) All equipment / structures shall be supported on open / raft foundations
- (b) The roads, ground floor slabs, trenches, channels and other lightly loaded structures with foundation intensities less than 5.0 t / sq.m may be supported on open / shallow foundation resting on virgin soil. All foundations shall be designed in accordance with provisions of the relevant parts of the latest revisions of Indian Standards.
- (c) Foundations shall be designed to resist all loads, including those due to wind or seismic, construction loads, and any other load as applicable and as specified elsewhere in the specification.
- (d) Foundation shall be designed for worst combination of loads as described elsewhere in the specification.
- (e) For identifying the subsoil for founding purposes, the Contractor shall depute / post an experienced qualified geologist / geotechnical engineer so that the specified strata as conceived in the design is reached.



#### 10.1.2 Other Requirements

- (i) In case of high ground water table, for excavations comprehensive dewatering arrangement shall be required. Scheme for dewatering and design with all computations and back-up data of dewatering and sheet piling shall be submitted for Owner / Engineer information.
- (ii) The founding level for trenches / channels shall be decided as per functional requirement. The bottom of excavation shall be properly compacted prior to casting of bottom slab of trenches / channels.
- (iii) Excavation for open foundations shall be covered with PCC immediately after reaching the founding level. In case of any local loosening of soil at founding level during excavation, the same shall be removed and compensated by PCC. The foundation pits shall be maintained dry during the complete construction period by means of suitable dewatering systems.
- (iv) Backfilling, around foundations and bottom of pipes, thrust blocks, etc. shall be done with excavated earth or approved material in layers of 300 mm compacted thickness so as to achieve 90% standard proctor density for cohesive soil and 75% relative density for cohesionless soil.
- (v) Excess / surplus excavated material shall be disposed off by the Contractor as per the instructions of the Owner upto a lead of about 5 km.
- (vi) CBR tests for flexible pavement design shall be carried out by Contractor after earth filling has been completed, if applicable.

#### 11.0.0 PAINTING OF STEEL STRUCTURES

All structural steel sections shall be derusted by sand blasting to grade Sa2<sup>1</sup> / 2. Epoxy resin based zinc rich primer should be applied in 2 coats(70 $\mu\text{m}$ ), followed by mio epoxy intermediate paint in 2 coats(110 $\mu\text{m}$ ) and polyurethane finish paint in 2 coats (70 $\mu\text{m}$ ). Total thickness of dry film shall not be less than 250 $\mu\text{m}$ .

#### 12.0.0 PLINTH PROTECTION

1000mm wide Plinth protection and garland drains shall be provided around all buildings

#### 13.0.0 FINISHING SCHEDULE

The finishing schedule as given below shall be adhered to by the Contractor. However, at the time of detailed engineering, the Owner reserves the right to alter the finishing schedule and specifications and such changes shall have no financial implication whatsoever to the Owner. The Contractor shall also submit the colour scheme for the various structures for the approval of the Owner / Engineer.



### 13.1.0 Flooring

- a) The nominal total thickness of floor finish shall be 50mm.
- b) All operating floor of pump houses, MCC rooms etc. shall have floor finish with metallic hardener topping 12 mm thick.
- c) Sunken RCC slab shall be provided in false flooring area and toilet area so as to keep the finished floor level of these areas same as that of the surrounding areas.
- d) All WC and urinals shall have heavy duty ceramic tiles and dado shall have glazed tiles of minimum 5mm thickness upto 2.2m height.
- e) Skirting shall be 150 mm high and shall match with the floor finish.
- f) Floors of battery room and any other floor coming in contact with Acid / Alkali shall have ceramic unglazed vitreous acid / alkali resisting tiles and dado shall also be provided with the same tiles for minimum 1 meter height. The bedding for laying of tiles shall be potassium silicate mortar conforming to IS: 4832 (Part-I) and resin based mortar like epoxy etc. (Provided in joints)
- g) Floors / stair cases in areas prone to slippage due to oil spillage, etc. shall be provided with an anti-skid tiles.
- h) Floors of control equipment room, computer room and UPS shall be finished with Mirror polished Vitrified Ceramic Tiles.
- i) General circulation areas, lift entrance area, office areas, etc. shall be provided with vitrified ceramic tiles.
- j) Risers and treads of staircases shall be provided with anti-skid tiles. Steel staircases shall have grating or chequered plates as per the requirement.
- k) Cable vaults areas shall have integral floor finish to concrete base as per IS: 2571.

### 13.2.0 Roof

- a) Roof of all buildings shall consist of cast-in-situ RCC slab.
- b) All roofs shall be provided with extra heavy duty water proofing treatment comprising of nine courses as per IS:1346 (using three layers of bitumen felt as per IS:1322) and with foam concrete 40 mm thick as per IS:6598 for thermal insulation. 12 mm thick cement sand plaster (1:4) shall be provided over the foam concrete. Cement concrete tiles shall be provided over the water proofing treatment in the required area for handling of equipment and movement of personnel.



The Contractor shall furnish a performance guarantee of the water proofing treatment for a minimum period of 8 years.

- c) For efficient disposal of rain water, the run off gradient for the roof shall not be less than 1:100. Screed concrete 1:2:4 (using 12.5 mm coarse aggregate) and / or cement mortar (1:3) shall be used to provide the gradient. However, where thickness of roof under bed exceeds 25mm screed concrete shall be used.
- d) HDPE down comers shall be provided to drain off the rain water from the roof. The number and size of down comers shall be governed by IS:1742 and IS:2527.

#### 13.3.0 Walls

- a) All walls shall be non-load bearing in-filled panel walls.
- b) All external walls shall be minimum one brick thick masonry wall.
- c) All internal walls shall be minimum one brick thick except the internal partition walls for office area and toilets, which may be half brick thick.
- d) For all air conditioned areas / rooms, wherever metal cladding is envisaged as cladding material, additional brick masonry wall (230m thick) shall also be provided in addition to metal cladding for effective air conditioning. This brick wall shall be plastered & painted.
- e) RCC transoms and mullions of size 115x115mm with suitable reinforcement shall be provided wherever necessary to reinforce the brickwork.
- f) 50 mm thick DPC (1:1.5:3) with water proofing compound followed by bitumen coating 85/25 grade as per IS:702 @ 1.7 KN/sq.cm shall be provided at plinth level before starting the masonry work.
- g) The bricks having minimum 50 kN/sq.cm compressive strength shall be used for non-load bearing super structure masonry work.
- h) The bricks shall be laid with cement mortar (1:6) for one brick thick walls and (1:4) for half brick thick walls. IS:1905 and IS:2212 shall be followed for brick work design and construction.

#### 13.4.0 Plastering

- a) For all buildings and pump houses, plaster on outer face of external walls shall be 18mm thick in cement-sand mortar 1:6. Inner face of external walls shall have 12mm thick cement sand plaster (1:6).



- b) Even side of internal walls shall have 12 mm thick sand plaster (1:6) and uneven side of internal walls shall have 18 mm thick cement sand plaster (1:6).
- c) Inside surface of walls of control room, UPS room, office areas, entrance lobby, corridors etc. shall be provided with 2mm thick plaster of paris punning over the plastered surface.
- d) All RCC ceilings except in cable vaults and over false ceilings shall be provided with 6mm thick cement sand plaster (1:4).
- e) IS:1661 shall be followed for all plastering work.

#### 13.5.0 Painting

- a) The external face of all buildings shall be provided with cement paint finish as per IS:5410.
- b) Acrylic emulsion paint shall be provided (on inside walls) for air-conditioned areas etc as per IS:5444 (Part-I). All other areas shall be provided with oil bound distemper as per IS:428.
- c) Battery room and all other areas coming in contact with acid / alkali fumes shall have chemical resistant paint as specified.
- d) All ceilings shall be suitably white washed.
- e) All fire exits shall be painted in P.O red / signal red colour shade, which shall not be used anywhere else except to indicate emergency or safety measures.
- f) For painting on concrete, masonry, and plastered surface IS:2395 (Part-I and II) shall be followed. For painting on steel work and ferrous metals, IS:1477 (Part I & II) shall be followed. For painting on wood works IS:2338 (Part I & II) shall be followed.
- g) For exposed structural steel, columns and beams provision under painting in General Technical Specification shall be followed.

#### 13.6.0 Doors & Windows

- a) WC and urinals shall have PVC paneled doors as per IS.
  - a. All other doors shall be steel doors consisting of double plate flush door shutters.
- b) Windows and ventilators other than those specified above shall be of steel as per IS: 1038.



- c) Rolling shutters with suitable operating arrangement manual / Electric (as per IS:6248) according to size shall be provided in buildings to facilitate operations.
- d) Opening for windows of MCC room on ground floor shall be provided with fixed MS grill in addition to the main window.
- e) Fire-Proof doors with panic devices shall be provided at all fire exit points as per the recommendations of Tariff Advisory committee (TAC) / NFPA. These shall be as per IS:3614 (Part I and II). Fire rating of the doors shall be as per TAC / NFPA requirements. However, minimum rating shall be for 2 hrs. Type of doors shall be double cover-plated type with mineral wool insulation.

#### 13.7.0 Glazing

- a) Windows and ventilators located at a higher elevation (where frequent replacement is not feasible) and those located in fire prone areas shall be provided with wired glass of minimum 6mm thickness conforming to IS:5437 Transparent Acrylic sheet may be provided at higher elevation except in fire prone areas.
- b) Glazing in control room between AC and non AC areas shall be with composite double glazing of two 6mm thick sheet glass hermetically sealed and separated by 12 mm gap for thermal insulation. Toughened safety glass conforming to IS:2553 shall be used.
- c) Ground glass of minimum 4-mm thickness shall be used in toilets.
- d) Minimum thickness of glazing in other areas shall be 4mm. Float glass or flat transparent sheet glass shall conform to IS:2835.
- e) For glazing work IS:10873 and IS:3548 shall be followed.

#### 13.8.0 False Ceiling

All air conditioned areas shall be provided with Gypsum board false ceiling system.

### 14.0.0 WATER SUPPLY & SANITATION

- a) Roof water tank of adequate capacity depending on the number of users and minimum 8 hours storage shall be provided for buildings as applicable. Polyethylene/ RCC water storage tank conforming to IS:12701 shall be used.
- b) UPVC pipes shall be used for internal piping works for potable water supply.
- c) HDPE pipes shall be used for sanitary works above ground level.



- d) Minimum one toilet with all the facilities shall be provided on each floor of all buildings and pump houses. The number of toilets and the facilities provided therein shall depend on the total number of users. IS:1172 shall be followed for working out the basic requirements for water supply, drainage and sanitation. In addition, IS:2064 and IS:2065 shall also be followed.
- e) Each toilet shall have the following minimum fittings. All the fittings shall be chromium plated fancy type.
  - i) WC (Indian type) Orissa Pattern (580x440mm) as per IS:2556 (Part-3) with all fittings (for separate toilet block) including CI flushing cistern of 10 liters capacity as per IS:774, and WC (Western type ) 390mm high as per IS:2556 (Part-2) with toilet paper roll holder and all fittings (for attached toilets including chromium plated flush pipe.
  - ii) Urinal (430x260x350 mm size) with all fittings as per IS:2546 (Part-6, Sec.1).
  - iii) Wash basin (550x440mm) with all fittings as per IS:2556 (Part-4)
  - iv) Bathroom Mirror (600x450x5.5mm thick).
  - v) CP brass tower rail (600x20mm)
  - vi) Soap holder and liquid soap dispenser
  - vii) Rotating type chromium plated shower rose with extension arm inlet size 15mm (for toilet blocks having separate bathing facility), Ventilation shaft shall also be provided for all toilet blocks. Provision of Janitor room shall be kept in each building. Provision for installation of water cooler shall be kept.
- f) An eye & face fountain (combined unit with receptacle) conforming to IS:10592 shall be provided for battery room.
- g) Stainless steel kitchen sink (750 mm size) for pantry shall be provided. Laboratory sink shall be of vitreous china of size 600x400x200mm conforming to IS:2556 (Part-5).

#### 15.0.0 PLANT & STORM WATER DRAINAGE

- a) The plant and storm water drainage shall take into account the topography of the plant area, area drainage pattern, intensity of rainfall hourly rainfall for a return period of 1 in 50 years.
- b) The maximum velocity for pipe drains and open drains shall be limited to 2.4m/sec and 1.8m/sec respectively. However, minimum velocity (for self-cleansing) of 0.6m/sec shall be ensured. Bed slope not milder than 1 in 1000 shall be provided.
- c) For pipe drains, concrete pipes of class NP2 as per IS:458 shall be used. However, for road crossings, etc, higher strength pipe of class NP3 shall be provided. Manholes shall be provided at every interval, at connection points and at every change of alignment.



- d) For open trapezoidal drains, brick masonry lining on sides and bottom shall be provided. Bricks shall be laid in cement mortar and joints pointed flush. The thickness of lining shall be minimum 115mm. The lining shall be with fly ash bricks of class designation 50 laid in cement sand mortar (1:4) and flush pointed with cement sand mortar (1:2). The side slopes upon which lining has to rest shall be made such that no earth pressure is exerted upon lining in any condition. However, slopes shall not be steeper than 1V:0.5H.
- e) In general, all plants effluent drainage shall be through buried concrete pipes and all storm water drainage shall be through open drains / pipes drains. Open storm water drains shall be provided on both sides of the roads and shall be designed to drain the road surface as well as all the free and covered areas etc.
- f) Open drains may be connected to the buried pipe drains at intervals maximum 30m through manholes. Plant effluents shall be suitably treated by the Contractor to meet all the prevalent statutory requirements and local pollution control norms and treated effluents shall be conveyed to the storm water drainage system at a suitable location for its final disposal.

#### 16.0.0 ROADS

Proper approach road shall be provided to all facilities from the nearest existing road.

- a) Bitumen roads designed for class 'E' of traffic, i.e., traffic intensity of 450-1500 per day (Heavy vehicles exceeding 3 tones laden weight).
- b) California Bearing Ratio (CBR) method shall be followed for the design of roads. A detailed CBR test which is an adhoc penetration test shall be carried out as per the procedure outlined in IS:2720 (Part XVI). All the culverts shall be designed for IRC class 'AA' loading and checked for class 'A' loading. Compacted moorum shoulders of minimum 150 mm thickness shall be provided on either side of the roads.
- c) For design of RCC pipes, for drains and culverts, IS:456 and IS:783 shall be followed.
- d) Double lane roads shall be with 7.5m wide with 2.5m wide shoulders on either side of the road.
- e) Single lane roads shall be with 4.0m wide with 1.0m wide shoulders on either side of the road.
- f) Contractor shall furnish a detailed layout drawing for roads including the above-mentioned access roads along with his offer indicating all buildings, equipment layout etc.



- g) Finished top (crest) of roads shall be 350mm above the surrounding grade level.
- h) Road construction shall be as per IRC standards.

## 17.0.0 FENCING

Minimum 3.0m high fencing above the toe wall shall be provided around areas where fencing is necessary due to security / safety / statutory requirements. Fencing shall comprise of 2.4m high PVC coated galvanized chain link fence of minimum 8 gauge (including PVC coating) of mesh size 75mm and galvanized barbed wire on inclined member up to a height of 0.6m above the chain link fence. The diameter of steel wire of chain link fence excluding PVC coating shall not be less than 12 gauge. Steel entry gate shall be provided for all fenced areas.

## 18.0.0 MISCELLANEOUS SPECIFICATIONS

- a) Concrete shall be carefully cured and special importance shall be given during the placing of concrete and removal of shuttering.
- b) Monorails, monorail girders and fixtures shall be provided, wherever required.
- c) Doors and windows on external walls of buildings shall be provided with RCC sunshade over the opening with 300mm projection on either side of the opening. Projection of sunshade from the wall shall be minimum 450mm over window opening and 750mm over door openings.
- d) All stairs shall have a maximum riser height of 180mm and a minimum tread width of 250 mm. Minimum width of stairs shall be 1200mm. Aluminum angle nosing with minimum 50x25x3 mm angle shall be provided for edge protection in RCC stairs.
- e) For fire safety requirements of buildings IS:1641 and IS:1642 shall be followed in addition to TAC / NFPA requirements.
- f) Angle 50x50x6mm (minimum) with lugs shall be provided for edge protection all round cut outs / openings in floor slab, edges of drain supporting grating covers, edges of RCC cable / pipe trenches supporting covers, edges of manholes supporting covers, supporting edges of precast covers and any other place where breakage of corner of concrete is expected.
- g) All drains inside the buildings shall have minimum 40mm thick grating covers. In areas where heavy equipment loads would be coming, precast RCC covers shall be provided in place of steel grating.
- h) Floor of switchgear room shall have embedded channel suitable for easy movement of breaker panels.



- i) Anti-termite chemical treatment shall be given to all vulnerable areas susceptible to termite including column pits, wall trenches, foundation of buildings, filling below the floors etc. as per IS:6313 and other relevant Indian Standards.
- j) Hand railing, minimum 900mm high shall be provided around all floor / roof openings, projections, balconies, walkways, platform, steel stairs etc. All handrails and ladder pipes shall be 32mm nominal bore MS pipes (medium class) and shall be galvanized as per IS:4736 and IS:1239. All rungs and ladders shall also be galvanized and minimum weight of galvanizing shall be 450 g/sq.m.
- k) All grating shall be pressure locked type (preferably electro-forged).
- l) For RCC stairs, hand railing with 20mm square MS bar balustrades with suitable MS flats and aluminum handrails shall be provided.
- m) For all buildings, suitable arrangement for draining out waste collected from equipment blow downs, leakage, floor washings, fire fighting, etc. shall be provided for each floor.
- n) All cables and pipes in outlying area shall run above ground over steel trestles or other supporting structures for easy inspection and maintenance except in transformer yard area / switch yard area and some other localized area where the same can run in RCC trenches. However, for facilities, where buried pipes and cables are permitted by Owner, the same can be provided with proper cable identification tags. In case of trestles, minimum 7.0m head clearance shall be provided for road and railway crossings.
- o) All cable and pipe trenches shall be of RCC with minimum M20 grade. Trenches located outside buildings shall project at least 200 mm above the finished formation level so that no storm water shall enter into trench. The bottom of the trench shall be sloped suitably for draining out the collected water into sump pit. The precast covers shall be of minimum M-20 grade and shall not weight more than 65 kg. Lifting hooks shall be provided in the precast covers.
- p) All steel platforms above grade shall be constructed with kick plates at edge of platform to prevent tools or materials form falling off the platform.
- q) All roofs shall be provided with access through a staircase / cage-ladders.
- r) Duct banks consisting of PVC conduits for cables shall be provided with proper sealing arrangement.
- s) All up stands and parapet walls on roof shall be of RCC construction for all buildings. Minimum height of parapet walls shall be 750mm.
- t) Independent network of lines for sewerage and drainage shall be provided.



- u) All sand filling shall be compacted to minimum 90% of the relative density. Backfilled earth shall be compacted to minimum 90% of the Standard Proctor's density at OMC.
- v) However, the sub-grade for the roads and embankment filling shall be compacted to minimum 95% of the Standard Proctor's density at OMC.
- w) Detailed scheme for dewatering shall be prepared before starting of deep excavation work. IS:9758 shall be followed as general guidance for dewatering.
- x) All cable vaults shall be located above ground level i.e. cable vaults shall not be provided as basement in the buildings.
- y) Ground Floor slab of buildings shall be of RCC of M20 grade and shall be minimum 150 mm thick. The slab shall rest on a well-compacted stone metal filling of minimum 230mm thick.

## 19.0.0 CONCRETE

Concrete work shall be carried out as per IS:456. Mix design concrete shall be used other than lean concrete work where nominal / volume mix can be permitted. Design mix shall be carried out as per IS:10262.

Minimum grade of concrete for various structures / areas other than machine foundations shall be as follows:

M30 - For all superstructure RCC works in buildings and structures, duct banks, paving, cable and pipe trenches, precast coves and lining of drains.

M30 - For all underground structures including basements, foundations, piles, pile caps, water retaining / carrying structures. Substructure of pump houses, grade beams and any other structures as per the requirements.

### Notes:

- 1 Higher grade of concrete than specified above may be used at the discretion of the Contractor.
- 2 20 mm and down aggregate shall be used for all concrete works.
- 3 All grades of concrete shall conform to IS:456.

Special requirements for concreting of major equipment foundations shall be as given below:

#### 1 Coarse Aggregates

Sound and durable crushed granite stone aggregates only shall be used. All aggregates shall be tested for alkali aggregate reaction. Materials, which contain high percentage of reactive silica, shall not be used. In exceptional cases, high percentage of reactive silica content aggregate may be allowed



where low alkali content cement shall be used.. Unless otherwise specifically approved by the Engineer, the tests shall be carried out for a temperature range from 10° C to 65° C and for 60 (sixty) temperature cycle.

Graded aggregate up to 40 mm (max.) size shall be used. For narrow sections and areas having congestion of reinforcement smaller size aggregates may be used.

- 2 Plywood formwork shall be used for all water retaining / conveying structures and for all over ground concrete works..
- 3 Weigh Batching Plants shall be mobilized for all machine foundations.
- 4 Machine foundations shall be cast in a single pour.

## 20.0.0 GROUT

Non-shrink flowable grout shall be used for under pinning work below base plate of columns. Nominal thickness of grout shall be 50 mm. Non-shrink cum Plasticiser admixture shall be added in the grout. Crushing strength of the grout shall generally be one grade higher than the base concrete. Minimum grade of grout shall be M-25. For grouting of base of machine foundation high flowable strength ready mixed non-shrink grout shall only be used.

## 21.0.0 MATERIALS

### 21.1.0 Cement

Ordinary Portland cement shall be used for all construction work as well as for concrete work in cooling tower.

All structural concrete shall be design mix. Ready Mix Concrete (RMC) may be used where feasible.

### 21.2.0 Aggregates

- i) Coarse aggregate - Coarse aggregate for concrete shall be chemically inert, hard, strong, and durable against weathering, of limited porosity and free from deleterious materials. It shall be properly graded and shall meet the requirements of IS:383.
- ii) Sand – Sand shall be hard, durable, clean and free from adherent coatings of organic matter and clay balls or pellets. Sand, when used as fine aggregate in concrete shall conform to IS:383 for plaster IS:1542 and for masonry work it shall conform to IS:2116.

### 21.3.0 Reinforcement Steel

High strength deformed steel bars of grade Fe-500 shall conform to IS:1786. Mild steel and medium tensile steel bars and hard drawn steel wire shall conform to grade-1 of IS:432 (Part-I). Welded wire fabric shall conform to IS:1566.



#### 21.4.0 Structural Steel

Structural steel (Including embedded steel) shall be straight, sound, and free from twists, cracks, flaws, laminations and all other defects. Structural steel shall be of tested quality conforming to IS:2062 or IS:8500. The grade and type of steel shall be as specified. Chequered plate shall conform to IS:3502 and pipes for hand rail shall conform to medium grade of IS:1161.

#### 21.5.0 Bricks

Fly Ash Bricks shall be used for the project.

#### 21.6.0 Water

Water used for cement concrete, mortar, plaster, grout, curing, washing of coarse aggregate, soaking of bricks, etc. shall be clean and free from injurious amount of oil, acids, alkalis, organic matters or other harmful substances in such amounts that may impair the strength of durability of the structure. Potable water shall generally be considered satisfactory for all masonry and concrete works, including curing. The Contractor shall carry out necessary tests in advance to prove the suitability of the water proposed to be used. When water from the proposed sources is used for making the concrete, the maximum permissible impurities, development of strength and initial setting time of concrete shall meet the requirements of IS:456.

### 22.0.0 STATUTORY REQUIREMENTS

- a) The Contractor shall comply with all the applicable statutory rules pertaining to Factories Act, Fire Safety Rules of Tariff Advisory Committee, Water Act for pollution control, Explosive Act, etc.
- b) Provisions of safety, health and welfare according to Factories Act shall be complied with. These shall include provision of continuous walkway (minimum 500mm wide) along the crane – girder at crane girder level on both sides of building, comfortable approach to EOT crane cabin, railing, fire escape, locker room for workmen, pantry, toilets, rest rooms etc.
- c) Provisions for fire proof doors, number of staircases, fire separation wall, lath plastering / encasing the structural members (in fire prove areas), etc., shall be made according to the recommendations of Tariff Advisory committee.
- d) Statutory clearances and norms of State Pollution Control Board shall be followed as per Water Act for effluent quality from plant.

### 23.0.0 INSPECTION, TESTING & QUALITY CONTROL

- a) The Contractor shall carry out all sampling and testing in accordance with the relevant Indian Standards and / or International Standards and shall conduct such tests as are called for by the Owner / Engineer. Tests shall be done in



the field and at a laboratory approved by the Owner / Engineer and the Contractor shall submit to the Owner / Engineer, the test results in triplicate within three days after completion of a test. In addition, the Contractor shall furnish the original test certificate of the manufacturers of various materials.

- b) The Contractor shall submit and finalize a detailed filed Quality Assurance Programme before starting of construction work according to the requirement of the specifications. This shall include frequency of sampling and testing, nature / type of test, method of test, setting of a testing laboratory, arrangement of testing apparatus / equipment deployment of qualified / experienced manpower, preparation of format for record, Field Quality Plan, etc. On finalized field quality plan, the Owner shall identify customer hold points beyond which work shall not proceed without written approval from the Owner / Engineer.
- c) A comprehensive testing facility for major items for work, viz. Earthwork, concreting and structural steel work (including welding) shall be made at site. In addition, workmanship and dimensional tolerance shall also be checked.

#### **24.0.0 APPLICABLE CODES & STANDARDS**

All the electronic copies of the below mentioned codes shall be supplied by the Contractor during the detail engineering to the Owner / Engineer.

This Section lists codes and standards to be adopted and the principal structures of the Project, and briefly describes the basic concept, requirements, and features pertinent to each.

Following is a general list of codes and standards to be used in the design of civil works of the Project. Specific applicable codes and standards are identified in System Design Description / Technical Specifications as appropriate. The latest editions / revision of following codes and standards along with addendums / amendments, if any, shall be followed.

##### **General**

- I Internationally accepted design codes and standards, which are equivalent or superior to corresponding Indian Standards.
- II National Building Code of India.
- III "Accepted Standards" and "Good Practice" listed in the appendix to National Building Code of India.
- IV IS 1200 Method of measurement of Building and Civil Engineering Works
- V IS 1256 Code of Practice for Building Bylaws.



## Earthwork

- i IS 1498 Classification and identification of soils for General Engineering purposes.
- ii IS 3764 Safety code for excavation work.
- iii IS 7293 Safety code for working with construction machinery.

## Concrete

- I IS 269 Ordinary and low heat Portland cement.
- ii IS 383 Coarse and fine aggregate from natural sources for concrete.
- iii IS 432 Mild steel and medium tensile steel bars and adjust hard drawn steel wire for concrete reinforcement.
- iv IS 455 Portland slag cement.
- v IS 456 Code of practice for plain and reinforced concrete.
- vi IS 460 Test sieves (all parts).
- vii IS 516 Methods of test for strength of concrete.
- viii IS 1199 Methods of sampling and analysis of concrete.
- ix IS 1566 Hard drawn steel wire fabric for concrete reinforcement.
- x IS 1786 High strength deformed steel bars and wires for concrete reinforcement.
- xi IS 1834 Hot applied sealing compounds for joints in concrete.
- xii IS 2386 Methods of test for aggregates for concrete (all parts).
- xiii IS 2502 Code of practice for bending and fixing of bars for concrete reinforcement.
- xiv IS 3370 Code of practice for concrete structures for storage of liquids (all parts).
- xv IS 3414 Code of practice for design and installation of joints in buildings.
  
- xvi IS 4948 Welded steel wire fabrics for general use.
- xvii IS 4995 Criteria for design of reinforced concrete bins for storage of triangular (all parts and powdery materials).
- xix IS 5525 Recommendation for detailing of reinforced concrete work.
- xx IS 6452 High alumina cement for structural use.
- xxi IS 7320 Concrete slump test apparatus.
- xxii IS 7861 Code of practice for extreme weather concreting (all parts).
- xxiii IS 8041 Rapid hardening Portland cement.
- xxiv IS 10262 Recommended guidelines for concrete mix design.

## Foundation

- i IS 1904 Code of practice for structural safety of buildings-shallow foundations.
- ii IS 2950 Code of practice for design and construction of raft foundation.



- iii IS 2974 Code of practice for design and construction of machine foundations (all parts).
- iv IS 3955 Code of practice for design and construction of well foundation.

### Loading

- i IS 875 Code of practice for structural safety of buildings loading standards.
- ii - Bridge Rules of Government of India, Ministry of Railways (Railway Board).
- iii ASCE Minimum Design Loads for buildings & other structures.

### Masonry

- i IS 712 Building lines.
- ii IS 12894 Specification of Fly ash bricks.
- iii IS 1077 Common burnt clay-building bricks.
- iv IS 1127 Recommendations for dimensions and workmanship of natural building stones for masonry work.
- v IS 1528 Methods of sampling and physical tests for refractory materials.
- vi IS 1597 Code of practice for construction of stone masonry (all parts).
- vii IS 2212 Code of practice for brickwork.
- viii IS 2116 Sand for masonry mortars.
- ix IS 2185 Concrete masonry units (all parts- hollows and solid concrete blocks).
- x IS 2250 Code of practice for preparation and use of masonry mortars.
- xi IS 2572 Code of practice for construction of hollow concrete block masonry.
- xii IS 2691 Burnt clay facing bricks.
- xiii IS 3414 Code of practice for design and installation of joints in buildings.
- xiv IS 3495 Methods of tests of burnt clay building bricks.
- xv IS 4441 Code of practice for use of silicate type chemical resistant mortar.
- xvi IS 4860 Acid resistant bricks.

### Doors, Windows and Ventilators

- i IS 399 Classification of commercial timbers and their zonal distribution.
- ii IS 883 Code of practice for design of structural timber in building.
- iii IS 1003 Timber paneled and glazed shutters (all parts).
- iv IS 1038 Steel doors, windows, doors and ventilators.



v	IS 1081	Code of practice for fixing and glazing of metal (steel and aluminum) doors, windows and ventilators.
vi	IS 1361	Steel windows for industrial buildings.
vii	IS 2835	Transparent sheet glass for glazing and framing purposes.
viii	IS 1948	Aluminum doors widows and ventilators.
ix	IS 1949	Aluminum windows for Industrial buildings
x	IS 2191	Wooden flush door shutters (cellular and hollow core type).
xi	IS 2202	Wooden flush door shutters (solid core type).
xii	IS 3103	Code of practice for Industrial Ventilation.
xiii	IS 3548	Code or practice for glazing in buildings.
xiv	IS 3614	Fire check doors.
xv	IS 4021	Timber door, windows, and ventilator frames.
xvi	IS 4351	Steel doorframes.
xvii	IS 6248	Metal rolling shutters and rolling grills.

### Roof & Flooring

i	IS 2204	Code of practice for construction of reinforced concrete shell roof.
ii	IS 3201	Criteria for the design and construction of precast concrete trusses.
iii	IS 2210	Criteria for design of RC shell structures and folded plates.
iv	IS 809	Rubber flooring materials for general purposes.
v	IS 1195	Bitumen mastic for flooring.
vi	IS 1196	Code of practice of laying bitumen mastic flooring.
vii	IS 1198	Code or practice for laying, fixing and maintenance of linoleum floors.
viii	IS 1237	Cement concrete flooring tiles.
ix	IS 1443	Code of practice for laying and finishing of cement concrete flooring tiles.
x	IS 2114	Code or practice for laying in situ terrazzo floor finish.
xi	IS 2571	Code of practice for laying in situ cement concrete flooring.
xii	IS 5491	Code of practice for laying in situ granolithic concrete floor topping.
xiii	IS 5766	Code of practice for laying burnt clay brick flooring.
xiv	IS 1197	Code of practice for laying of rubber floors.
xv	IS 2441	Code of practice for fixing ceiling coverings.

### Waterproofing

i	IS 1322	Bitumen felts for waterproofing and damp proofing
ii	IS 1346	Code of practice for waterproofing of roofs with bitumen felts.
iii	IS 1609	Code of practice for laying damp proof treatment using bituminous felts.



- iv IS 3036 Code of practice for laying lime concrete for a waterproofed roof finish.
- V IS 3037 Bitumen mastic for use in waterproofing of roofs.
- vi IS 3067 Code of practice for general design, details and preparatory work for damp proofing and waterproofing of buildings.
- vii IS 3384 Bitumen primer for use in water proofing and damp proofing.
- viii IS 4365 Code of practice for waterproofing of roofs.

### Soil Engineering

- i IS 1498 Classification and identification of soils for general engineering purposes.
- ii IS 1892 Code of practice for subsurface for foundations.
- iii IS 2131 Method for standard penetration test for soils.
- iv IS 2720 Methods of test for soils (all parts).

### Water Supply, Drainage and Sewerage

- i IS 404 Lead pipes.
- ii IS 458 Concrete pipes.
- iii IS 651 Salt glazed stoneware pipes and fittings
- iv IS 771 Glazed fire clay sanitary appliances (all parts).
- v IS 774 Flushing cisterns for water closets and urinals other than plastic cisterns.
- vi IS 783 Code of practice for laying of concrete pipes.
- vii IS 1172 Code of basic requirements for water supply, drainage and sanitation.
- viii IS 1626 Asbestos cement building pipes, gutters (all parts).
- ix IS 1742 Code of practice for building drainage.
- x IS 2064 Code of practice for selection, installation and maintenance of sanitary appliances.
- xi IS 2065 Code of practice for water supply in buildings.
- xii IS 2470 Code or practice for installation of septic tanks (all parts).
- xiii IS 3114 Code of practice for laying of cast iron pipes.
- xiv IS 4127 Code of practice for laying of glazed stoneware pipes.
- xv IS 12251 Code of practice for drainage of building basement.
- xvi IS 1200 (Part XVI) Method of measurement: Laying of water and sewer lines including appurtenant items.
- Xvii IS 1536 Centrifugally cast (spun) iron pressure piles for water, gas and sewage.
- xviii IS 1537 Vertically cast iron pressure pipe for water, gas and sewage.
- xix IS 3486 Cast iron spigot and socket drain pipes.
- xx IS 5329 Code of practice for sanitary pipe work above ground.
- xxi IS 3076 Low-density polyethylene pipes for potable water supplies.
- xxii IS 1538 Cast iron fittings for pressure pipes for water, gas, and sewage



xxiii	IS 1230	Cast iron rainwater pipes and fittings.
xxiv	IS 1729	Sand cast iron spigot and socket soil, waste and ventilation pipes, fittings and accessories.
xxv	IS 784	Pre-stressed concrete pipes.
xxvi	IS 1726	Cast iron manhole covers and frames.
xxvii	IS 5961	Cast iron grating for drainage purposes.
xxviii	IS 5219 (Part -I)	"P" and "S" traps.
xxix	IS 772	General requirements for enameled cast iron sanitary appliances.
xxx	IS 775	Cast iron brackets and supports for wash basins and sinks.
xxxi	IS 777	Glazed earthenware wall tiles.
xxxii	IS 2548	Plastic water closet seats and covers (all parts).
xxxiii	IS 2527	Code of practice for fixing rainwater gutters and down pipes for roof drainage.
xxxiv	IS 4111	Code of ancillary structures in sewerage system.

### Paving and Roadwork

- i IS 73 Paving bitumen.
- ii IS 702 Industrial bitumen.
- iii IS 1201 through 1220 Method of testing tar and bitumen materials.

Practice followed by Indian Road Congress (all parts).

### Earthquake Resistant Design

- i IS 1893 Criteria for earthquake resistant design of structures.
- ii IS 4326 Code of practice for earthquake resistant design and construction of buildings.

### Structural Steel Work

- i IS 800 Code of practice for general construction in steel.
- ii IS 802 Code of practice for use of structural steel in overhead transmission line. Part I: Load and permissible stresses. Part II: Fabrication, galvanizing, inspection and packing
- iii IS 806 Code of practice for use of steel tubes in general building construction.
- iv IS 808 Rolled steel beams, channels and angle sections.
- v IS 813 Scheme of symbols for welding.
- vi IS 814 Covered electrodes for manual metal arc welding of carbon and carbon manganese steel.
- vii IS 816 Code of practice for training and testing of metal arc welders.
- viii IS 817 Code of practice for training and testing of metal arc welders.



ix	IS 818	Code of practice for safety and health requirements in electric and gas welding and cutting operation.
x	IS 819	Code of practice for resistance spot welding for light assemblies in mild steel.
xi	IS 919	Recommendations for limits and fits for engineering.
xii	IS 1024	Code of practice for use of welding in bridges and structures subjected to dynamic loading.
xiii	IS 1161	Steel tubes for structural purposes.
xiv	IS 1182	Recommended practice for radiographic examination of fusion welded butt joints in steel plates.
xv	IS 1200 (Part VIII)	Method of measurement of steelwork and ironwork.
xvi	IS 1239	Mild steel tubes, tubular and other wrought steel fittings (all parts).
xvii	IS 1363	Black hexagonal bolts, nuts and locknuts (diameters 6 to 39mm) and black hexagon screws (diameter 6 to 24 mm) (all parts).
xviii	IS 1364	Precision and semi-precision hexagon bolts, screws, nuts and locknuts (diameter range 6 to 39 mm) (all parts).
xix	IS 1365	Slotted counter sunk head screws (diameter range 1.6 to 20 mm).
xx	IS 1367	Technical supply conditions for threaded steel fasteners.
xxi	IS 1443	Code of practice for laying and finishing of cement concrete flooring tiles.
xxii	IS 1608	Method for tensile testing of steel products.
xxiii	IS 1730	Dimensions for steel plate, sheet and strip for structural and general engineering purpose.
xxiv	IS 1731	Dimensions for steel flats for structural and general engineering purposes.
xxv	IS 1852	Rolling and cutting tolerances for hot rolled steel products.
xxvi	IS 1977	Structural steel (ordinary quality).
xxvii	IS 2016	Plain washers.
xxviii	IS 2062	Steel for general structural purposes.
xxix	IS 2074	Ready mixed paint, air-drying, rd oxide zinc-chrome, and priming.
xxx	IS 2633	Methods of testing uniformity of coating of zinc coated article.
xxxi	IS 3613	Acceptance tests or wire-flux combinations for submerged-arc welding of structural steels.
xxxii	IS 3664	Code of practice for ultrasonic pulse echo testing by contact and immersions methods.
xxxiii	IS 3757	High strength structural bolts.
xxxiv	IS 4000	High strength lesits in steel structures.
xxxv	IS 4759	Hot dip zinc coatings on structural steel and other allied products.
xxxvi	IS 5334	Code of practice for magnetic-particle flaw detection of welds.
xxxvii	IS 7215	Tolerances for fabrication of steel structure.
xxxviii	IS 7280	Base-wire electrodes for submerged arc welding of



		structural steel.
xxxix	IS 7318 (Part I)	Approval test for welders when welding procedure approval is not required.
xi	IS 8500	Structural steel – micro alloyed (medium and high strength qualities).
xii	IS 9595	Recommendation for metal arc welding of carbon and carbon manganese steels.
xiii	IS 9178	Criteria for design of steel bins for storage of bulk materials (all parts).

### Painting

i	IS 348	Specification for French Polish.
ii	IS 427	Specification for distemper, dry color as required.
iii	IS 428	Specification for distemper, oil emulsion, colors as required.
iv	IS 1477 (I and II)	Code of practice for painting of ferrous metal in buildings.
v	IS 2338 (I and II)	Code of practice for finishing of wood and wood based materials.
vi	IS 2339	Specification for aluminum paints for general purposes in dual containers.
vii	IS 2395	Code of practice for painting concrete, masonry and plaster surface.
viii	IS 2932	Specification for enamel, synthetic, exterior: (a) undercoating and (b) finishing
ix	IS 2933	Specification for enamel, exterior: (a) undercoating and (b) finishing.
x	IS 5410	Specification for cement paint.

### Other Standards

i	Indian Railway Standard - Schedule of Dimensions.
ii	Indian Railway Standard - Permanent Way Manual.
iii	IS 803 Code of practice for design, fabrication and erection of vertical mild steel cylindrical welded oil storage tanks.
iv	IS 11592 Code of practice for selection and design of belt conveyors. (This code is for defining the limiting deflections for conveyor supporting structures.)
v	IS 3067 Code of practice for General design details and preparatory works for damp proofing and waterproofing of buildings.



# **RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD**

## **Cooling Water System Package for Kota Super Thermal Power Station Unit # 5 (1 x 210 MW) Kota, Rajasthan, India**

[DOC. No. FCE-1117155-ME-DOC-SPC-3000-033]

**VOLUME II  
SECTION - 6  
TENDER DRAWINGS**

**FICHTNER Consulting Engineers (India) Private Limited**  
Chennai, Bengaluru, India



## INDEX

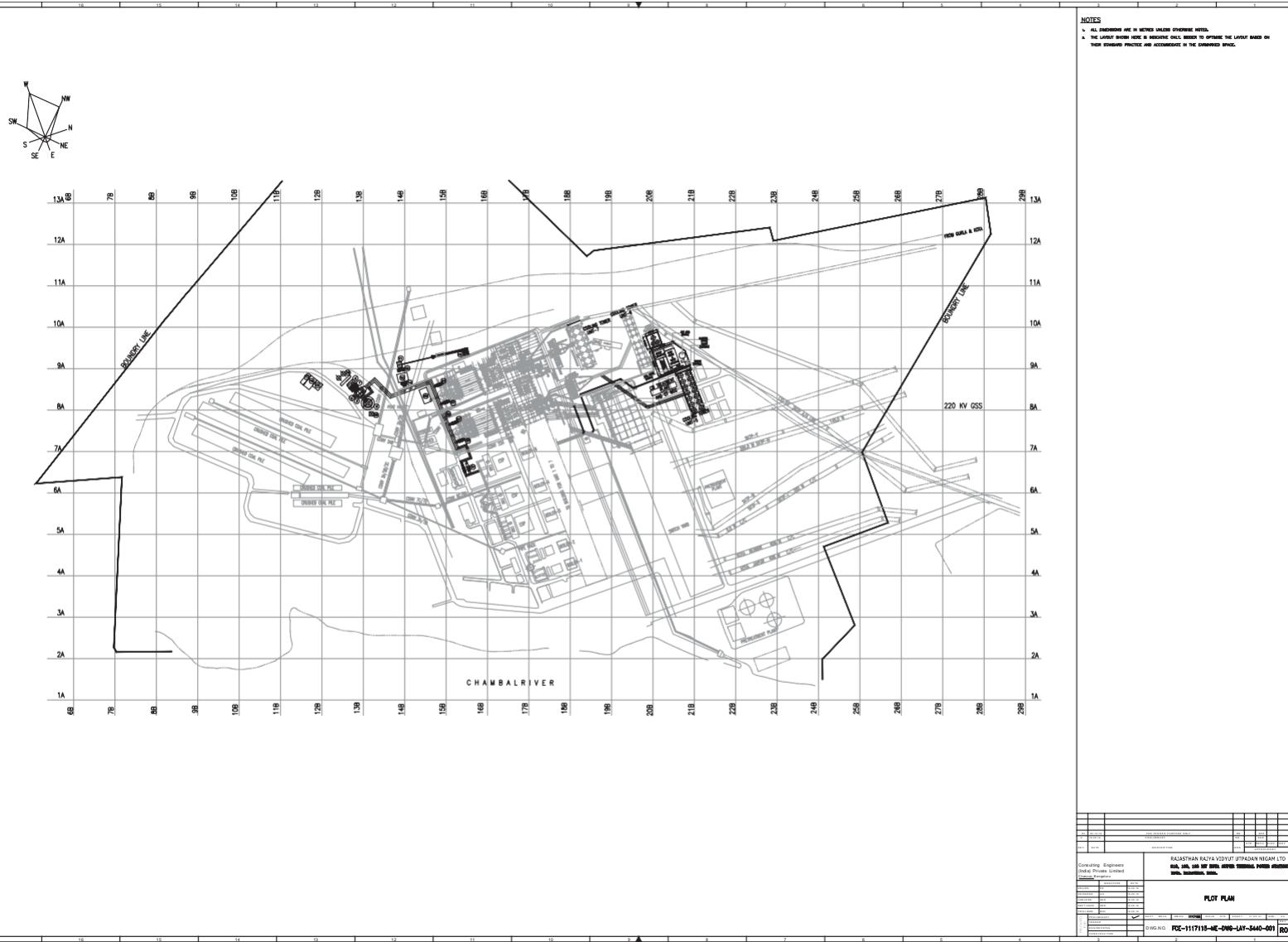
VOLUME	SECTION	TITLE
I	COMMERCIAL & GENERAL CONDITIONS	
	SECTION - 1.0	INVITATION FOR BIDS (IFB)
	ATTACHMENTS	
	ATTACHMENT - 1.0	INSTRUCTIONS TO BIDDER (ITB)
	ATTACHMENT - 2.0	GENERAL CONDITIONS OF CONTRACT(GCC)
	ATTACHMENT - 3.0	SPECIAL CONDITIONS OF CONTRACT (SCC)
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	6.0	TENDER DRAWINGS
	7.0	SCHEDULES
		ATTACHMENTS TO TENDER DOCUMENT

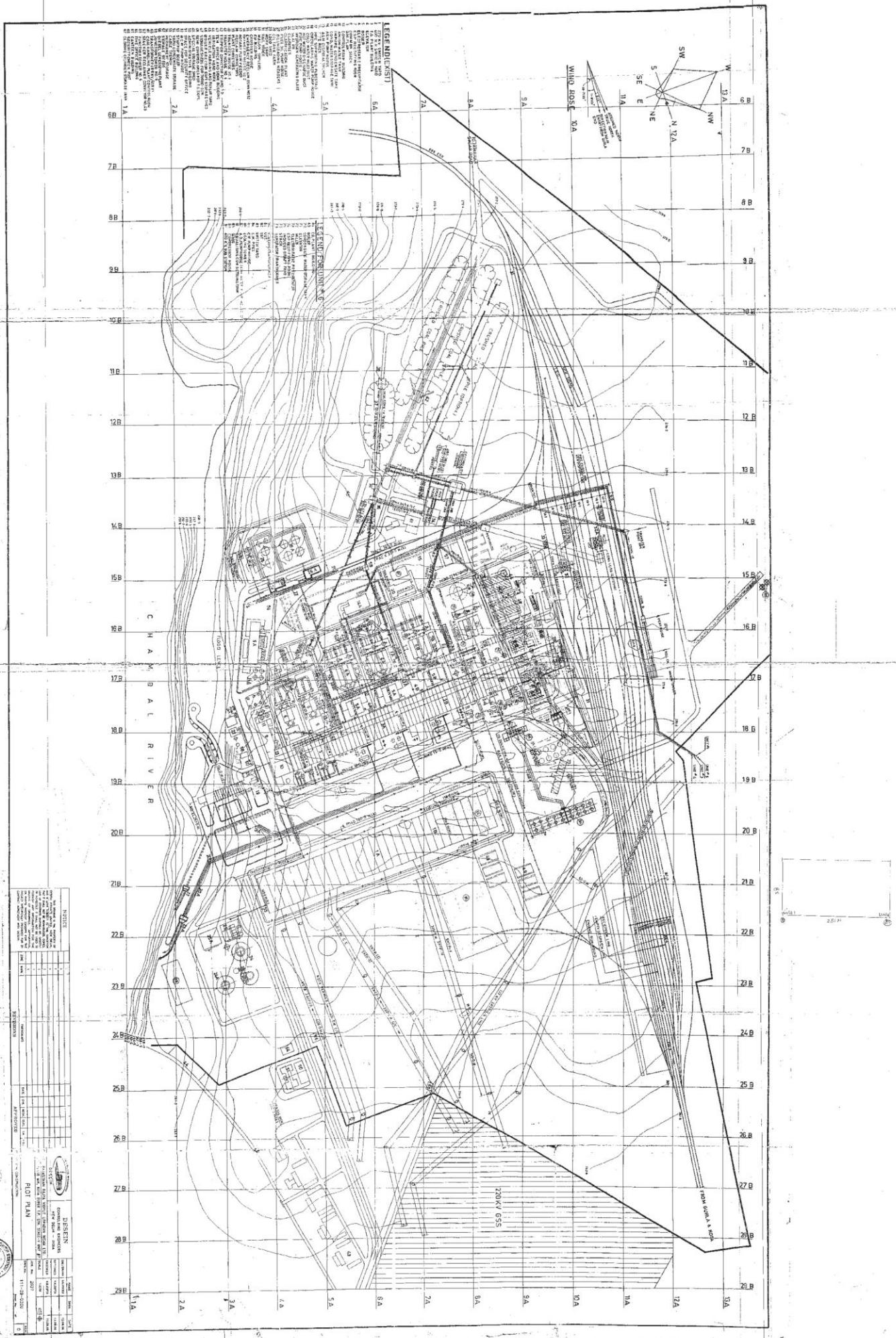


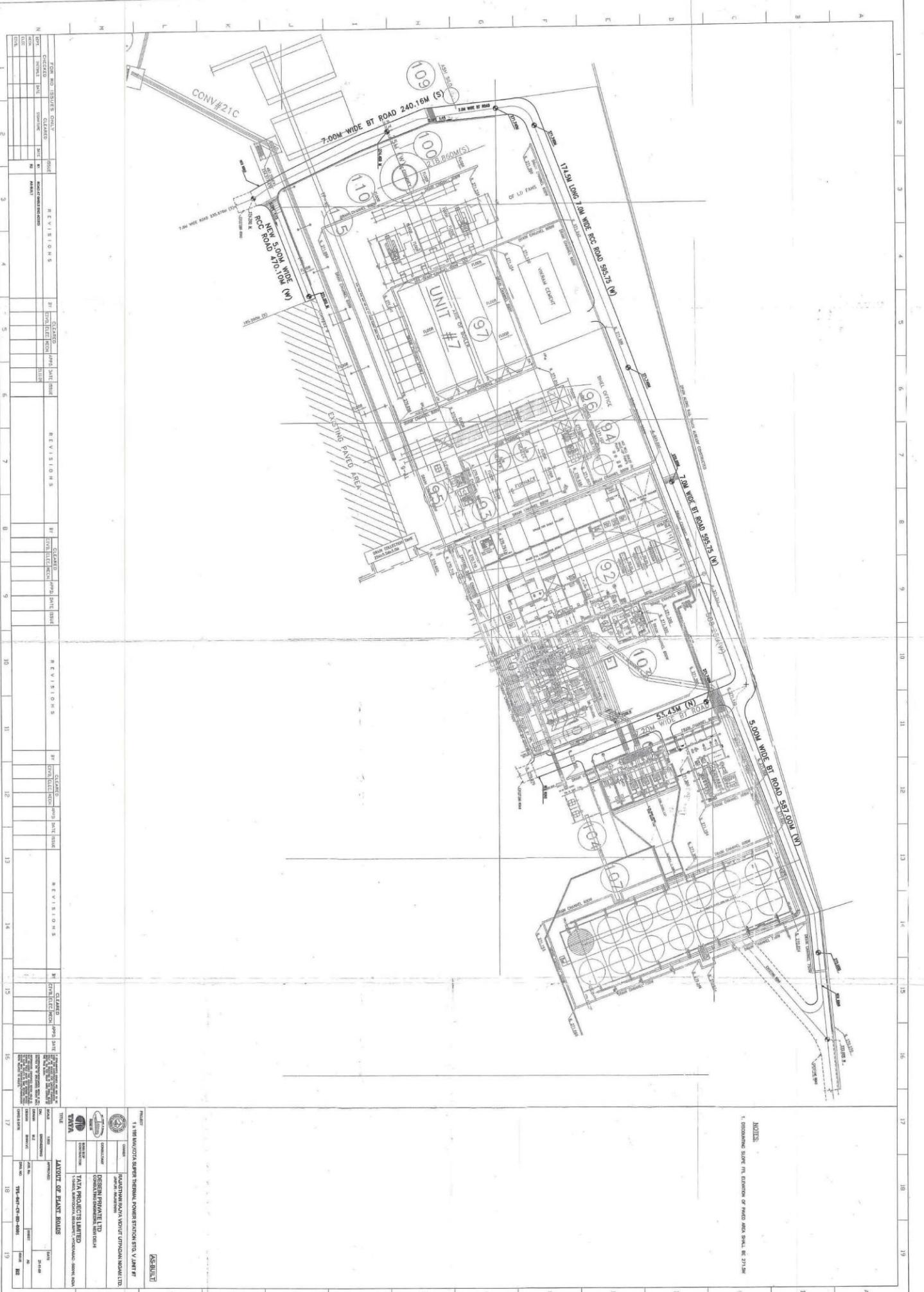
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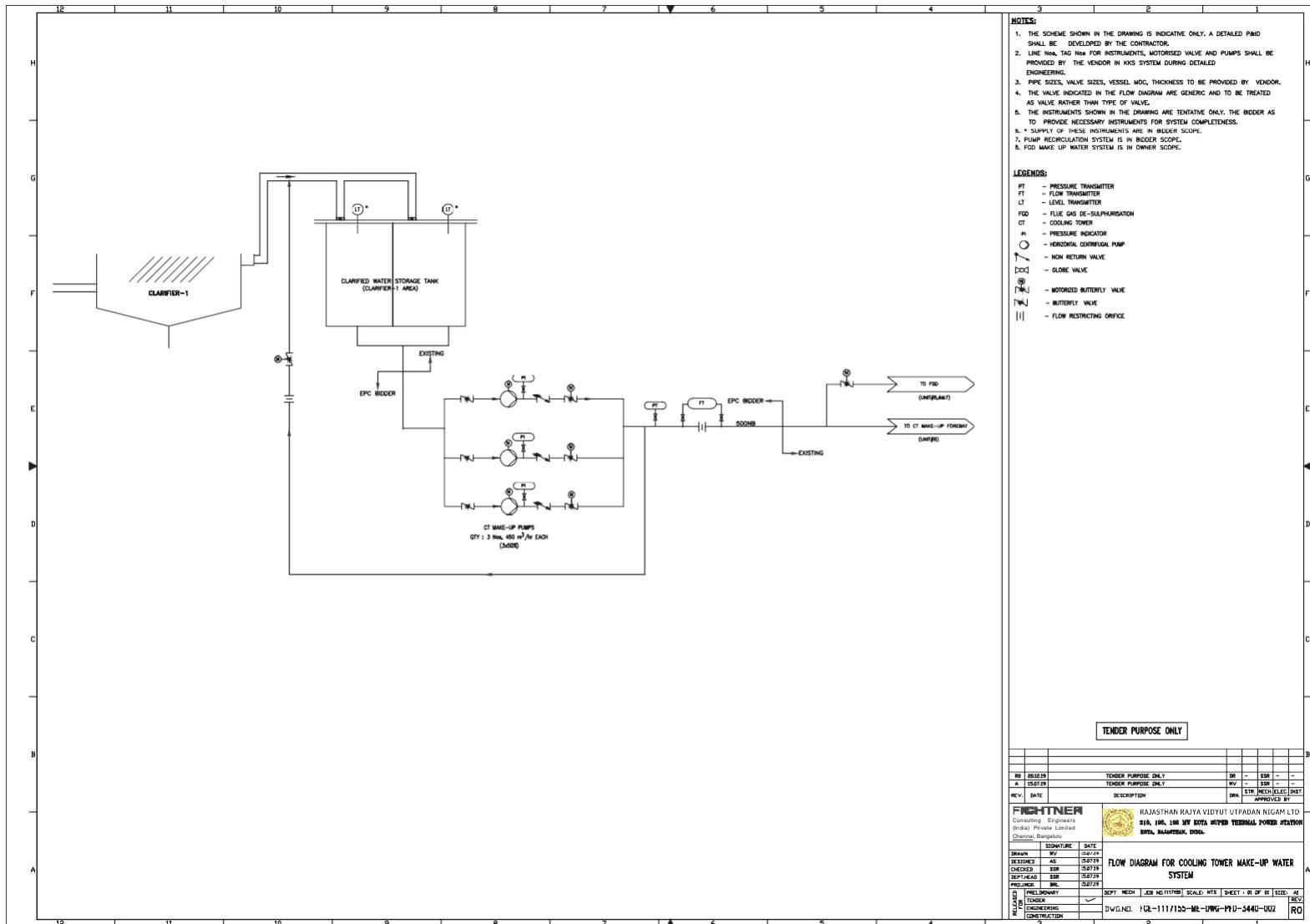
The following list of drawings/ documents are enclosed with the specification.

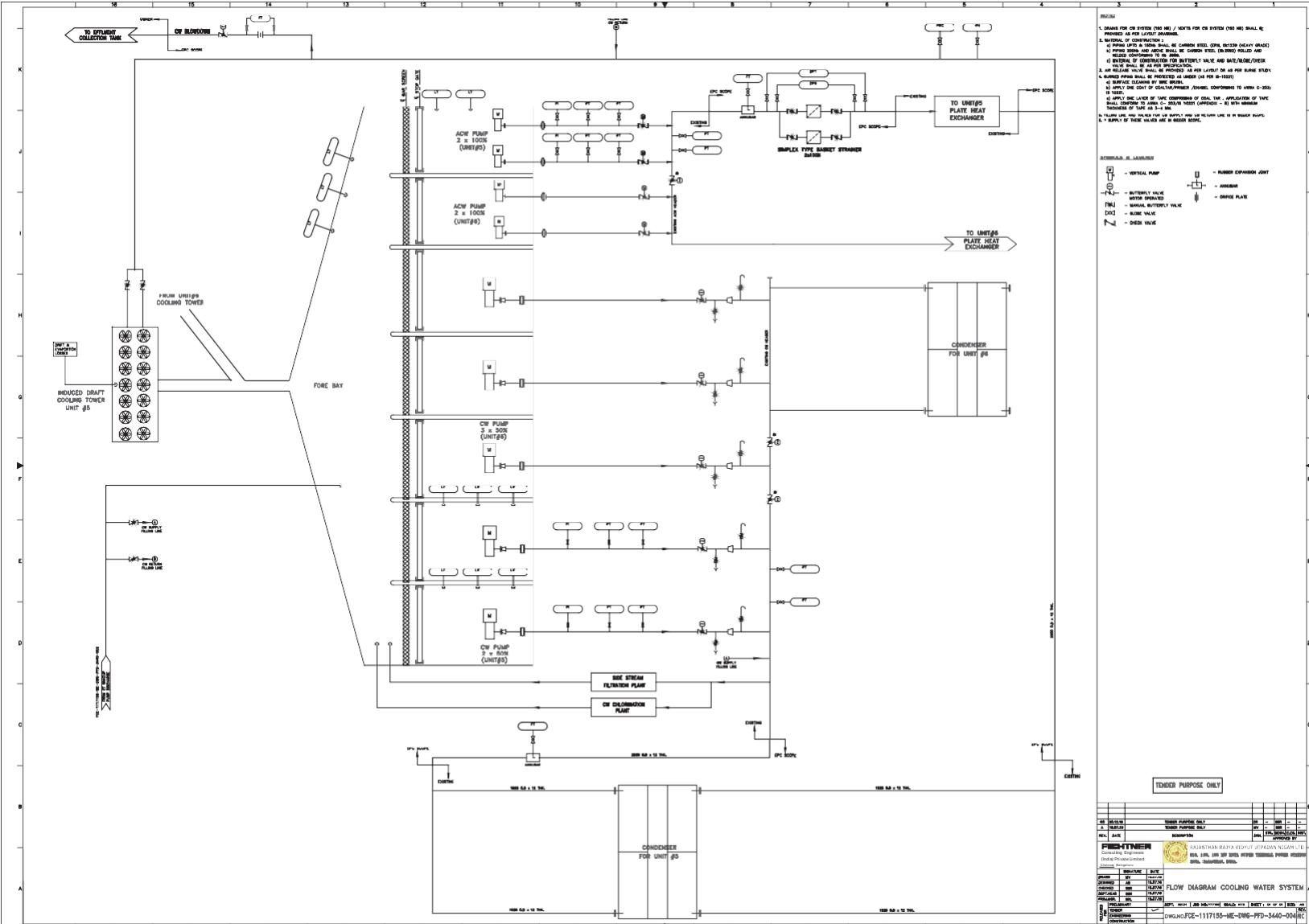
Sl. No.	Drawing No.	Drawing Title
<b>A</b>	<b>General</b>	
1.	FCE-1117155-ME-DWG-LAY-3440-001	Plot Plan
2.	111-29-0200	Plot Plan
3.	TPL-047-CV-RD-0001	Layout of Plant Roads
<b>B</b>	<b>Mechanical</b>	
1.	FCE-1117155-ME-DWG-PFD-3440-002	Flow diagram for Cooling Tower Make-up Water System
2.	FCE-1117155-ME-DWG-PFD-3440-003	Flow diagram for Cooling Water System
3.	FCE-1117155-ME-DWG-PFD-3440-004	Flow diagram for CW Treatment System (Chemical Dosing System) ( Sheet 1 of 3)
4.	FCE-1117155-ME-DWG-PFD-3440-004	Flow diagram for CW Treatment System (Side Stream Filtration) ( Sheet 2 of 3)
5.	FCE-1117155-ME-DWG-PFD-3440-004	Flow diagram for CW Treatment System (Chlorine Di-Oxide System) ( Sheet 3 of 3)
<b>C</b>	<b>Control &amp; Instrumentation</b>	For Tender drawing refer Volume II, Section 4, Detailed Technical Specification for Control & Instrumentation

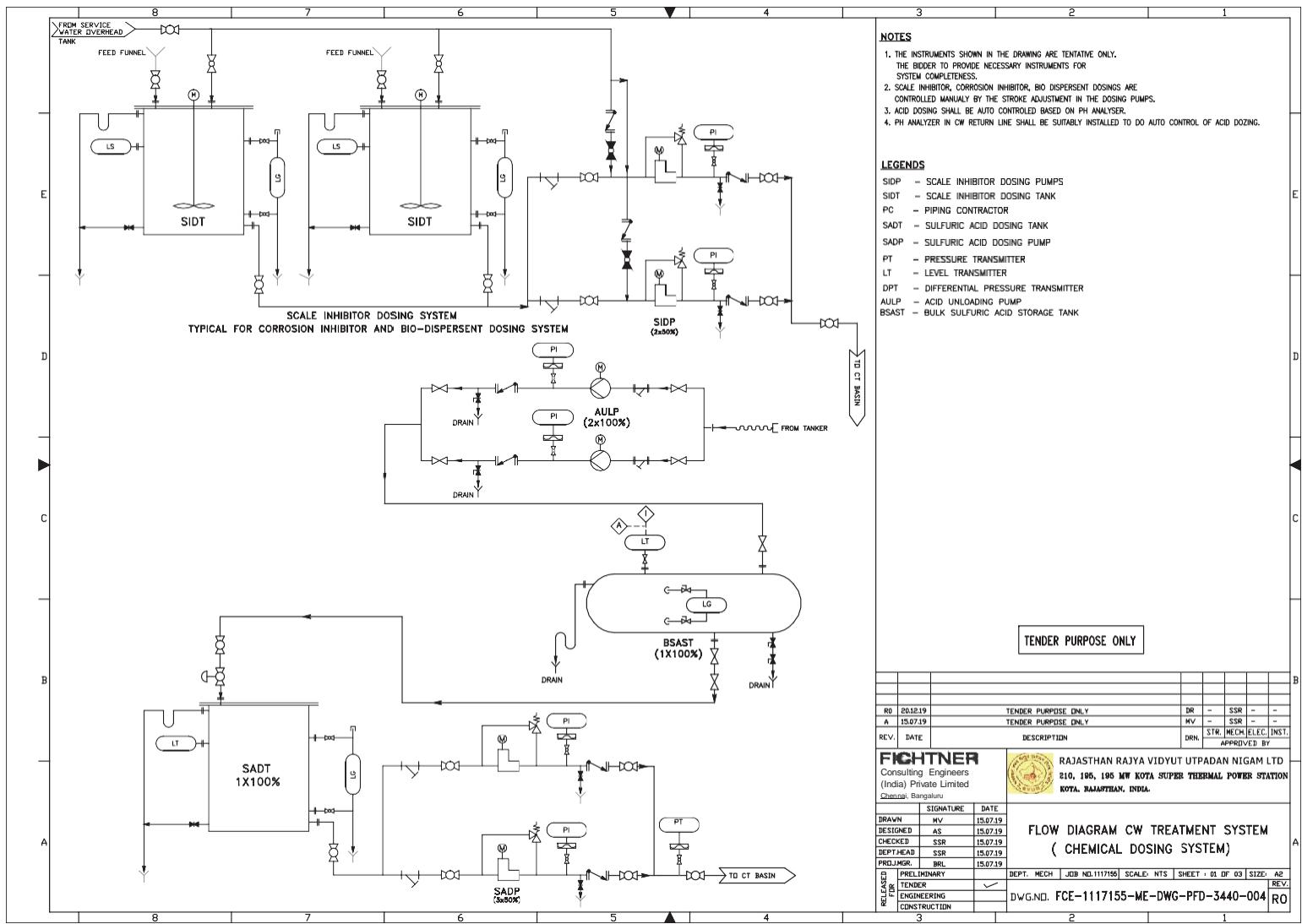


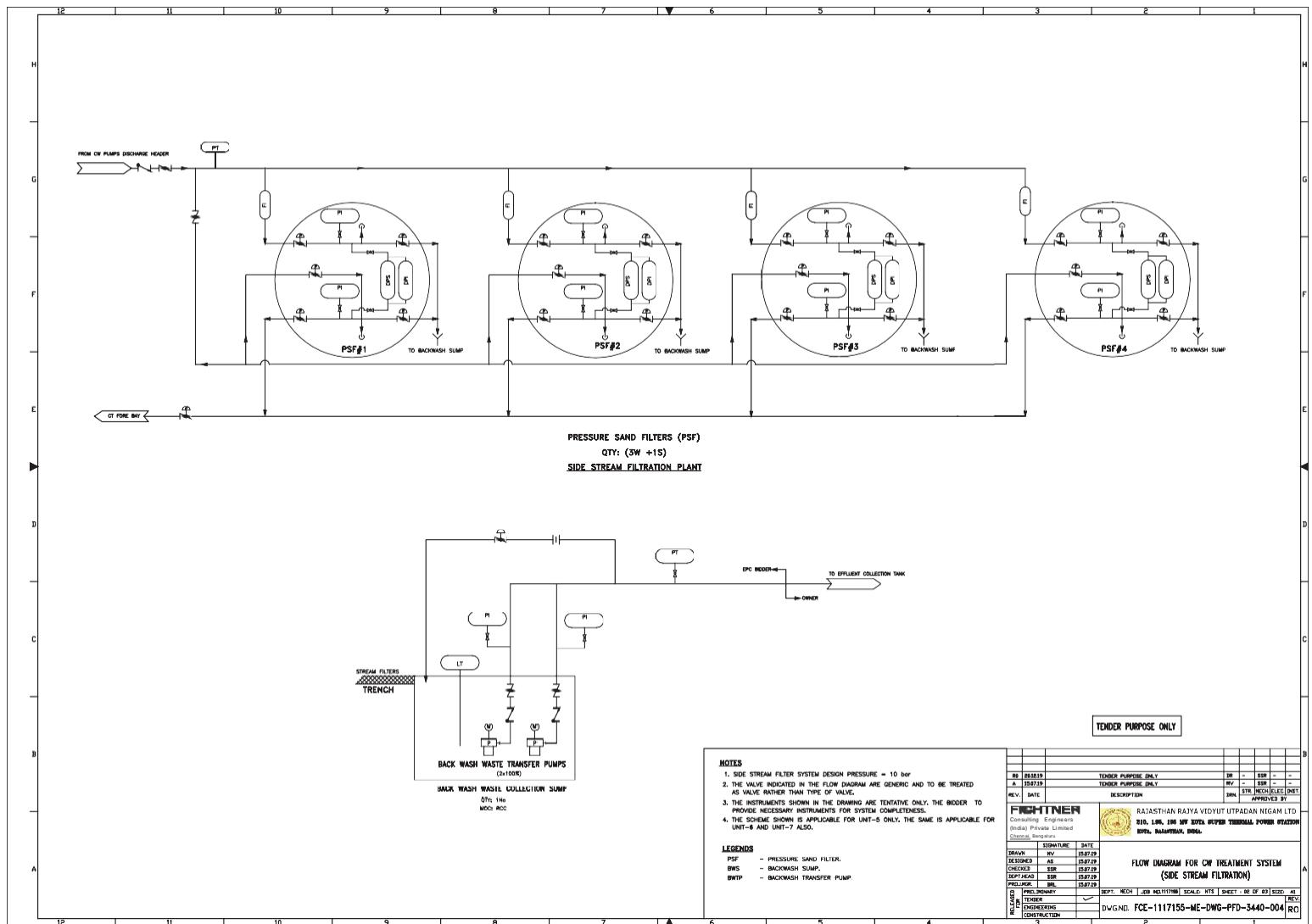


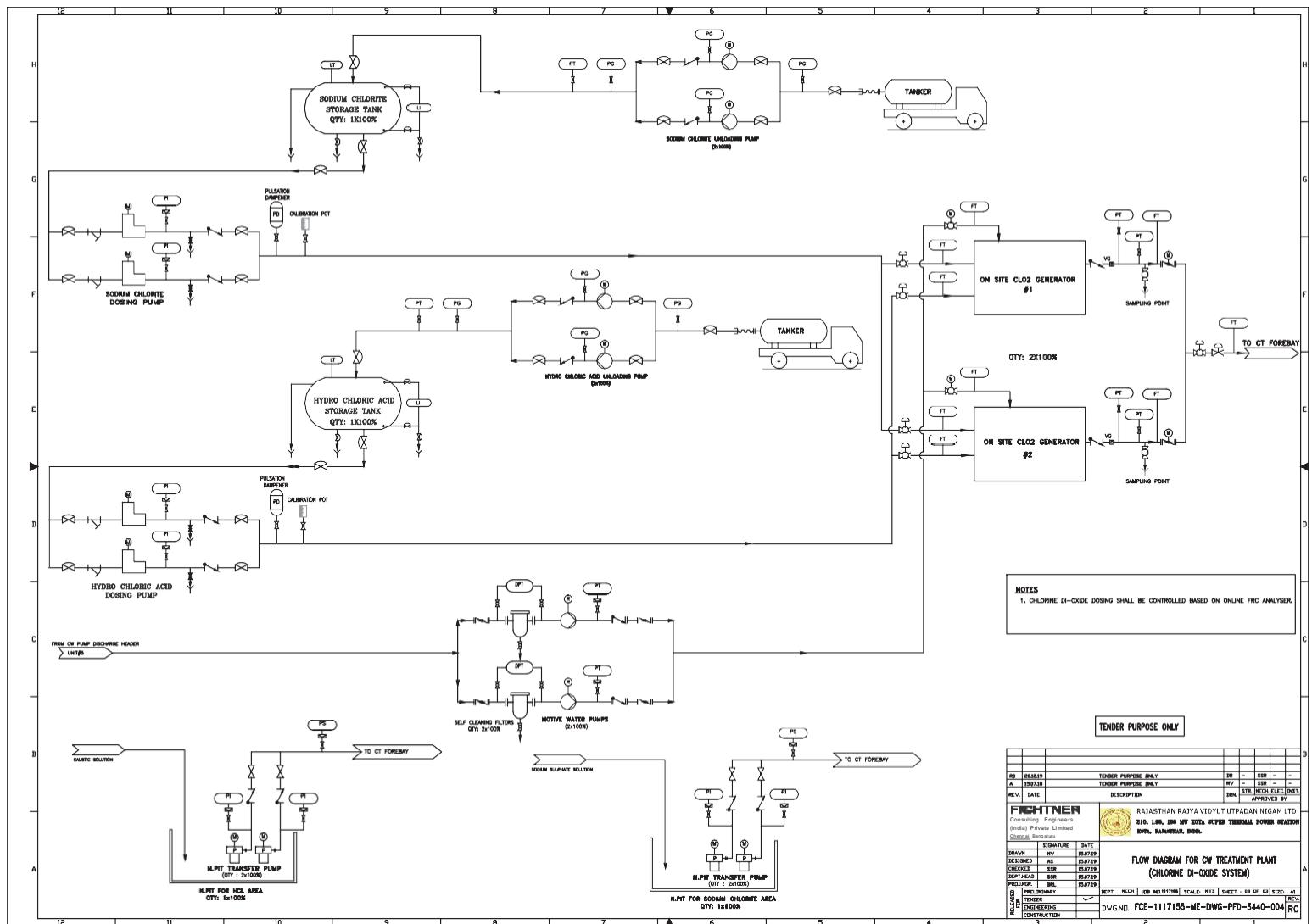














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VOLUME II  
SECTION 7  
SCHEDULES

**FICHTNER Consulting Engineers (India) Private Limited**  
Chennai-Bengaluru, India



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## SCHEDULE – 1A

### FUNCTIONAL GUARANTEES – COOLING TOWER

#### A. Category- I : Performance Guarantees under Liquidated Damages [L.D]

The Performance Guarantees which attract Liquidated Damages are as follows:

Sl. No.	Particular	Value inclusive of design, manufacture and all other Tolerances	Acceptable Shortfall limit with LD	Applicable Test Codes
1	Power consumption per fan at inlet of Motor terminal	.....kW	(+) 0.5% from the guaranteed auxiliary power consumption	

#### B. Guarantees under Category-II

The parameters/capabilities shall be demonstrated for various systems/ equipment shall include but not limited to the following:

Sl. No.	Particular	Value inclusive of design, manufacture and all other Tolerances	Acceptable Shortfall limit	Applicable Test Codes
1	Water Flow rate per cell	M <sup>3</sup> /HR	(-)0.0%	
2	Cooling range	10°C	+0.0°C	
3	Approach to wet bulb temperature	5°C	(+)1°C	

**SIGNATURE OF  
BIDDER**

\_\_\_\_\_

**NAME**

\_\_\_\_\_

**DESIGNATION**

\_\_\_\_\_

**COMPANY SEAL**

**DATE**

\_\_\_\_\_



## SCHEDULE – 1B

### FUNCTIONAL GUARANTEES – CW PUMPS

#### A. Category- I : Performance Guarantees under Liquidated Damages [L.D]

The Performance Guarantees which attract Liquidated Damages are as follows:

Sl. No.	Particular	Value inclusive of design, manufacture and all other Tolerances	Acceptable Shortfall limit with LD	Applicable Test Codes
1.0	Auxiliary power consumption of running pump/s	.....kVV	(+) 0.5% from the guaranteed auxiliary power consumption	

#### B. Guarantees Under Category-II

The parameters/capabilities shall be demonstrated for various systems/ equipment shall include but not limited to the following:-

Sl. No.	Particular	Value inclusive of design, manufacture and all other Tolerances	Acceptable Shortfall limit	Applicable Test Codes
1	Head of the pump at rated capacity		(-)1mwc	
2	Shut off head of the pump	mwc	Not more than existing Condenser Water box design pressure	
3	Pump capacity	m <sup>3</sup> /h	(-)5%	

SIGNATURE OF  
BIDDER \_\_\_\_\_

NAME \_\_\_\_\_

DESIGNATION \_\_\_\_\_

COMPANY SEAL

DATE \_\_\_\_\_



## SCHEDULE – 1C

### FUNCTIONAL GUARANTEES – ACW PUMPS

#### A. Category- I : Performance Guarantees under Liquidated Damages [L.D]

The Performance Guarantees which attract Liquidated Damages are as follows:

Sl. No.	Particular	Value inclusive of design, manufacture and all other Tolerances	Acceptable Shortfall limit with LD	Applicable Test Codes
1	Auxiliary power consumption of running pump/s	.....kVV	(+) 0.5% from the guaranteed auxiliary power consumption	

#### B. Guarantees Under Category-II

The parameters/capabilities shall be demonstrated for various systems/ equipment shall include but not limited to the following:-

Sl. No.	Particular	Value inclusive of design, manufacture and all other Tolerances	Acceptable Shortfall limit	Applicable Test Codes
1	Differential Head of the pump at rated capacity		(-)00mwc	
2	Shut off head of the pump	mwc	Not more than the existing PHE design pressure	
3	Pump capacity	m <sup>3</sup> /h	(-)0.00%	

**SIGNATURE OF  
BIDDER** \_\_\_\_\_

**NAME** \_\_\_\_\_

**DESIGNATION** \_\_\_\_\_

**COMPANY SEAL**

**DATE** \_\_\_\_\_



## SCHEDULE – 1D

### FUNCTIONAL GUARANTEES – CW TREATMENT SYSTEM

#### A. Category- I : Performance Guarantees under Liquidated Damages [L.D]

The Performance Guarantees which attract Liquidated Damages are as follows:

Sl. No.	Particular	Value inclusive of design, manufacture and all other Tolerances	Acceptable Shortfall limit with LD	Applicable Test Codes
1.	Auxiliary power Guarantee for CW treatment system		(+) 0.5% from the guaranteed auxiliary power consumption	

#### B. Guarantees under Category-II (Applicable for all three units)

The parameters/capabilities shall be demonstrated for various systems/ equipment shall include but not limited to the following:-

Sl. No.	Particular	Value inclusive of design, manufacture and all other Tolerances	Acceptable Shortfall limit	Applicable Test Codes
A	<b>SIDE STREAM FILTER</b>			
	Turbidity, NTU		(+)1ppm	
	TSS, ppm		(+)1ppm	
	Capacity of each filter, m <sup>3</sup> /hr		No Negative Tolerance	
	Net Output between two successive backwash, m <sup>3</sup>		No Negative Tolerance	
B	<b>Corrosion Rate</b>			
	MS, mpy		No Positive tolerance	



<b>Sl. No.</b>	<b>Particular</b>	<b>Value inclusive of design, manufacture and all other Tolerances</b>	<b>Acceptable Shortfall limit</b>	<b>Applicable Test Codes</b>
	Copper, mpy		No Positive tolerance	
	SS, mpy		No Positive tolerance	
<b>C</b>	<b>SCALING, MG/DM<sup>2</sup>/DAY</b>		No Positive tolerance	
<b>D</b>	<b>MICRO BIO FOULING COUNTS</b>			
	Total Viable Count (TVC), Counts/ml		No Positive tolerance	
	Sulphate reducing bacteria (SRB) , Counts /100 ml		No Positive tolerance	

- Note:**

Apart from above, bidder shall guarantee all pumps, blowers for rated capacity, Head, Noise level and Vibration level. The acceptable Tolerance shall be as per the applicable Standards.

#### **C. Guarantees under Category-III (Applicable for all three units)**

<b>Sl. No.</b>	<b>Particular</b>	<b>Value inclusive of design, manufacture and all other Tolerances</b>	<b>Acceptable Shortfall limit</b>	<b>Applicable Test Codes</b>
1	SSF Backwash frequency	.....hrs	No Negative Tolerance	
2	Chemical consumption		+/- 5 %	
	i) Sulphuric acid		+/- 5 %	
	ii) Scale inhibitor		+/- 5 %	
	iii) Corrosion inhibitor		+/- 5 %	
	iv) bio-dispersant		+/- 5 %	



Sl. No.	Particular	Value inclusive of design, manufacture and all other Tolerances	Acceptable Shortfall limit	Applicable Test Codes
	v) Hydrochloric acid for Chlorine di-oxide plant		+/- 5 %	
	vi) Sodium chlorite for chlorine di-oxide plant		+/- 5 %	

**SIGNATURE OF  
BIDDER** \_\_\_\_\_

**NAME** \_\_\_\_\_

**DESIGNATION** \_\_\_\_\_

**COMPANY SEAL**

**DATE** \_\_\_\_\_



## SCHEDULE – 1E

### FUNCTIONAL GUARANTEES – CT MAKE-UP PUMPS

#### A. Category- I : Performance Guarantees under Liquidated Damages [L.D]

The Performance Guarantees which attract Liquidated Damages are as follows:

Sl. No.	Particular	Value inclusive of design, manufacture and all other Tolerances	Acceptable Shortfall limit with LD	Applicable Test Codes
1	Auxiliary power consumption of running pump/s	.....kVV	(+) 0.5% from the guaranteed auxiliary power consumption	

#### B. Guarantees Under Category-II

The parameters/capabilities shall be demonstrated for various systems/ equipment shall include but not limited to the following:-

Sl. No.	Particular	Value inclusive of design, manufacture and all other Tolerances	Acceptable Shortfall limit	Applicable Test Codes
1	Differential Head of the pump at rated capacity		(-)00mwc	
2	Shut off head of the pump	mwc		
3	Pump capacity	m <sup>3</sup> /h	(-)0.00%	

**SIGNATURE OF  
BIDDER**

\_\_\_\_\_

**NAME**

\_\_\_\_\_

**DESIGNATION**

\_\_\_\_\_

**COMPANY SEAL**

**DATE**

\_\_\_\_\_



## SCHEDULE – 2

### GUARANTEED AUXILIARY POWER CONSUMPTION – CW SYSTEM

Complete list of auxiliary power consumption at input to motor including design, manufacture and all other tolerances shall be guaranteed by the Contractor as given below:

#### SCHEDULE OF AUXILIARY POWER CONSUMPTION

<b>Sl. No.</b>	<b>Particulars</b>	<b>Total number provided (Working + Standby) <u>for each unit</u></b>	<b>Power consumptio n for each motor / equipment at 100 % TMCR condition</b>	<b>Total Power consumptio n in kW at 100% TMCR condition <u>for each unit</u></b>	<b>Total Power consumption in kW at 100% TMCR condition</b>
<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>	<b>(5)</b>	<b>(6)</b>
<b>a)</b>	Sum of Items listed in schedule -1				
<b>b)</b>	<u>Any Other Items which is not included in schedule -1 (Bidder to list any other continuously running equipment)</u>  1 2 3				
	<b>Grand total value</b>	-	-		

Note : 1 Bidders to note that the grand total value as above will be considered for evaluation, Performance Guarantees and levy of Liquidated Damages (L.D).

**SIGNATURE** \_\_\_\_\_  
**OF BIDDER**

**NAME** \_\_\_\_\_

**SEAL OF THE COMPANY**

**DESIGNATION** \_\_\_\_\_

**COMPANY** \_\_\_\_\_

**DATE** \_\_\_\_\_



## SCHEDULE – 3

### TECHNICAL DATA SHEET (TO BE FILLED IN BY BIDDER))

#### 1.0 MECHANICAL

##### A. COOLING TOWER

SI.NO.	DESCRIPTION	UNIT	DATA
1.0	<b>GENERAL</b>		
1.1	Manufacturer's Name		
1.2	No. of Cells		
1.3	Material of construction		
2.0	<b>TOWER DATA</b>		
2.1	Type		
2.2	No. of cells working/standby	Nos.	
2.3	Water flow through each cell	M <sup>3</sup> /Hr	
2.4	L/G ratio		
2.5	Drift loss	%	
2.6	Evaporation loss	%	
2.7	Drift loss consumption	M <sup>3</sup> /Hr	
2.8	Evaporation loss consumption	M <sup>3</sup> /Hr	
2.8.1	Recirculation Allowance	deg C	
2.9	Active tower volume/cell	M <sup>3</sup>	
2.10	Splash surface/cell	M <sup>2</sup>	
2.11	Total wetted surface/cell	M <sup>2</sup>	
2.12	Min. pressure head required at the terminal point on including drop across isolation valve/nozzle spray nozzle header.	MWC	
2.13	Height of spray nozzle header from basin curb level	M	
2.14	Water area/Cell	M <sup>2</sup>	



SI.NO.	DESCRIPTION	UNIT	DATA
2.15	Air area/Cell	M <sup>2</sup>	
2.16	Water flow/sq.m of water area	M <sup>3</sup> /Hr	
2.17	Overall Dimensions (Internal dimension)		
a)	Total length	M	
b)	Total width	M	
c)	Height above basin curb	M	
d)	Fan stack height	M	
e)	Dia of fan stack at		
	i) stack base	M	
	ii) Outlet	M	
	iii) Throat	M	
2.18	Overall Tower Height	M	
2.19	Basin (Dimensions shall be internal dimension)		
a)	Storage capacity	M <sup>3</sup>	
b)	Length	M	
c)	Width	M	
d)	Depth	M	
2.20	Distribution System		
a)	Type (Description)		
b)	Height of hot water inlet above basin curb	M	
c)	Nozzle diameter	mm	
d)	Capacity of each nozzle	m <sup>3</sup> /Hr	
e)	Pressure drop across nozzle	kg/cm <sup>2</sup>	
f)	Specifications of all flanges		
g)	Nominal diameter and number of hot water inlet per cell		
h)	No. of valves/cell and sizes		
2.21	Drift Eliminators		
a)	Type		



SI.NO.	DESCRIPTION	UNIT	DATA
b)	No. of passes		
c)	Details of Miscellaneous Supplies		
d)	No. of Platforms		
3.0	<b>WEIGHTS</b>		
3.1	Weight of fan assembly	Kgs	
3.2	Weight of gear box	Kgs	
3.3	Weight of couplings	Kgs	
3.4	Weight of fan motor	Kgs	
3.5	Weight of drive shaft	Kgs	
3.6	Weight of isolation gate	Kgs	
3.7	Weight of trash screen	Kgs	

## B. CW AND ACW PUMPS

S. No.	DESCRIPTION	UNITS	VALUE/DETAILS
1.	Designation		
2.	Numbers offered		
3.	Design capacity	m <sup>3</sup> /hr	
4.	Differential head	MLC	
5.	Shut-off head	MLC	
6.	Hydrostatic pressure	kg/cm <sup>2</sup> (g)	
7.	Number of stages		
8.	Pump efficiency at duty point	%	
9.	Pump speed	rpm	
10.	Pump BKW	kW	
11.	Power input to driver at duty point	kW	
12.	NPSH required	MLC	
13.	Driver efficiency	%	
14.	Suction nozzle size	mm	



<b>S. No.</b>	<b>DESCRIPTION</b>	<b>UNITS</b>	<b>VALUE/DETAILS</b>
15.	Discharge nozzle size	mm	
16.	Type of coupling		
17.	Minimum capacity for continuous operation	m <sup>3</sup> /hr	
18.	External water requirement for sealing and cooling		
19.	Weight of bare pump	kg	
20.	Weight of driver	kg	
21.	Wight of common base plate	kg	
22.	Moment of inertia of rotor	kg-m <sup>2</sup>	
23.	material of construction		
a)	Casing		
b)	Impeller		
c)	Shaft		
d)	Shaft sleeve		
e)	Gland packing		
24.	Accessories provided		
a)	Companion flanges with gasket and fasteners		Yes / No
b)	Foundation bolts		Yes / No
c)	Coupling guard		Yes / No
d)	Drip tray		Yes / No
e)	Special maintenance tools		Yes / No
f)	Recommended spare parts		Yes / No

### C. RE JOINTS

<b>S. No.</b>	<b>DESCRIPTION</b>	<b>UNITS</b>	<b>VALUE/DETAILS</b>
1.	Designation-		
2.	Quantity offered	Nos	
3.	Maximum flow	m <sup>3</sup> /hr	



S. No.	DESCRIPTION	UNITS	VALUE/DETAILS
4.	Pressure drop	MLC	
5.	Material of construction:		
9.	Vacuum test	mm of Hg	
10.	Type /Ends (Restrained type with control unit tie rods / flanged drilled to match pump discharge)		
11.	Movements : a. Axial compression b. Axial Elongation c. Lateral movement	mm	
12.	Fasteners		

#### D. BUTTERFLY VALVES

S. No.	DESCRIPTION	UNITS	VALUE/DETAILS
1.	Service		
2.	Valve Size	MM	
3.	No. of Valves	m <sup>3</sup> /hr	
4.	Companion Flange to be supplied	MLC	
5.	Hand wheel		Yes/ NO
9.	Valve Opening/Closing Time	sec	
10.	Flow of Rate		
11.	Frequency of Operation	mm	
12.	Pressure drop at max.flow when valve fully open	mmWC	
13	Material of Construction for : Body ,Disc, Shaft, Bearing etc.		
14	Test Pressure for : Body and Disc	kG/cm <sup>2</sup>	
15	Seat leakage		
16	Weight	Kg	



## E. HVAC SYSTEM

### SPLIT TYPE AIR CONDITIONING UNITS

Sl. No.	Description	Unit	Data
<b>A</b>	<b>GENERAL</b>		
1	Standard		
2	Type		
3	Overall weight	kg	
<b>B</b>	<b>COMPRESSOR</b>		
1	Type		
2	No. of Compressor		
3	Capacity	TR	
4	Refrigerant		
5	Condensing Temp.	Deg C	
6	Evaporating		
7	Compressor speed	RPM	
8	Energy Efficiency Ratio		
9	Power consumption	kW	
10	Motor rating	kW	
11	Power Supply		
12	<u>Protection Devices</u>		
	High/low pressure protection		
	Oil Pressure Switch		
	Single phase protection		
	Overload protection		
13	<u>Controls</u>		
	Adjustable thermostatic switch		
	Automatic unloader		
14	<u>Accessories</u>		
	External Crankcase heater		
	Vibration Isolator		
	Suction gas strainer		



Sl. No.	Description	Unit	Data
<b>C</b>	<b>COOLING COIL</b>		
1	Coil Type		
2	No. of Rows		
3	Coil Tube dia	mm	
4	Tube thickness	mm	
5	Fin thickness	mm	
6	Fin spacing	mm	
7	Coil face area	m <sup>2</sup>	
8	Coil face velocity	m/s	
9	Air side fouling factor		
10	Expansion valve		
<b>D</b>	<b>BLOWER FAN</b>		
1	Fan Type		
2	No. of fans		
3	Fan capacity	m <sup>3</sup> /hr	
4	Fan static pressure	mm of WC	
5	Fan static efficiency	%	
6	Fan shaft power	kW	
7	Fan rated speed	RPM	
8	Fan drive		
9	Fan drive motor type		
10	Power Supply		
11	Motor rating	kW	
<b>E</b>	<b>CASING</b>		
1	Type		
2	Frame		
3	Acoustic Insulation		
4	Evaporator drain pan		
5	Inlet RA Grille		
<b>F</b>	<b>REFRIGERANT PIPING &amp; VALVES</b>		
1	Piping		



Sl. No.	Description	Unit	Data
2	Valve		
<b>G</b>	<b>CONDENSER</b>		
1	Type		
2	Refrigerant Inlet temperature	Deg C	
3	Refrigerant outlet temperature	Deg C	
4	Number of passes		
5	Number of tube bundles		
6	Heat exchange rate		
7	LMTD (including correction factor)		
8	Fouling factor		
9	Surface area		
<b>H</b>	<b>TESTING &amp; INSPECTION</b>		
1	Material Testing		
2	Pressure testing		
3	Compressor		

### VENTILATION SYSTEM

Sl. No.	Description	Unit	Data
<b>A</b>	<b>AXIAL FLOW FANS</b>		
1.0	General		
1.1	Standard		
1.2	Mounting		
1.3	Service		
1.4	Type		
<b>2.0</b>	<b>OVERALL WEIGHT</b>	kg	
2.1	Performance		
2.2	Capacity	m <sup>3</sup> /hr	
2.3	Air density	kg/m <sup>3</sup>	
2.4	Total pressure	mmWC	
2.5	Static pressure	mmWC	
2.6	Static efficiency	%	



Sl. No.	Description	Unit	Data
2.7	Total efficiency	%	
2.8	Rated speed	RPM	
2.9	Critical speed		
2.10	Fan shaft power		
2.11	Motor power rating		
<b>3.0</b>	<b>NO. OF BLADES</b>		
3.1	Construction		
3.2	Fan impeller		
3.3	Fan shaft		
3.4	Fan casing		
3.5	Fan Hood & Cowl		
3.6	Bird Screen		
3.7	Conned Inlet		
3.8	Inlet screen		
<b>4.0</b>	<b>BOLTS &amp; NUT</b>		
4.1	Fan Drive		
4.2	Type		
4.3	Drive Motor		
4.4	Power supply		
4.5	Motor ambient temp.		
4.6	Motor Insulation		
<b>5.0</b>	<b>MOTOR ENCLOSURE</b>		
5.1	Fan Accessories		
5.2	Exhaust Hood		
5.3	Cowl		
5.4	Conned inlet		
5.5	Inlet screen		
5.6	Flexible connection		
5.7	Fan supporting frame		
5.8	Grouting frame		
5.9	Vibration isolator		
5.10	Backdraft damper		
5.11	Air Filters		



Sl. No.	Description	Unit	Data
<b>6.0</b>	<b>DISCONNECT SWITCH</b>		
6.1	Testing and Inspection		
6.2	Material Testing		
6.3	Dynamic balancing		
6.4	Performance testing		
	Notes :		
	1) Fan motor shall be suitable for DOL starting.		
<b>B</b>	<b>BELT DRIVEN AXIAL FLOW FANS (SPARK RESISTANT CONSTRUCTION)</b>		
<b>1.0</b>	<b>General</b>		
1.1	Standard		
1.2	Type		
1.3	Special requirement		
1.4	Arrangement		
1.5	Overall weight	kg	
<b>2.0</b>	<b>Performance</b>		
2.1	Capacity		
2.2	Air Density		
2.3	Static pressure		
2.4	Total pressure		
2.5	Rated Speed		
2.6	Static Efficiency		
2.7	Total Efficiency		
2.8	Fan Shaft power		
2.9	Critical Speed		
2.10	No. of Blades		
2.11	Recommended Motor Rating		
<b>3.0</b>	<b>Fan Drive</b>		
3.1	Type		
3.2	Drive Motor		
3.3	Power Supply		
3.4	Motor ambient temp.		
3.5	Motor Insulation		



Sl. No.	Description	Unit	Data
3.6	Motor Enclosure		
<b>4.0</b>	<b>Fan Accessories</b>		
4.1	Exhaust cowl		
4.2	Bird screen		
4.3	Backdraft damper		
4.4	Inlet case		
4.5	Inlet screen		
4.6	Fan supporting frame/Grouting frame		
4.7	Vibration isolator		
4.8	Sliding rail for fan motor		
4.9	Disconnect switch		
<b>5.0</b>	<b>Material Of Construction</b>		
5.1	Impeller		
5.2	Fan shaft		
5.3	Shaft sleeve		
5.4	Casing		
5.5	Inlet Case		
5.6	Cowl		
5.7	Bolts & Nut		
5.8	Inlet Screen		
5.9	Bird Screen		
<b>6.0</b>	<b>TESTING &amp; INSPECTION</b>		
6.1	Material Testing		
6.2	Dynamic Balancing		
6.3	Performance testing		
	<b>Notes:</b>		
	1) Fan motor shall be suitable for DOL Starting.		



#### F. COOLING TOWER MAKE UP WATER SYSTEM

SI.No.	Description	Data
	<b>COOLING TOWER MAKE UP PUMPS</b>	
1)	Type	
2)	Capacity(Each)	
3)	MOC	
4)	Quantity	
5)	Head	

#### G. CW TREATMENT SYSTEM

S.No	Description	Data
A.	<b>Scale Inhibitor Tank</b>	
1)	Type	
2)	MOC	
3)	Quantity	
4)	Capacity	
B.	<b>Scale Inhibitor Dosing Pump</b>	
1)	Type	
2)	MOC	
3)	Quantity	
4)	Capacity for each pump	
C.	<b>Corrosion Inhibitor Tank</b>	
1)	Type	
2)	MOC	
3)	Quantity	
4)	Capacity	
D.	<b>Corrosion Inhibitor Dosing Pump</b>	
1)	Type	
2)	MOC	
3)	Quantity	



S.No	Description	Data
4)	Capacity for each pump	
<b>E.</b>	<b>Bio-Dispersant Dosing Tank</b>	
1)	Type	
2)	MOC	
3)	Quantity	
4)	Capacity	
<b>F.</b>	<b>Bio-Dispersant Dosing Pump</b>	
1)	Type	
2)	MOC	
3)	Quantity	
4)	Capacity for each pump	
<b>G.</b>	<b>Piping</b> [For Scale Inhibitor/Corrosion Inhibitor/Dispersant]	
<b>H.</b>	<b>Valves</b> [For Scale Inhibitor/Corrosion Inhibitor/Dispersant]	
<b>I.</b>	<b>Bulk Sulphuric Acid Storage Tank</b>	
1)	Type	
2)	MOC	
3)	Quantity	
4)	Capacity	
<b>J.</b>	<b>Sulphuric Acid Unloading Pumps</b>	
1)	Type	
2)	MOC	
3)	Quantity	
4)	Capacity	
5)	Head	
<b>K.</b>	<b>Piping [Acid Dosing]</b>	
<b>L.</b>	<b>Valves [Acid Dosing]</b>	
<b>M.</b>	<b>Sulphuric Acid Dosing Pumps</b>	
1)	Type	



S.No	Description	Data
2)	MOC	
3)	Quantity	
4)	Capacity for each pump	
<b>N.</b>	<b>Sulphuric acid dosing Tank</b>	
1)	Type	
2)	MOC	
3)	Quantity	
4)	Capacity	
<b>O.</b>	<b>Side Stream Filtration(Typical data sheet to be provided for all three units)</b>	
1)	Type of filters	
2)	Number of filters	
4)	Capacity per filter	
5)	Design Pressure	
6)	Type	
7)	Size	
9)	MOC of shell & dished ends	
<b>P.</b>	<b>AIR SCOURING BLOWERS(Typical data sheet to be provided for all three units)</b>	
1)	Type	
2)	Quantity	
3)	Capacity and Head	
4)	MOC	
<b>Q.</b>	<b>SSF BACK WASH WATER COLLECTION SUMP(Typical data sheet to be provided for all three units)</b>	
1)	Capacity	
2)	MOC	
3)	Quantity	
4)	Size	



S.No	Description	Data
R.	<b>SSF BACK WASH WASTE TRANSFER PUMP(Typical data sheet to be provided for all three units)</b>	
1)	Capacity	
2)	Head	
3)	MOC	
4)	Quantity / Type	
S.	<b>CHLORINE DI-OXIDE SYSTEM</b>	
1)	<b>Bulk Sodium Chlorite storage tank</b>	
	Type	
	MOC	
	Quantity	
	Capacity	
2)	<b>Sodium Chlorite Unloading Pumps</b>	
	Type	
	MOC	
	Quantity	
	Capacity	
	Head	
3)	<b>Bulk Hydrochloric acid storage tank</b>	
	Type	
	MOC	
	Quantity	
	Capacity	
4)	<b>Hydrochloric acid Unloading Pumps</b>	
	Type	
	MOC	
	Quantity	
	Capacity	
	Head	



S.No	Description	Data
5)	<b>Sodium Hypochlorite dosing pumps</b>	
	Type	
	MOC	
	Quantity	
	Capacity	
	Head	
6)	<b>Hydrochloric acid dosing pumps</b>	
	Type	
	MOC	
	Quantity	
	Capacity	
	Head	
7)	<b>Dilution water/Booster water pumps</b>	
	Type	
	MOC	
	Quantity	
	Capacity	
	Head	
8)	<b>Onsite ClO<sub>2</sub> Generator</b>	
	Type	
	MOC	
	Quantity	
	Capacity(Each)	
	Design dosing rate	
	Dosing frequency per day	



S.No	Description	Data
9)	<b>Neutralization Pit</b>	
	Qty	
	MOC	
	Capacity(Each)	
	Type	
	Size	
10)	<b>Neutralization waste transfer pumps</b>	
	Qty	
	MOC	
	Capacity(Each)	
	Type	

Note: Bidder shall provide the details to modification carried out in existing CW treatment facilities

**SIGNATURE** \_\_\_\_\_

**OF BIDDER**  
**NAME** \_\_\_\_\_

**SEAL OF THE COMPANY**

**DESIGNATION** \_\_\_\_\_

**COMPANY** \_\_\_\_\_

**DATE** \_\_\_\_\_



## 2.0 ELECTRICAL

Bidder shall furnish technical data in the following schedules along with the offer.

The schedule for data to be submitted for approval after award of contract will be issued to the successful Bidder during detail engineering.

### 2.1 HT Switchgear

Sl. No.	Description	Unit	Data
<b>1.0</b>	<b>SWITCHGEAR ASSEMBLY</b>		
1.1	Make		
1.2	Type		
1.3	Reference Standard		
1.4	Voltage (Nom. / Max.)	kV	
1.5	Phase, Frequency	No, Hz	
1.6	<b>Short Circuit Rating</b>		
	a. Interrupting MVA (sym.) for 3 sec	MVA	
	b. Short-time for 3 sec.	kA (rms)	
1.7	<b>Insulation Level</b>		
	a. Impulse Withstand	kV (peak)	
	b. 1-min. 50 Hz. Voltage withstand	kV (rms)	
1.8	Metal-clad construction?	Yes / No	
1.9	Degree of Protection		
1.10	Minimum thickness of sheet metal used	mm	
1.11	Switchgear completely assembled, wired and tested at factory	Yes / No.	
<b>2.0</b>	<b>CONSTRUCTION</b>		
2.1	Draw-out feature provided for :		
	a. Circuit breaker with service, test and disconnected position	Yes / No.	
	b. Voltage Transformer	Yes / No.	
2.2	<b>Breaker Cubicle</b>		



Sl. No.	Description	Unit	Data
	a. Cubicle door can be closed with breaker in TEST position	Yes / No.	
	b. Working zone limits from floor level	mm	
2.3	All meters, switch & relays flush mounted type	Yes / No	
<b>3.0</b>	<b>BUSBAR</b>		
3.1	Make		
3.2	Material & Grade		
3.3	Reference, Standard		
3.4	Cross sectional area	Sq. mm	
	Size	mmxmm	
3.5	Continuous Current rating at ambient of 50°C		
3.6	Current density	A / mm <sup>2</sup>	
3.7	Maximum temperature rise over 50°C	°C	
3.8	Short time current for 3 sec.	kA (rms)	
<b>4.0</b>	<b>CIRCUIT BREAKER</b>		
4.1	Make		
4.2	Type		
4.3	Reference Standard		
4.4	Rated voltage	KV	
4.5	Rated frequency	Hz.	
4.6	No. of poles	No.	
4.7	<b>Rated Current</b>		
	a. Continuous (at site condition, 50°C ambient & within cubicle)	Amp.	
	b. Short-time current for 3 sec.	kA (rms)	
4.8	Maximum temperature rise over 50°C ambient	°C	
4.9	Rated operating duty		
4.10	Interrupting capacity at rated		



Sl. No.	Description	Unit	Data
	voltage and operating duty		
	a. Symmetrical	kA (rms)	
	b. DC component	%	
4.11	Rated making current	kA (peak)	
4.12	Maximum over voltage factor when switching off		
	a. Unloaded transformer		
	b. Loaded transformer		
	c. Unloaded Lines		
	d. Induction Motor		
4.13	<b>At 100% interrupting capacity</b>		
	a. Opening time (max.)	ms	
	b. Arcing time (max.)	ms	
	c. Total tripping time (max.)	ms	
4.14	Total closing time (max.)	ms	
4.16	No. of breaker operations permissible without requiring inspection, replacement of contacts and other main parts		
	a. At 100% rated current		
	b. At 100% rated interrupting current		
4.17	Type of contacts		
	a. Main		
	b. Arcing		
4.18	Material of contacts		
	a. Main		
	b. Arcing		
	c. Whether contacts silver plated		
	d. Thickness of silver plating		
4.19	Type of arc control device provided		
4.20	<b>Operating Mechanism</b>		



Sl. No.	Description	Unit	Data
	a. Type		
	b. No. of breaker operations stored		
	c. Trip free or fixed trip		
	d. Anti-pumping features provided		

## 2.2 Dry Type Transformers

Sl.No.	DESCRIPTION	Rating-1	Rating-2
1.	Name & Place of Manufacturer		
2.	Type, Service		
3.	Reference Standards		
4.	MVA rating		
5.	Rated no load voltage ratio (kV)		
6.	Rated frequency		
7.	Number of phases		
8.	Connections		
	a. HV winding		
	b. LV windings		
9.	Vector group		
10.	Direction of Power flow		
11.	Off load tap Changer		
	a. Type		
	b. Tap Range		
	c. Tap step		
12.	Type of Transformer Neutral earthing for LV		
13.	Type of Cooling		
14.	Temperature rise over 50 deg C ambient .		
15.	Efficiencies at 75 Deg. C at 0.8 Power factor at full load		
16.	Component losses		



Sl.No.	DESCRIPTION	Rating-1	Rating-2
	a. No load loss at rated voltage on principal tapping & at rated frequency		
	b. Load loss at rated current at principal tapping at 75 Deg. C excluding auxiliary loss		
17.	Impedance voltage at rated current HV-LV (Nominal tap )		
18.	Rated HV current at rated voltage and rated frequency		
19.	Rated LV current at rated voltage and rated frequency		
20.	Short circuit withstand Duration		
21.	Short circuit withstand current (kA)		
	a)HV		
	b)LV		
22.	Type of Termination		
	a) HV		
	b) LV		
23.	Total Weight		
24.	Overall dimensions		
	a) Length (mm)		
	b) Breath (mm)		
	c) Height (mm)		
25.	Type of windings		
	a. HV windings		
	b. LV windings		
26.	Winding Current density		
	a. HV		
	b. LV		
27.	Core		
	a. Material & grade of core laminations		
	b. Thickness of core laminations		



### 2.3 415V Non-Segregated Phase Busduct

Sl.No.	Description	Units	Rating-1	Rating-2
1.	Make			
2.	Type			
3.	Reference Standard			
4.	Shape & Size of Busduct			
5.	Voltage Class	V		
6.	Rated Voltage	V		
7.	Degree of protection			
<b>8.</b>	<b>Insulation Level</b>			
	a) 1 min power frequency withstand Voltage	kV rms		
9.	Rated Continuous Current at 50°C ambient temperature	Amps		
<b>10.</b>	<b>Maximum temperature rise over 50°C ambient</b>			
	a) Bus Conductor	Deg C		
	b) Bus Enclosure	Deg C		
	c) Bus joint-Plain / tinned	Deg C		
	d) Bus joint-Silver plated	Deg C		
<b>11.</b>	<b>Rated Short Time Current</b>			
	a) Symmetrical kA for 1 sec	kA		
	b) Momentary	kA Peak		
<b>12.</b>	<b>Material &amp; Grade</b>			
	a) Conductor			
	b) Enclosure			
<b>13.</b>	<b>Conductivity</b>			
	a) for Conductor			
14.	Conductor Shape			
15.	Conductor Size	mm		



Sl.No.	Description	Units	Rating-1	Rating-2
16.	Conductor weight / metre	kg		
<b>17.</b>	<b>Enclosure Data</b>			
	a) Phase Spacing	mm		
	b) Phase to phase clearance	mm		
	c) Phase to earth clearance	mm		
	d) Overall Dimensions	mm		
	e) Thickness of sheet steel	mm		
<b>18.</b>	<b>D.C. Resistance of conductor at</b>	$\mu\Omega/M/p$ h		
	a) 20°C			
	b) 90°C			
<b>19.</b>	<b>A.C. Resistance of conductor at</b>	$\mu\Omega/M/p$ h		
	a) 20°C			
	b) 90°C			
20.	50 Cycle Reactance in Ohm/meter/phase	$\Omega/M/ph$		
21.	Weight per meter run of Busduct	kg		
22.	Guaranteed loss per 3phase per metre	watts		

#### 2.4 LV SWITCHGEAR

(Data to be furnished for each Switchboard)

Sl. No.	Description	Unit	PCC	MCC	DB
<b>1.</b>	<b>SWITCHGEAR ASSEMBLY</b>				
a)	Make				
b)	Reference standard(s)				
c)	Rated voltage & frequency	V & Hz			
d)	Short circuit rating				
	Short circuit withstand rating for 1 second	kA(rms)			



Sl. No.	Description	Unit	PCC	MCC	DB
	Dynamic short circuit withstand rating	kA (peak)			
e)	One minute power frequency withstand voltage	kV(rms)			
f)	Degree of Protection				
g)	Type of steel				
h)	Sheet steel thickness for load bearing member	mm			
i)	Sheet steel thickness for enclosure & door	mm			
j)	Thickness for gland plate	mm			
k)	Construction of PCC-Form 4b, Drawout	Yes / No			
l)	Construction of MCC-Form 4b, Drawout	Yes / No			
m)	Construction of DB-Form 4b, Fixed	Yes / No			
n)	Overall dimension of each switchboard (Separate list to be furnished)	mm x mm x mm			
<b>2.</b>	<b>BUS BAR</b>				
a)	Material & grade of main horizontal bus bar				
b)	Material & grade of Earth bus bar				
c)	Maximum temperature rise over 50°C	°C			
d)	Short circuit withstand rating for 1 second	kA(rms)			
e)	Dynamic short circuit withstand rating	kA(peak)			
f)	Bus bar provided with				
	• Insulating sleeve	Yes / No			
	• Phase barriers	Yes / No			
	• Cast resin shrouds for joint	Yes / No			
g)	Bus connections silver plated / made with anti-oxide grease				
<b>3.</b>	<b>CIRCUIT BREAKER</b>				
a)	Make				



Sl. No.	Description	Unit	PCC	MCC	DB
b)	Rated voltage & frequency	V & Hz			
c)	In-panel rating of following IEC rated breakers at 50°C design ambient temperature				
	• 4000A breaker	A			
	• 3200A breaker	A			
	• 2500A breaker	A			
	• 2000A breaker	A			
	• 1600A breaker	A			
	• 1250A breaker	A			
	• 1000A breaker	A			
	• 800A breaker	A			
	• 630A breaker	A			
d)	Short circuit withstand rating for 1 second	kA(rms)			
e)	Short circuit breaking current	kA(rms)			
f)	Short circuit making current	kA(peak)			
g)	Maximum temperature rise over 50°C ambient	°C			
h)	Rated operating duty				
i)	Total tripping time (max.)	ms			
j)	Total closing time (max.)	ms			
k)	No. of breaker operations permissible without requiring inspection, replacement of contacts and other main parts				
	At 100% rated current				
	At 100% rated interrupting current				
l)	Material of contacts				
	Main				
	Arcing				
m)	Thickness of silver plating	mm			
n)	Type of operating mechanism				
o)	VA burden & rated voltage for				
	• Spring charging motor	VA & V			



Sl. No.	Description	Unit	PCC	MCC	DB
	• Closing coil	VA & V			
	• Trip coil	VA & V			
<b>4.</b>	<b>Isolating Switch</b>				
a)	Make				
b)	Type				
c)	Rated voltage	V			
d)	Utilization category				
<b>5.</b>	<b>MCCB</b>				
a)	Make				
b)	Type				
c)	Rated voltage	V			
d)	Current rating				
e)	Short circuit current rating				
<b>6.</b>	<b>Power Contactors</b>				
a)	Make				
b)	Rated voltage	V			
c)	Coil voltages	V			
d)	Utilization category				
	• Reversible motor				
	• Non-reversible motor				
	• DC application				
<b>7.</b>	<b>Multi-function Meter</b>				
a)	Make				
b)	Type				
c)	Accuracy class				
d)	Measuring functions				
<b>8.</b>	<b>Energy Meter</b>				
a)	Make				
b)	Type				
c)	Accuracy class				
d)	Measuring functions				
<b>9.</b>	<b>Relays</b>				
a)	Type & make of motor protection				



Sl. No.	Description	Unit	PCC	MCC	DB
	relay				
b)	Type & make of feeder protection relay				
c)	Type & make of voltage relay				
d)	Type & make of check synchronizing relay				
<b>10.</b>	<b>Local Push Button Stations</b>				
a)	Enclosure material & thickness				
b)	Degree of protection of enclosure				
<b>11.</b>	<b>Local Push Button Stations (Flame-proof Type)</b>				
a)	Enclosure material & thickness				
b)	Degree of protection of enclosure				
<b>12.</b>	<b>Local Motor Starters</b>				
c)	Enclosure material & thickness				
d)	Degree of protection of enclosure				
<b>13.</b>	<b>MPCB</b>				
e)	Make				
f)	Type				
g)	Rated voltage	V			
h)	Current rating				
i)	Short circuit current rating				
<b>14.</b>	<b>MCB</b>				
j)	Make				
k)	Type				
l)	Rated voltage	V			
m)	Current rating				
n)	Short circuit current rating				



## 2.5 UPS Battery

Sl. No.	Description	Unit	Data
1	Manufacturer of battery		
2	Quantity	Nos.	
3	Applicable standard		
4	DC System Voltage	V	
5	Battery type		
6	Type of Container		
7	Type of the cell		
8	Cell designation as per IS		
9	Cell dimensions	mmxm mxmm	
10	Weight of complete cell <ul style="list-style-type: none"><li>• Without electrolyte</li><li>• With electrolyte</li></ul>	Kg	
11	Plates <ul style="list-style-type: none"><li>• No.of positive plates per cell</li><li>• Types of positive plates</li><li>• Types of negative plates</li></ul>		
12	No. of Cells per battery		
13	Rated cell voltage		
14	Ampere Hour rating	AH	
15	Battery capacity referred to a cell end voltage	AH	
16	Load cycle duration	Hours	
17	10 hour rating at 27°C to 1.85V per cell / 5 hour rating at 27°C to 1.1V per cell	A	
18	Minimum cell voltage during duty cycle		
19	WH efficiency		
20	AH efficiency		
21	Float charging ( Volt / cell , Amp)	V,Amp	



<b>Sl. No.</b>	<b>Description</b>	<b>Unit</b>	<b>Data</b>
22	Boost charging ( Volt / cell , Amp) • Start • Finish	V,Amp	
23	Maximum short circuit current for a dead short across terminals	KA	
24	Internal resistance of • Battery • Each cell of battery	Ohm	
25	Taps provided of cell No.		
26	Internal resistance of each cell of battery	Ohm	
27	Mounting arrangement		
28	Racks • Material • No. of racks • Overall dimension of rack		

## 2.6 UPS

<b>SI.No</b>	<b>Description</b>	<b>Unit</b>	<b>Data</b>
1.	General		
a)	UPS rating	kVA/kW	
b)	Make		
c)	Make & place of manufacture		
d)	No. of UPS		
e)	Type		
f)	Reference Standard		
g)	Input AC Voltage with variation	V	
h)	Input Frequency , Hz with variation	Hz	
i)	Output Voltage with variation	V	
j)	Out put Frequency , Hz with variation	Hz	
k)	Design Ambient temperature		
l)	Efficiency of complete UPS (AC)	%	



SI.No	Description	Unit	Data
	to AC)		
m)	DC System voltage	V	
n)	Total Harmonic distortion		
o)	Voltage regulation	%	
p)	Frequency regulation	%	
q)	Transient voltage regulation	%	
r)	Over load response of UPS		
s)	Dynamic response		
t)	Noise level	dB	
u)	Cooling		
v)	Communication interface		
w)	Heat dissipation	kW	
x)	Thickness of sheet metal		
y)	Dimensions in mm (LxDxH)		
z)	Weight of complete panel(kg)		
aa)	Paint shade - inside - out side		
bb)	List of protections/ indications/ metering/annunciations provided in UPS		
<b>2.</b>	<b>UPS Enclosure</b>		
a)	Material		
b)	Thickness of sheet		
c)	Degree of protection		
<b>3.</b>	<b>Charger/Rectifier</b>		
a)	Make		
b)	Type		
c)	Current rating		
d)	Voltage rating		
<b>4.</b>	<b>Static inverter</b>		
a)	Make		
b)	Type		
c)	Current rating		



SI.No	Description	Unit	Data
d)	Voltage rating		
e)	AC output voltage variation		
f)	Guaranteed efficiency		
g)	Total harmonic content at rated load		
5.	<b>Static transfer switch</b>		
a)	Make		
b)	Type		
c)	Current Rating	A	
d)	Voltage rating	V	
e)	Transfer time	m.sec	
6.	<b>Manual by-pass switch</b>		
a)	Make		
b)	Type		
c)	Current Rating	A	
d)	Voltage rating	V	
7.	<b>Voltage stabilizer</b>		
a)	Make		
b)	Type		
c)	Capacity	kVA	
e)	Input voltage & no. of phase		
h)	Type of cooling		
i)	Class of insulation		
o)	Voltage regulation for input variation of +/- 10% and 0 to 100% load variation and PF 0.6 to 1.0		
p)	Servomotor drive details		
q)	Output Current at Rated voltage	A	
8.	<b>Input Transformer</b>		
a)	Make		
b)	KVA rating	kVA	



SI.No	Description	Unit	Data
c)	Voltage ratio, frequency & no. of phase		
d)	Vector group		
e)	Insulation class		
f)	Rated current		
	<b>Output Transformer</b>		
a)	Make		
b)	KVA rating	kVA	
c)	Voltage ratio, frequency & no. of phase		
d)	Vector group		
e)	Insulation class		
f)	Rated current		
<b>9.</b>	<b>MCCB</b>		
a)	Make		
b)	Rating	A	
c)	Type		
<b>10.</b>	<b>HRC and Semiconductor Fuses</b>		
a)	Make		
b)	Type		
c)	Rating	A	
<b>11.</b>	<b>Cables</b>		
a)	Make		
b)	Type		
c)	Conductor material		
d)	Insulation material		
f)	Cable size between UPS-A & UPS-B	Sq.mm	
g)	Cable size between UPS & SCVS	Sq.mm	



## 2.7 HIGH VOLTAGE POWER CABLE

(Data shall be furnished for each voltage grade, each type and size of cable)

SI.No	Description	Units	Data
1.	Make		
2.	Applicable standard		
3.	Cable size	Sq.mm	
4.	Rated voltage	V	
5.	Earthed/Unearthed grade		
6.	Continuous current rating at 50°C air ambient temperature (For single core cables rating shall be based on bonding screen at both the ends in trefoil form)	A	
7.	Continuous current rating at 40°C ground ambient temperature	A	
8.	Short circuit withstand current for 1 sec duration for		
a)	Conductor	kA rms	
b)	Metallic screen	kA rms	
9.	Conductor		
a)	Material		
b)	Grade		
c)	Nominal cross sectional area	Sq.mm	
10.	Conductor screening		
a)	Material and type		
b)	Approx. thickness of extruded layer	mm	
11.	Insulation		
a)	Nominal thickness of insulation	mm	
b)	Type of curing		
c)	Identification of cores		
12.	Type of extrusion		
13.	Insulation screening		
a)	Material and type		
b)	Approx. thickness of extruded layer	mm	



Sl.No	Description	Units	Data
14.	Metallic Screen		
a)	Material		
b)	Cross section area of screen		
15.	Inner sheath		
a)	Material		
b)	Thickness of sheath (min)	mm	
c)	Extruded or not		
16.	Armour		
a)	Type of material of armour wire		
b)	Dimension of wire	mm x mm	
c)	No. of armour wires		
17.	Outer sheath		
a)	Material and type		
b)	Thickness of sheath	mm	
c)	Minimum Oxygen index		
d)	Minimum Temperature index		
e)	Maximum Smoke Density		
f)	Light Transmission		
g)	Maximum Acid gas emission		
18.	Overall diameters of cable	mm	
19.	Cable Drums		
a)	Type		
b)	Material		

## 2.8 LOW VOLTAGE POWER CABLE

(Data shall be furnished for each type and size of cable)

Sl.No	Description	Units	Data
1.	Make		
2.	Applicable standard		
3.	Cable size	Sq.mm	
4.	Rated voltage	V	
5.	Continuous current rating at 50°C air ambient temperature (For single core cables rating)	A	



Sl.No	Description	Units	Data
	shall be for trefoil form)		
6.	Continuous current rating at 40°C ground ambient temperature	A	
7.	Conductor		
a)	Material		
b)	Grade		
c)	Nominal cross sectional area	Sq.mm	
8.	Insulation		
a)	Nominal thickness of insulation	mm	
b)	Type of curing		
9.	Inner sheath		
a)	Material		
b)	Thickness of sheath (min)	mm	
c)	Extruded or not		
10.	Armour		
a)	Type of material of armour wire		
b)	Dimension of wire	mm x mm	
c)	No. of armour wires		
11.	Outer sheath		
a)	Material and type		
b)	Thickness of sheath	mm	
c)	Colour of sheath		
d)	Minimum Oxygen index		
e)	Minimum Temperature index		
f)	Maximum Smoke Density		
g)	Light Transmission		
h)	Maximum Acid gas emission		
12.	Overall diameters of cable	mm	
13.	Cable Drums		
a)	Type		
b)	Material		
14.	Additional data for Fire survival cables		



Sl.No	Description	Units	Data
a)	Conductor material		
b)	Insulation material		
c)	Inner sheath material		
d)	Armour material		
e)	Outer sheath material		
f)	Fire withstand rating as per IEC:60331		

## 2.9 CONTROL CABLE

(Data shall be furnished for each type and size of cable)

Sl.No.	Description	Units	Data
1.	Make		
2.	Applicable standard		
3.	Cable size	Sq.mm	
4.	Rated voltage	V	
5.	Continuous current rating at 50°C air ambient temperature	A	
6.	Continuous current rating at 40°C ground ambient temperature	A	
7.	Conductor		
a)	Material		
b)	Grade		
c)	Nominal cross sectional area	Sq.mm	
d)	Conductor strands	Nos./mm	
8.	Insulation		
a)	Nominal thickness of insulation	mm	
b)	Identification of cores		
9.	Inner sheath		
a)	Material		
b)	Thickness of sheath (min)	mm	
c)	Extruded or not		
10.	Armour		
a)	Type of material of armour wire		
b)	Dimension of wire	mm x	



Sl.No.	Description	Units	Data
		mm	
c)	No. of armour wires		
11.	Outer sheath		
a)	Material and type		
b)	Thickness of sheath	mm	
c)	Colour of sheath		
d)	Minimum Oxygen index		
e)	Minimum Temperature index		
f)	Maximum Smoke Density		
g)	Light Transmission		
h)	Maximum Acid gas emission		
12.	Overall diameters of cable	mm	
13.	Cable Drums		
a)	Type		
b)	Material		
14.	<b>Additional data for overall screened cables</b>		
a)	Thickness and coverage of polyester tape	mm and %	
b)	Thickness and coverage of Al-mylar tape	mm and %	
c)	Size of ATC drain wire	mm x mm	
d)	Core to core capacitance	µF	
e)	Core to screen capacitance	µF	
f)	L/R ratio		
g)	Drain wire resistance	Ω/kM	
15.	<b>Additional data for individually screened and overall screened cables</b>		
a)	Thickness and coverage of polyester tape for individual screen	mm	
b)	Thickness and coverage of Al-mylar tape for individual screen	mm	
c)	Size of ATC drain wire for	mm x	



Sl.No.	Description	Units	Data
	individual screen	mm	
d)	Core to core capacitance	$\mu\text{F}$	
e)	Core to screen capacitance	$\mu\text{F}$	
f)	L/R ratio		
g)	Drain wire resistance for individual screen	$\Omega/\text{kM}$	
h)	Thickness and coverage of polyester tape for overall screen	mm	
i)	Thickness and coverage of Al-mylar tape for overall screen	mm	
j)	Size of ATC drain wire for overall screen	mm x mm	
k)	Drain wire resistance for overall screen	$\Omega/\text{kM}$	

## 2.10 ILLUMINATION SYSTEM

Sl.No.	Description	Unit	Data
1	<b>LED Medium Bay Luminaire</b>		
a)	Make		
b)	Catalogue no.		
2	<b>LED Integral type Well glass Luminaire.</b>		
a)	Make		
b)	Catalogue no.		
3	<b>LED Integral type Well glass Luminaire</b>		
a)	Make		
b)	Catalogue no.		
4	<b>LED Integral type Well glass Luminaire</b>		
a)	Make		
b)	Catalogue no.		
5	<b>LED Low bay type Luminaire</b>		
a)	Make		
b)	Catalogue no.		



Sl.No.	Description	Unit	Data
6	<b>Flame proof Luminaire</b>		
a)	Make		
b)	Catalogue no.		
c)	Degree of protection		
7	<b>general purpose rail type LED luminaire</b>		
a)	Make		
b)	Catalogue no.		
8	<b>Industrial trough type LED luminaire</b>		
a)	Make		
b)	Catalogue no.		
9	<b>Corrosion proof type LED luminaire</b>		
a)	Make		
b)	Catalogue no.		
10	<b>Dust proof &amp; jet proof LED luminaire</b>		
a)	Make		
b)	Catalogue no.		
11	<b>Commercial Mirror optics type surface mounting LED luminaire</b>		
a)	Make		
b)	Catalogue no.		
12	<b>Commercial Mirror optics type recess mounting LED luminaire for luxalon ceiling.</b>		
a)	Make		
b)	Catalogue no.		
13	<b>Commercial low glare Mirror optics type recess mounting LED luminaire for luxalon ceiling.</b>		
a)	Make		
b)	Catalogue no.		



Sl.No.	Description	Unit	Data
14	<b>LED Street lighting Luminaire.</b>		
a)	Make		
b)	Catalogue no.		
15	<b>LED flood lighting Luminaire complete with control gear box.</b>		
a)	Make		
b)	Catalogue no.		
16	<b>LED Lamps( to be furnished for each rating)</b>		
a)	Make		
b)	Type		
c)	Lumen output ( for each rating)	Lumens	
17	<b>Lighting Panel ( to be furnished for each type)</b>		
a)	Make & Place of manufacture		
b)	Degree of protection		
c)	Rating & type of incomer	A	
d)	Rating & type of outgoing feeders	A	
e)	Short circuit rating of MCB		
18	<b>Street Lighting Panel</b>		
a)	Make & Place of manufacture		
b)	Degree of protection		
c)	Rating & type of incomer	A	
d)	Rating & type of outgoing feeders	A	
e)	Rating of contactor	A	
f)	Short circuit rating of MCB		
19	<b>Switch box</b>		
a)	Make & Place of manufacture		
b)	Material of enclosure		
c)	Type, model no. & rating of Switches	A	
d)	Type, model no. & rating of	A	



Sl.No.	Description	Unit	Data
	socket		
<b>20</b>	<b>Receptacle Panel ( to be furnished for each type)</b>		
a)	Make & Place of manufacture		
b)	Material of enclosure		
c)	Degree of protection		
d)	Rating & type of incomer	A	
e)	Rating & type of outgoing feeders	A	
f)	Short circuit rating of MCB		
<b>21</b>	<b>6/16A commercial Receptacles</b>		
a)	Make & Place of manufacture		
b)	Type & model no.		
c)	Type & rating of switch	A	
d)	Type & rating of receptacle	A	
<b>22</b>	<b>20A industrial Receptacles of each type</b>		
a)	Make & Place of manufacture		
b)	Type of enclosure		
c)	Degree of protection		
d)	Type & rating of MCB	A	
e)	Type & rating of receptacle	A	
<b>23</b>	<b>63A industrial Receptacles of each type</b>		
a)	Make & Place of manufacture		
b)	Type of enclosure		
c)	Degree of protection		
d)	Type & rating of switch & fuse	A	
e)	Type & rating of receptacle	A	
<b>24</b>	<b>Lighting poles</b>		
a)	Make & Place of manufacture		
b)	Type & material		
c)	Height		
d)	Weight	kg	



Sl.No.	Description	Unit	Data
e)	Diameter	mm	
f)	Bracket length	mm	
g)	Thickness of galvanizing		
<b>25</b>	<b>Lighting Mast</b>		
a)	Make & Place of manufacture		
b)	Type		
c)	Height	M	
d)	Weight	kg	
e)	Thickness of galvanizing		
f)	Type & rating winch motor		
<b>26</b>	<b>Wires</b>		
a)	Make & Place of manufacture		
b)	Conductor material & size	Sq.mm	
c)	Applicable standard		
<b>27</b>	<b>Wire way duct</b>		
a)	Make & Place of manufacture		
b)	Type		
c)	Size	mm	
d)	Applicable standard		
e)	Material		
f)	Standard length		
g)	Thickness		
<b>28</b>	<b>Rigid steel Conduit</b>		
a)	Make & Place of manufacture		
b)	Size	mm	
c)	Applicable standard		
d)	Material		
e)	Duty		
f)	Thickness of galvanizing		
<b>29</b>	<b>Conduit Fittings</b>		
a)	Make & Place of manufacture		
b)	Applicable standard		
c)	Material		



Sl.No.	Description	Unit	Data
d)	Thickness of galvanizing		
<b>30</b>	<b>Flexible steel Conduit</b>		
a)	Make & Place of manufacture		
b)	Size	mm	
c)	Applicable standard		
d)	Material		
<b>31</b>	<b>Junction Boxes ( To be furnished for each type)</b>		
1.0	Make & Place of manufacture		
1.0	Type of enclosure		
1.0	Degree of protection		
1.0	Type & rating terminal blocks		
<b>32</b>	<b>Portable emergency Lantern</b>		
a)	Make & Place of manufacture		
b)	Rating of lamp		
c)	Type & rating of battery		
d)	Back up lighting time		
e)	Type of enclosure		
<b>33</b>	<b>Ceiling Fans</b>		
a)	Make & Place of manufacture		
b)	Type & Size		
c)	Power rating		
d)	Make & type of electronic regulator		
<b>34</b>	<b>Pedestal Fans</b>		
a)	Make & Place of manufacture		
b)	Type & Size		
c)	Power rating		
d)	Make & type of electronic regulator		
<b>35</b>	<b>AC MLDB/ DCELDB</b>		
a)	Make		
b)	Reference standard(s)		
c)	Rated voltage & frequency	V & Hz	



Sl.No.	Description	Unit	Data
d)	Short circuit withstand rating for 1 second	kA(rms)	
e)	Dynamic short circuit withstand rating	kA(peak)	
f)	Degree of Protection		
g)	Type of steel		
h)	Busbar Material & grade		
i)	Maximum temperature rise over 50°C	°C	
j)	Short circuit withstand rating for 1 second	kA(rms)	
k)	Dynamic short circuit withstand rating	kA(peak)	
<b>36</b>	<b>Lighting transformer</b>		
a)	Make		
b)	Type		
c)	kVA rating		
d)	Rated voltage ratio	V	
a)	Winding Insulation		
a)	Temperature rise		
a)	Winding material		
b)	Total loss		



## 2.11 Cable Trays

Sl.No.	Description	Offered Data			
		600 mm	450 mm	300 mm	150 mm
1	<b>General</b>				
a)	Name of the Supplier				
b)	Place of manufacture				
c)	Material				
d)	Thickness of Galvanising				
2	<b>Ladder type Tray</b>				
a)	Standard length				
b)	Sheet steel thickness				
c)	Tray Height				
d)	Weight per meter				
e)	Rung spacing				
3	<b>Perforated type Tray</b>				
a)	Standard length				
b)	Sheet steel thickness				
c)	Tray Height				
d)	Weight per meter				
4	<b>Tray Cover</b>				
a)	Standard length				
b)	Sheet steel thickness				
c)	Weight per meter				
5	<b>Coupler plate</b>				
a)	Size				
b)	Sheet steel thickness				
6	<b>Bends</b>				
a)	Sheet steel thickness				
b)	Height				
c)	Bending radius				
d)	Weight				
7	<b>Tees</b>				
a)	Sheet steel thickness				



Sl.No.	Description	Offered Data			
		600 mm	450 mm	300 mm	150 mm
b)	Height				
c)	Bending radius				
d)	Weight				
<b>8</b>	<b>Cross</b>				
a)	Sheet steel thickness				
b)	Height				
c)	Bending radius				
d)	Weight				
<b>9</b>	<b>Reducers</b>				
a)	Sheet steel thickness				
b)	Height				
c)	Bending radius				
d)	Weight				
<b>10</b>	<b>Elbows</b>				
a)	Sheet steel thickness				
b)	Height				
c)	Bending radius				
d)	Weight				
<b>11</b>	<b>Hardwares</b>				
a)	Material				
b)	Thickness of Galvanising				
<b>12</b>	<b>Cable tray support system</b>				
a)	Name of the Supplier				
b)	Type				
c)	Material				
d)	Thickness of Galvanising				

## 2.12 Cabling Accessories

Sl.No.	Description	Offered Data
<b>1</b>	<b>TERMINATION KITS</b>	
a)	Make:	
b)	Type:	



Sl.No.	Description	Offered Data
c)	Voltage Grade & Size:	
d)	Kit no. as per catalogue	
<b>2</b>	<b>STRAIGHT THROUGH JOINTS</b>	
a)	Make:	
e)	Type:	
f)	Voltage Grade & Size:	
g)	Kit no. as per catalogue	
<b>3</b>	<b>CABLE GLANDS</b>	
a)	Make of gland:	
b)	Standards Applicable	
c)	Type of compression	
d)	Material:	
e)	Type of surface finish	
<b>4</b>	<b>CABLE LUGS</b>	
a)	Make of lugs:	
b)	Standards Applicable	
c)	Type	
d)	Material:	
e)	Whether tinning provided for copper lugs	
<b>5</b>	<b>EARTHING MATERIAL</b>	
a)	Make	
b)	Standards Applicable	
c)	Weight of zinc coating	
	• For flats 5mm thick and over	
	• For flats under 5mm thickness	
	• For wires	
<b>6</b>	<b>LIGHTNING PROTECTION SYSTEM</b>	
a)	Make	
b)	Standards Applicable	
c)	Weight of zinc coating	
	• For flats 5mm thick and over	



Sl.No.	Description	Offered Data
	<ul style="list-style-type: none"><li>• For flats under 5mm thickness</li></ul>	
	<ul style="list-style-type: none"><li>• For rods</li></ul>	
<b>7</b>	<b>TREFOIL CLAMPS</b>	
a)	Material	
b)	Type	
c)	Size	
d)	Short circuit withstand rating	
<b>8</b>	<b>OMEGA CLAMPS</b>	
a)	Make	
b)	Material and type	
c)	Surface Treatment of steel clamps	
d)	Minimum thickness of Galvanization	
<b>9</b>	Nylon self locking tie strips	
a)	Width (mm)	
b)	Tensile Strength (kg)	
<b>10</b>	<b>STRIP CLAMPS</b>	
a)	Make	
b)	Material and type	
c)	Surface Treatment of steel clamps	
d)	Minimum thickness of Galvanization	
<b>11</b>	<b>FIRE STOP SEAL SYSTEM</b>	
a)	Make & Place of manufacture	
b)	Type	
c)	Fire rating	
d)	Applicable standards for testing	
e)	Type of system	
f)	Fire rating	
g)	Major Components of sealing system	



**2.13 HT Motors**  
(To be furnished for each rating of Motor)

Sl.No.	Description	Unit	11kV motor
1.	Make and place of manufacture		
2.	Application		
3.	Type of motor		
4.	Frame size		
5.	Required BKW rating of the driven equipment	kW	
6.	Design margin considered	%	
7.	Rated continuous output of motor at 50°C ambient	kW	
8.	Starting current at rated voltage	% of FLC	
9.	No. of hot / cold starts		
10.	Degree of protection of enclosure		
11.	Method of cooling		
12.	Insulation class		
13.	Temperature rise over 50°C ambient. (by resistance)	°C	
14.	Motor terminal box		
	• Type		
	• Fault withstand current and time		

**2.14 LT Motors**  
(To be furnished for each rating of Motor)

Sl.No.	Description	Specified Data	Details by Bidder
1.	Make and place of manufacture		
2.	Application		
3.	Quantity		
4.	Type of motor	Squirrel cage	
5.	Duty	S1	
6.	Applicable standard	IS:325	



SI.No.	Description	Specified Data	Details by Bidder
7.	Frame size		
8.	Required BKW rating of the driven equipment	....kW	
9.	Design margin considered	Minimum 10%	
10.	Rated continuous output of motor at 50°C ambient	.....kW	
11.	Rated voltage and frequency	415V, 50Hz	
12.	Full load current	.... Amps	
13.	Efficiency at 100% load	%	
14.	Energy efficient rating		
15.	Type of starting	DOL	
16.	No. of hot / cold starts	3/2	
17.	Degree of protection of enclosure	IP55	
18.	Method of cooling	TEFC	
19.	Insulation class	F	
20.	Temperature rise over 50°C ambient. (by resistance)	70°C	
21.	Electric Actuator		
	• Make		
	• Type (with integral starter)		
	• Model no.		
	• Rating		

## 2.15 AMF (Auto-On Mains Failure) Panel

Sl. No.	Description	Units	Data
1.	<b>General</b>		
2.	Make		
3.	Type		
4.	Reference standard		



Sl. No.	Description	Units	Data
5.	Overall dimension		
6.	Degree of protection		
7.	Type & Thickness of sheet metal used		
8.	<b>Rating</b>		
a)	Voltage	V	
b)	Current rating		
c)	Short circuit withstand current rating for 1 sec	kA	
d)	Peak withstand current rating	kAp	
9.	<b>Busbar</b>		
a)	Material & grade		
b)	Bus bar size	mm x mm	
c)	Continuous Current rating at 50 deg C ambient.		
d)	Maximum temperature rise over design ambient temperate of 50° C - at busbar - at joints	° C	
10.	<b>Current Transformer</b>		
a)	Make		
b)	Type		
c)	Rating		
d)	CT ratio, VA burden & Accuracy class		
11.	<b>Voltage Transformer</b>		
a)	Make		
b)	Type		
c)	Rating	V	
d)	Voltage ratio, VA burden & Accuracy class		
12.	<b>Relays</b>		



<b>Sl. No.</b>	<b>Description</b>	<b>Units</b>	<b>Data</b>
a)	Make & type of each relay		
b)	List of protections provided		
13.	<b>Switches</b>		
a)	List of control switches provided		
14.	<b>Meters</b>		
a)	List of meters provided		
15.	<b>Indications</b>		
a)	List of indication lamps provided		
16.	<b>Alarms/Annunciation</b>		
a)	List of alarms provided		
17.	<b>ACB</b>		
a)	Make		
b)	Type & Model no.		
c)	Current rating		
d)	No.of poles		
e)	Short-time withstand current for 1 sec.	kA	
f)	Peak withstand current	kAp	
18.	<b>Painting</b>		
a)	Inside shade		
b)	Outside shade		
c)	Paint thickness	Microns	

**SIGNATURE** \_\_\_\_\_  
**OF BIDDER**

**NAME** \_\_\_\_\_

**SEAL OF THE COMPANY**

**DESIGNATION** \_\_\_\_\_

**COMPANY** \_\_\_\_\_

**DATE** \_\_\_\_\_



**SCHEDULE – 4**  
**DEVIATION SCHEDULE TO COMMERCIAL SPECIFICATION**

[ REFER VOLUME-1, ATTACHMENT-4.0 ]



**SCHEDULE – 5**  
**DEVIATION SCHEDULE TO TECHNICAL SPECIFICATION**

[ REFER VOLUME-1, ATTACHMENT-4.0 ]



**SCHEDULE – 6**  
**SCHEDULE OF SUB-VENDORS / SUB-CONTRACTORS LIST**

Sl. No.	Equipment/Item	Sub Vendor/Sub Contractor	Place	Experience Details

**SIGNATURE  
OF BIDDER** \_\_\_\_\_

**NAME** \_\_\_\_\_

**SEAL OF THE COMPANY**

**DESIGNATION** \_\_\_\_\_

**COMPANY** \_\_\_\_\_

**DATE** \_\_\_\_\_



SCHEDULE – 7  
QUALITY ASSURANCE PLAN

Sl. No.	Component	Characteristic Checked	Classifi- Ction	Type of Check	Quantu m of Check	Reference Document s	Acceptanc e Norm	Format of Record	Inspection By			Remarks
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11

LEGENDS : P- PERFORMANCE, W-WITNESS, V-VERIFY, 1-CONSULTANT, 2-VENDOR, 3-OWNER



Rajasthan Rajya Vidyut Utpadan Nigam Ltd  
1x210 MW KSTPS Kota (Unit- 5)

Technical Specification for  
Cooling Water System

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**SCHEDULE – 8**  
**DETAILS OF SIMILAR WORKS DONE DURING PAST FIVE YEARS**  
[ REFER VOLUME-1, ATTACHMENT-4.0 ]



## SCHEDULE – 9

### CONCURRENT COMMITMENTS OF THE BIDDER

[ REFER VOLUME-1, ATTACHMENT-4.0 ]



**SCHEDULE – 10**

**UTILITY CONSUMPTION LIST**

Sl. No.	System / Equipment	Quantity	Quantity per Operation Mode		Electricity (KW)		Cooling Water (M3/HR) kg/cm <sup>2</sup> (g)		Clarified Water (M3/HR) kg/cm <sup>2</sup> (g)	
			C	I	C	I	C	I	C	I

C – Continuous

I – Intermittent

T – Operating Hours per 24 Hours

**SIGNATURE  
OF BIDDER  
NAME** \_\_\_\_\_  
\_\_\_\_\_

**DESIGNATION** \_\_\_\_\_

**COMPANY** \_\_\_\_\_

**DATE** \_\_\_\_\_

**SEAL OF THE COMPANY**



**SCHEDULE – 11**

**LUBRICANTS LIST**

ITEM NO.					EQUIPMENT						
Sl. No.	GRADE	MAKER'S BRAND				Initial Charge (L/SET)	Replacement Charge		Make-Up		Location To Be Used
		CALTE X	MOBIL E	ESSO	SHELL		Quantity (L/Set)	Interval	Quantity	Interval	

**SIGNATURE  
OF BIDDER** \_\_\_\_\_

**NAME** \_\_\_\_\_

**DESIGNATION** \_\_\_\_\_

**COMPANY** \_\_\_\_\_

**DATE** \_\_\_\_\_

**SEAL OF THE COMPANY**



## SCHEDULE – 12

### OVERALL TIME SCHEDULE

[ REFER VOLUME-1, ATTACHMENT-4.0 ]



## SCHEDULE – 13

### REQUIREMENTS OF THE CONTRACTOR AT SITE

[ REFER VOLUME-1, ATTACHMENT-4.0 ]



**SCHEDULE – 14**

**CONTRACTOR'S RESOURCE DEPLOYMENT SCHEDULE**

[ REFER VOLUME-1, ATTACHMENT-4.0 ]



SCHEDULE – 15

## SCHEDULE OF WEIGHTS AND DIMENSIONS

The BIDDER shall state hereunder the weights and dimensions of various packages for shipment comprising the complete scope.

**SIGNATURE  
OF BIDDER**

**NAME**

## **SEAL OF THE COMPANY**

## **DESIGNATION**

## COMPANY

## DATE



## SCHEDULE – 16

### SCHEDULE OF PLACES OF TEST AND INSPECTION

The Bidder shall indicate the item of Equipment to be supplied, name of the Manufacturer or Sub-Contractor and place of test and inspection as shown below:

Item of Equipment	Manufacturer/Sub-Contractor	Place of test and Inspection
1	2	3

---

**SIGNATURE** \_\_\_\_\_

**OF BIDDER  
NAME** \_\_\_\_\_

**SEAL OF THE COMPANY**

**DESIGNATION** \_\_\_\_\_

**COMPANY** \_\_\_\_\_

**DATE** \_\_\_\_\_



## SCHEDULE – 17

### SCHEDULE OF RECOMMENDED SPARES

[ REFER VOLUME-1, ATTACHMENT-4.0 ]



## SCHEDULE – 18

### SCHEDULE OF MAINTENANCE TOOLS AND TACKLES

[ REFER VOLUME-1, ATTACHMENT-4.0 ]



**SCHEDULE – 19**

**CHECK LIST**

[ REFER VOLUME-1, ATTACHMENT-4.0 ]



# **RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD**

## **Cooling Water System Package for Kota Super Thermal Power Station Unit # 5 (1 x 210 MW) Kota, Rajasthan, India**

[ Doc. No. . FCE-1117155-ME-DOC-SPC-3000-033]

### **VOLUME II ATTACHMENTS**

**FICHTNER Consulting Engineers (India) Private Limited**  
Chennai, Bengaluru, India



## INDEX

VOLUME	SECTION	TITLE
I	COMMERCIAL & GENERAL CONDITIONS	
	1.0	INVITATION FOR BIDS (IFB)
	2.0	INSTRUCTIONS TO BIDDERS (ITB)
	3.0	GENERAL CONDITIONS OF CONTRACT (GCC)
	4.0	SPECIAL CONDITIONS OF CONTRACT (SCC)
	5.0	ERCTION & COMMISSIONING CONDITIONS OF THE CONTRACT (ECC)
	6.0	BID DATA SHEET (BDS)
	7.0	FORMS AND SCHEDULES (FS)
II	TECHNICAL SPECIFICATION	
	1.0	GENERAL TECHNICAL SPECIFICATION
	2.0	DETAILED TECHNICAL SPECIFICATION - MECHANICAL
	3.0	DETAILED TECHNICAL SPECIFICATION - ELECTRICAL
	4.0	DETAILED TECHNICAL SPECIFICATION - CONTROL & INSTRUMENTATION
	5.0	DETAILED TECHNICAL SPECIFICATION - CIVIL
	6.0	TENDER DRAWINGS
	7.0	SCHEDULES
ATTACHMENTS TO TENDER DOCUMENT		



## VOLUME II

### ATTACHMENTS

#### LIST OF ATTACHMENTS

1. Soil Investigation Report
2. GA & Data Sheet for Condenser - Unit#5
3. Data Sheet for Plate Heat Exchanger - Unit#5
4. Capacity of Crane in Unit#6 Cooling Water Pump house
5. Condenser GA - Unit#5
6. Technical Specification of CW & ACW Pumps - Unit#6
7. Composite Water Scheme - Unit#5
8. Circulating Water System - Unit#5
9. CW Pump House Layout of Foundation & Forebay - Unit#6
10. Raw Water, CT Make-up, Sludge Transfer, CW Drain & CT Blowdown Isometric
11. Circulating Water System (Flow Diagram) Unit 6
12. C.W. Pump House And Piping Unit 6
13. P & ID- CW System Unit # 7
14. Piping & Pipe support GA PTP Unit 7
15. Cooling Water - Isometric Unit 7
16. P & I Drawing of corrosion inhibitor & anti-scalant system Unit 7
17. P & I Drawing of 2 x 80 KgHr C.W. Chlorination System Unit # 7
18. P & I Diagram for 2X75 KgHr C.W. Chlorination System Unit 6
19. P & I Drawing of Acid storage system Unit 7
20. P & I Drawing of Leak absorption system Unit # 7
21. Front & Back view of store shed at KSTPS
22. Order No. 25-11/6/2018-PG, dated 02/07/2020, issued by Ministry of Power, Government of India
23. Reference drawing - Additional existing drawings for Coupler, Incomer, Motors of Unit-7 and details of existing CW & ACW Pumps of Unit-6

To : C E (CIVIL) RVUN, JAIPUR



ORIENTAL CONSULTING ENGINEERS

04

Table No.

Site : Soil investigation for 1 x 105 MW Unit - VII of Kota Thermal Power Station. Location: T.G. Area Client : M/s. Rajasthan Rajya Vidyal Utpadhan Nigam Ltd. Casing : 100/125 mm						1000-1624 L.C.O.	3			
Depth (m)	Casing (m)	Blk/ mm	Log	Soil/Rock Description	Sample No.	SPT	Soil Type		Water Table Depth (m)	Total Thickness (m)
							15	30		
							60	100		
0.0	0.85	8.85		Reddish Yellow Soil with Gravel	105-1	0.00-0.30				
					105-1	0.30-0.80	25	50	75	100
1.0					SPT-1	0.85-0.95				
2.0					1-4	0.88-1.15				
3.0					5-9	1.85-2.15				
4.0					10-18	2.05-3.05				
5.0					19-32	3.85-5.45				
6.0	14.30			Fine grained Crystalline Pink Fresh Ferruginous Quartzite	33-49	5.45-7.00				
7.0					50-67	7.05-8.65				
8.0					68-85	8.65-10.15				
9.0					86-98	10.15-11.65				
10.0					99-100	11.65-13.25				
11.0					101-106	13.25-14.50				
12.0					107-118	14.50-15.15				
13.0				Bore hole is terminated at a depth of 15.15 m below G.L.						

105 = Disturbed Sample

WS

Wash Sample

X - Y - Z - Rock Phase No.

107 = Undisturbed Sample

SPT

Standard Penetration Test



### Carib-Edo





## 5.8 ROCK TEST ANALYSIS:

Rock samples were collected from the bore holes and tested in laboratory. The results are given in Table - 22

TABLE - 22  
ROCK TEST ANALYSIS

Sr.N No	BH. No.	Sample No.	Depth (m)	Specific Gravity	Dry Density (gm/cc)	Compressive Strength (Kg/cm <sup>2</sup> )
1	BH - 1	15	3.75	2.89	2.67	294.76
2		25	5.00	2.91	2.69	346.17
3		48	7.00	2.93	2.77	412.75
4		98	12.95	2.96	2.75	489.79
5	BH - 2	9	1.50	2.87	2.66	215.77
6		15	2.55	2.92	2.71	389.11
7		29	3.95	2.94	2.74	415.43
8		33	6.15	2.97	2.76	516.22
9		49	7.00	3.02	2.80	749.01
10	BH - 3	12	2.60	2.89	2.67	298.15
11		14	3.15	2.91	2.72	356.49
12		31	5.80	2.96	2.75	398.12
13		37	7.45	2.99	2.77	541.23
14		43	9.10	3.24	2.88	1245.23
15	BH - 4	12	2.15	2.86	2.69	308.49
16		21	2.90	2.89	2.73	399.12
17		30	4.00	2.93	2.78	416.32
18		42	6.15	2.97	2.80	452.44
19		53	7.45	3.02	2.83	498.15
20		58	9.30	3.10	2.85	949.37
21	BH - 5	6	1.00	2.89	2.67	278.65
22		20	2.45	2.94	2.69	345.62
23		31	4.15	2.96	2.72	399.87
24		48	6.25	3.01	2.75	515.62
25		69	10.45	3.07	2.80	718.94
26	BH - 6	10	2.00	2.91	2.69	312.05
27		27	4.15	2.95	2.71	349.66
28		40	5.35	2.98	2.75	414.87
29		63	8.00	3.04	2.79	469.95
30		84	10.55	3.08	2.83	675.41
31	BH - 7	19	3.00	2.85	2.66	288.15
32		43	6.15	2.91	2.71	315.99
33		70	9.25	2.94	2.75	359.17
34		83	12.25	2.98	2.79	418.32
35		93	15.20	3.09	2.83	649.54





## 6.0 Summary Recommendations:

From the borelogs shown in Table No. 1 to 12, it is observed that there are two horizons at proposed Thermal Power Project at Kota.

First horizon observed is Brownish to Yellowish Soil. The thickness of this layer varies from 0.23 m to 0.80 m except from BH-11 & BH-12 where Filled up Soil with Boulders is observed at the G.L. The N value observed in this horizon is more than 50.

The safe bearing capacity is determined with  $N = 50$  at a depth of 1.00 m below the G.L. The width of foundation is not known, therefore the  $B = 2.0$  is considered for calculation purpose.

$$N = 50, N' = 32.50, \phi = 37^\circ, \phi' = 26^\circ, N_c = 55.63, N_q = 42.92, N_f = 66.19, \gamma = 1.549 \text{ kN/m}^3$$

$$B = 2.00 \text{ m}, D = 1.00 \text{ m}$$

$$UBC = c N_c S_c d_c i_c + q(N_c - 1) s_q d_q i_q + \frac{1}{2} B \cdot r \cdot N_f S_f d_f i_f W$$

$$S_c = 1.3 \text{ considering square foundation. } S_q = 1.2, S_f = 0.8, W = 0.5$$

$$D_c = 1 + 0.2 D_f / B \cdot N \phi = 1.480$$

$$\sqrt{N \phi} = 1.60 \quad i_c = i_q = i_f = \text{considered as 1.}$$

$$D_q = d_f = 1 + 0.1 D_f / B \sqrt{N \phi} = 1.24$$

$$UBC = 0.549 \times 1.0 \times 42.92 \times 1.2 \times 1.24 \times 1.0 + 0.5 \times 2.0 \times 0.549 \times 66.19 \times 0.8 \times 1.24 \times 1 \times 0.5$$

$$UBC = 53.09 \text{ T/m}^2$$

$$SBC = 17.70 \text{ T/m}^2 = 1.770 \text{ Kg/cm}^2$$

As per IS-8009 pt I, settlement for  $N = 50, B = 2.0 = 4.7 \times 10^{-3} \times q \text{ m}$

Settlement =  $0.022 \text{ m} = 2.2 \text{ cm} = 22 \text{ mm}$

The settlement is less than permissible settlement of 40 mm. However the SBC of 15 T/m<sup>2</sup> is recommended for foundations about 1.0 m below G.L.





Second horizon observed is Fine Grained Crystalline Pink Fresh Ferruginous Quartzite. The core recovery of the rock mass varied from 28.00% to 100.00% and RQD varies from NIL to 100.00 %. The compressive strength of the rock mass varies from 278.65 Kg/cm<sup>2</sup> to 1245.23 Kg/cm<sup>2</sup>. The minimum of observed compressive strength of rock mass is considered for determination of the safe bearing capacity.

$$SBC = qa \times 0.1 = 278.65 \times 0.1 = 27.865 \text{ kg/cm}^2 = 278.65 \text{ T/m}^2$$

The safe bearing capacity of Fine Grained Crystalline Pink Fresh Ferruginous Quartzite mass is recommended as 275.00 T/m<sup>2</sup> at a depth of 1.50 m below the ground level.



Regd. Office & H.O: Vidyut Bhawan, Janpath, Jyoti Nagar, Jaipur-302005  
KOTA SUPER THERMAL POWER STATION  
OFFICE OF THE SUPERINTENDING ENGINEER (CAM)  
0744-2370414, 2370061 (FAX) E- MAIL: [secamktps@gmail.com](mailto:secamktps@gmail.com)

NO. RVUN / KSTPS / SE (CAM) / F. / D- 1121

Date 26/3/19

The Superintending Engineer (CHP-OPR/R&M)  
KSTPS, RVUN, Kota

Sub:- Cooling Tower Installation in Unit #5 KTPS, Kota

Ref:- Mail from The Chief Engineer ( Civil – Environment ), Jaipur on dt 19.09.2019

In above cited subject, please find attached drawings as desired for further needful.

S.N.	Drawing.	-
1	GA & Data sheet for Condenser for Unit #5	
2	Data sheet for plant heat exchanger for Unit #5	
3	Capacity of Crane in Unit#6 . Cooling Water Pump house	25/ 5 Ton E. O.T and 5 ton & 3 Ton Underslung E.O.T Cranes.

Encl:- As above.

  
Superintending Engineer (CAM)  
KSTPS, RVUN, Kota

Copy Submitted to the following for kind perusal

1. Chief Engineer, KSTPS, RVUN, Kota.

  
Superintending Engineer (CAM)  
KSTPS, RVUN, Kota  


## 1.1.2 FITTINGS

Following fittings have been provided on the condenser are as follows:

- (a) Level indicators for hotwell and water boxes
- (b) Level switches with isolating valves
- (c) Two nos. stand pipes with a provision for isolation and draining
- (d) Vent and drain valves for water boxes.

## 1.2 DATA SHEET FOR CONDENSER

Sl. No.	Description	Data	Values
(i)	Design C.W. Temperature	°C	33.0
(ii)	C.W. Temperature rise	°C	8.76
(iii)	Back pressure	mm HgC	76.0
(iv)	C.W. Flow quantity	cub.M/hr	27000
(v)	C.W. side press. drop	MWC	4.5
(vi)	No. of C.W. pass	-	2
(vii)	No. of tubes:		
	(a) Condenser zone		17296
	(b) A/C zone		1922
(viii)	Tube Dimensions		
	(a) Tube OD x thickness	mm x mm	25.4 x 1.00
	(b) Ordering length	mm	7600
(ix)	Tube material:		
	(a) Condensing zone		90-10/Cu-Ni
	(b) A/C zone		90-10/Cu-Ni
(x)	Percentage tube thinning		7-10%
(xi)	W/box design pressure	kg/cm <sup>2</sup>	3.5
(xii)	W/box hydraulic test pr.	kg/cm <sup>2</sup>	4.5

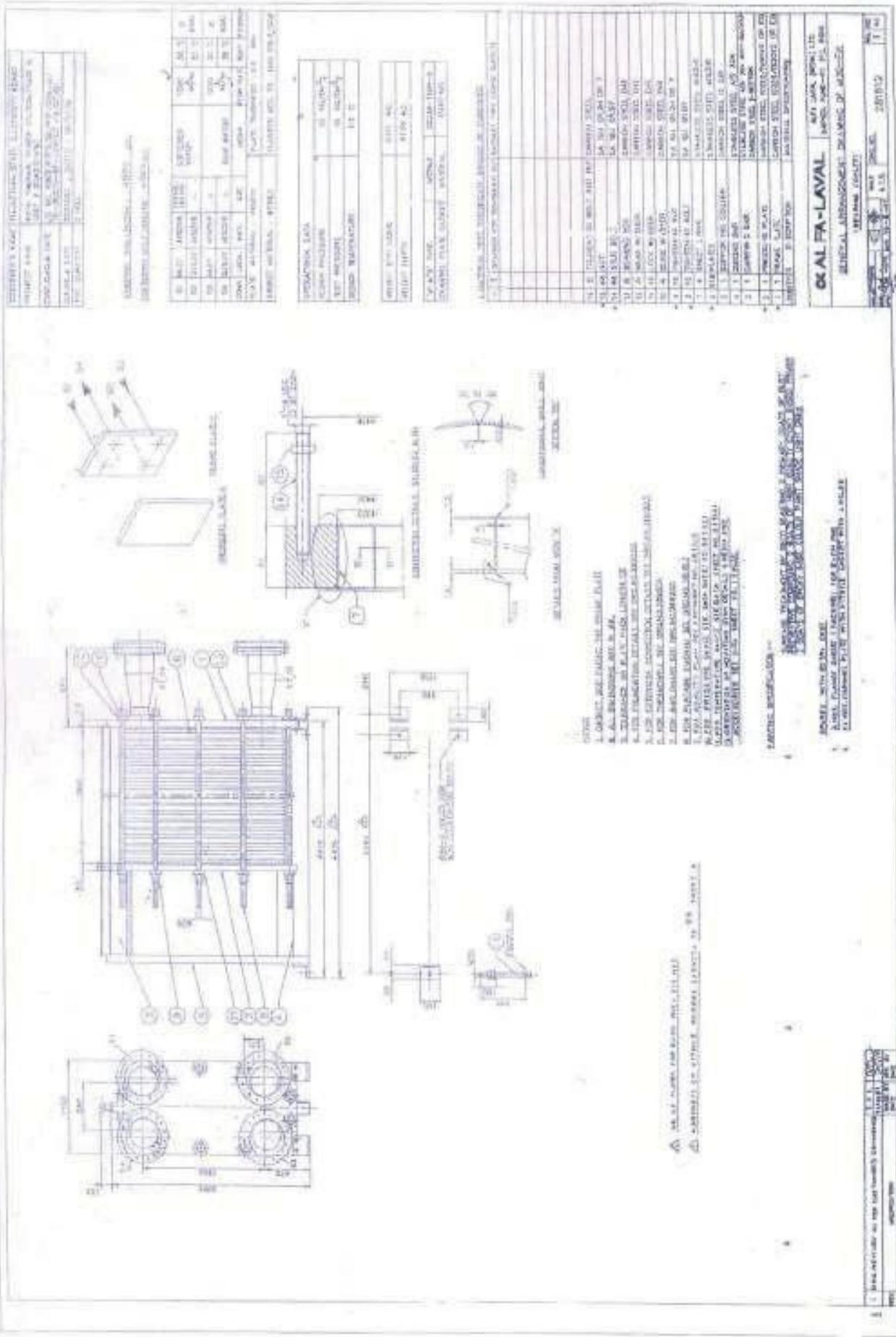
## 1.12 FITTINGS

Following fittings have been provided on the condenser are as follows:

- (a) Level indicators for hotwell and water boxes
- (b) Level switches with isolating valves
- (c) Two nos. stand pipes with a provision for isolation and draining.
- (d) Vent and drain valves for water boxes.

## 1.2 DATA SHEET FOR CONDENSER

Sl. No.	Description	Data	Values
(i)	Design C.W. Temperature	°C	33.0
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(iii)	Back pressure:	mm HgC	76.0
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(v)	C.W. side press. drop	MWC	4.5
(vi)	No. of C.W. pass	-	2
(vii)	No. of tubes:		
	(a) Condenser zone		17296
	(b) A/C zone		1922
(viii)	Tube Dimensions		
	(a) Tube OD x thickness	mm x mm	25.4 x 1.00
	(b) Ordering length	mm	7500
(ix)	Tube material		
	(a) Condensing zone		90-10/Cu-Ni
	(b) A/C zone		90-10/Cu-Ni
(x)	Percentage tube thinning		7-10%
(xi)	W/box design pressure	kg/cm <sup>2</sup>	3.5
(xii)	W/box hydraulic test pr.	kg/cm <sup>2</sup>	4.5

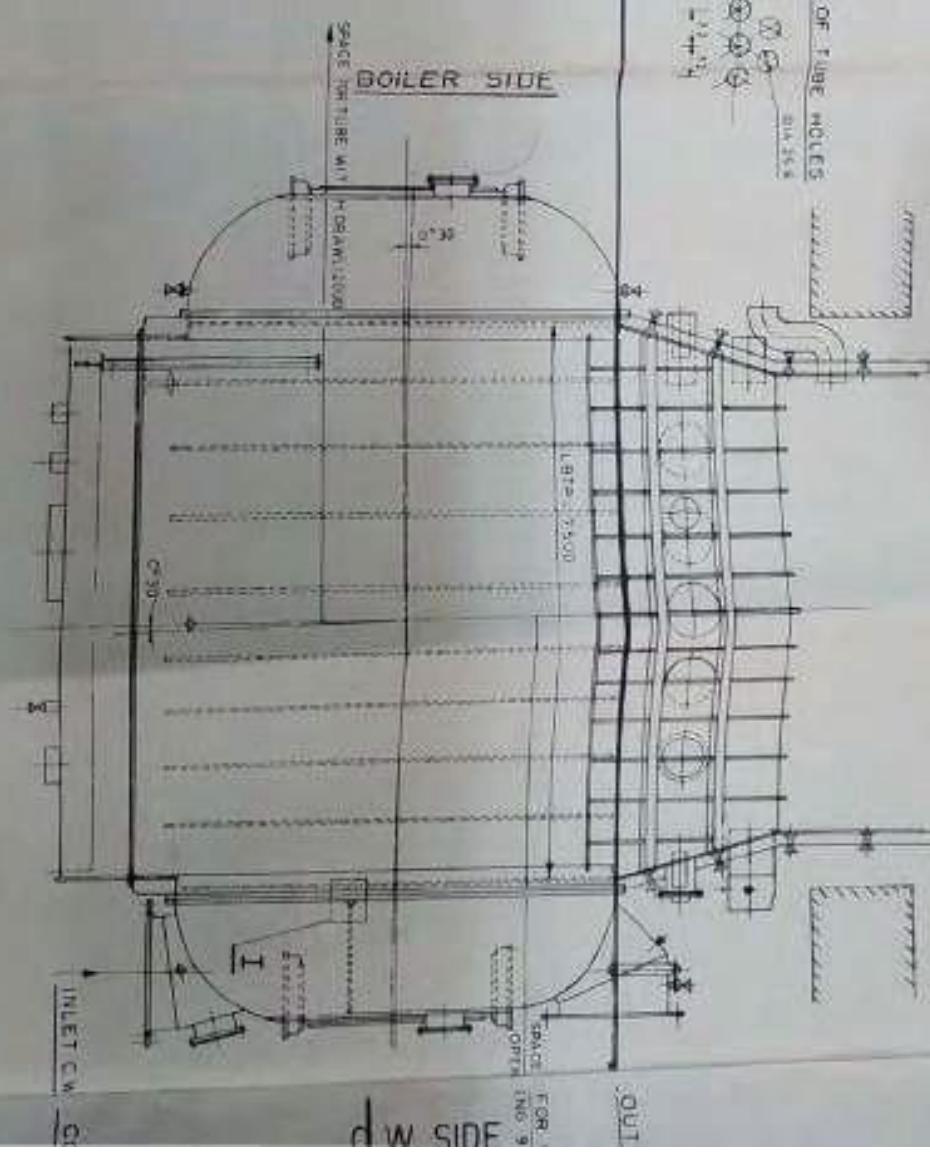
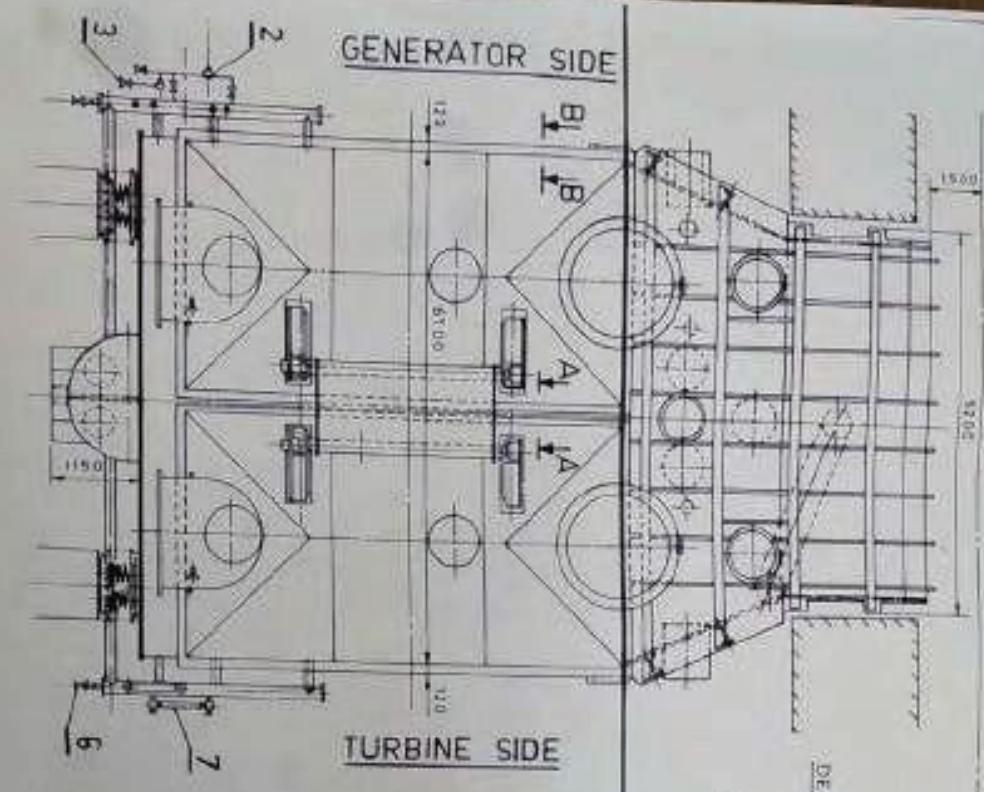


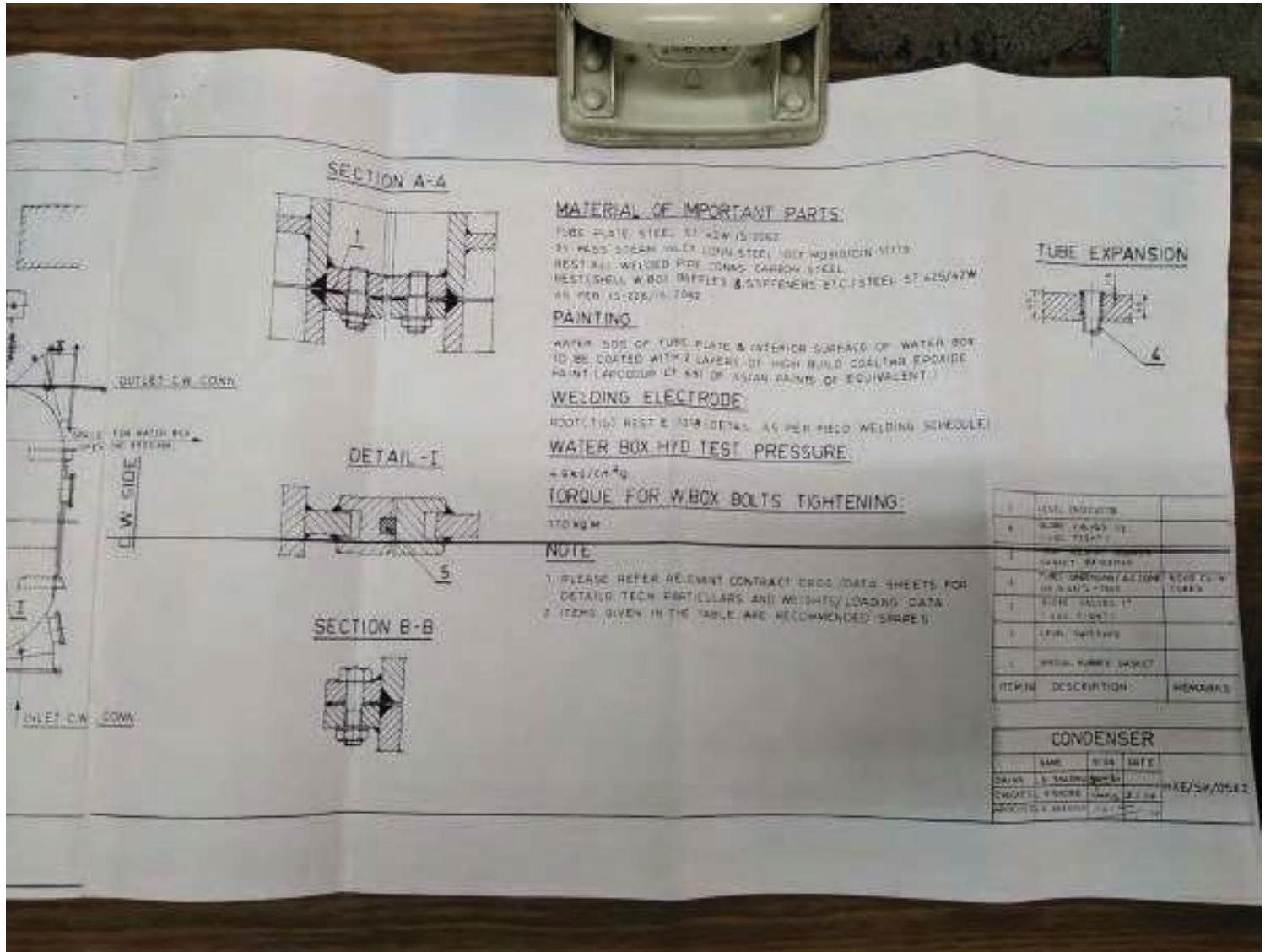
## **OPERATION & MAINTENANCE MANUAL**

ROCKWELL E. D. T. CRANES

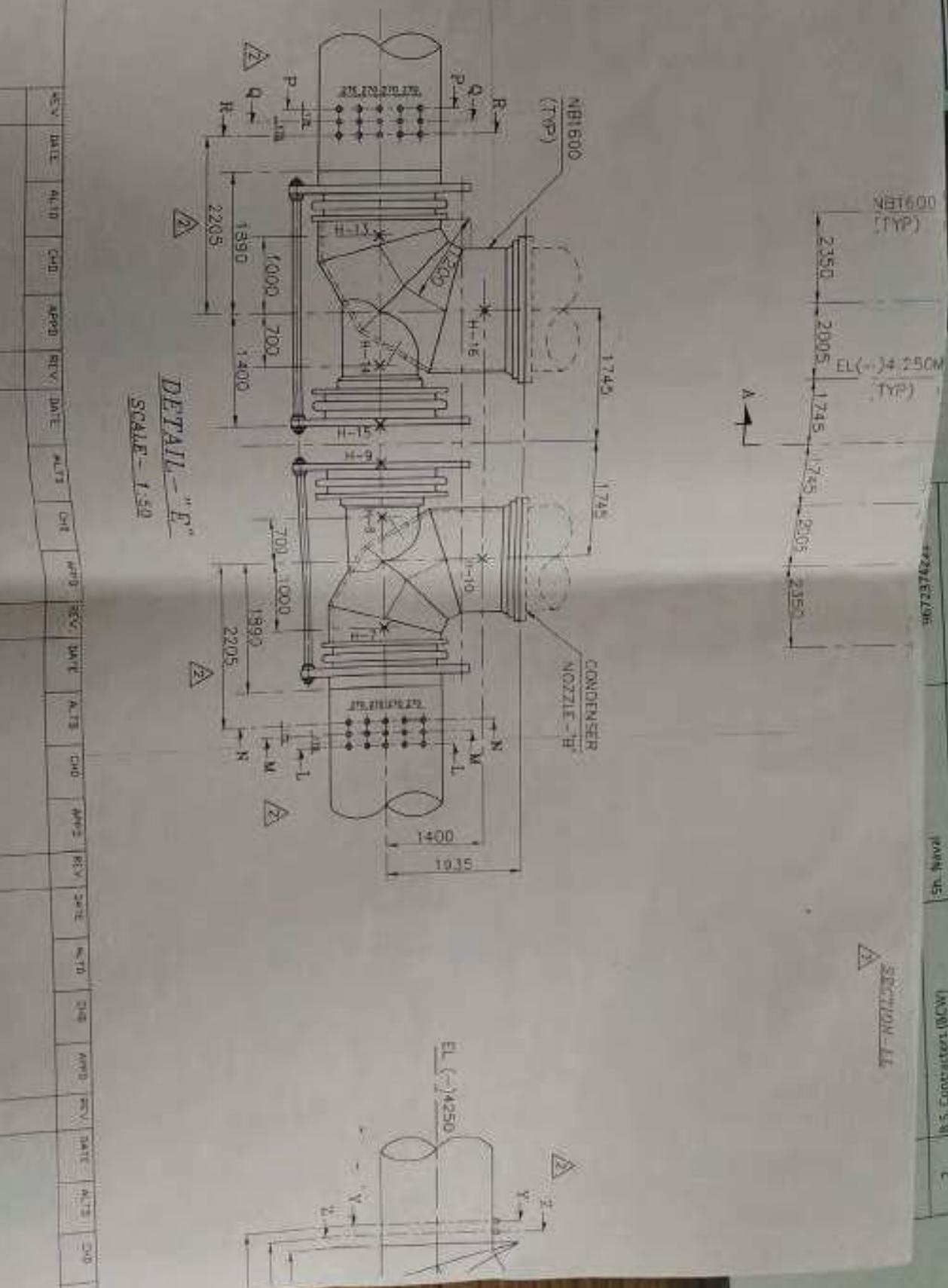
<b>CAPACITY</b>	2.5/3 Ton E.O.T and 5Ton & 3 Ton Counterbalance E.O.T Cranes.
<b>QTY.</b>	3 Nos.
<b>SUPPLIED TO</b>	Govt Executive Engineer (Guru Nanak Dev University) STPS, Kois (Ra)
<b>ORDER REF.</b>	PANJU/SPTD-EXENT/2002 41202394 on 25/08/2002
<b>YEAR OF MFG.</b>	2002
<b>DESIGNED &amp; MANUFACTURED BY</b>	ROCKWELL HOISTS CRANES PVT LTD.
<b>FACTORY</b>	<b>REGD. OFFICE</b>
69/10/2, NEEL WAL ROAD, TIKRI KALAN DELHI - 110 041.	412, SUNBHA TOWER B, DISTRICT CENTRE, JANAK PURI NEW DELHI-110 058.
TEL : 011 - 28352047, 28352282	TEL : 28551201, 2854997
E-MAIL :- <a href="mailto:rocky.affairs2001@rediffmail.com">rocky.affairs2001@rediffmail.com</a>	

CYL OF TURBINE





CW-LAYOUT(R3) LATEST



SECTION - PP

SECTION-VI

SECTION-CC

This technical drawing shows a cross-section of a building's foundation and superstructure. The vertical axis is labeled with elevation levels: EL (-) 600 at the top, followed by 1650, 100, and 850. Horizontal dimensions include 3075 on the left, 1650 above the central column, and 600 on the far left. A central vertical column is labeled K10THK. A horizontal beam is labeled FK. A large bracket on the left indicates a height of 1000. A small vertical dimension of 100 is shown near the bottom right. A legend at the bottom right identifies symbols for concrete (C), steel (S), and rebar (R).

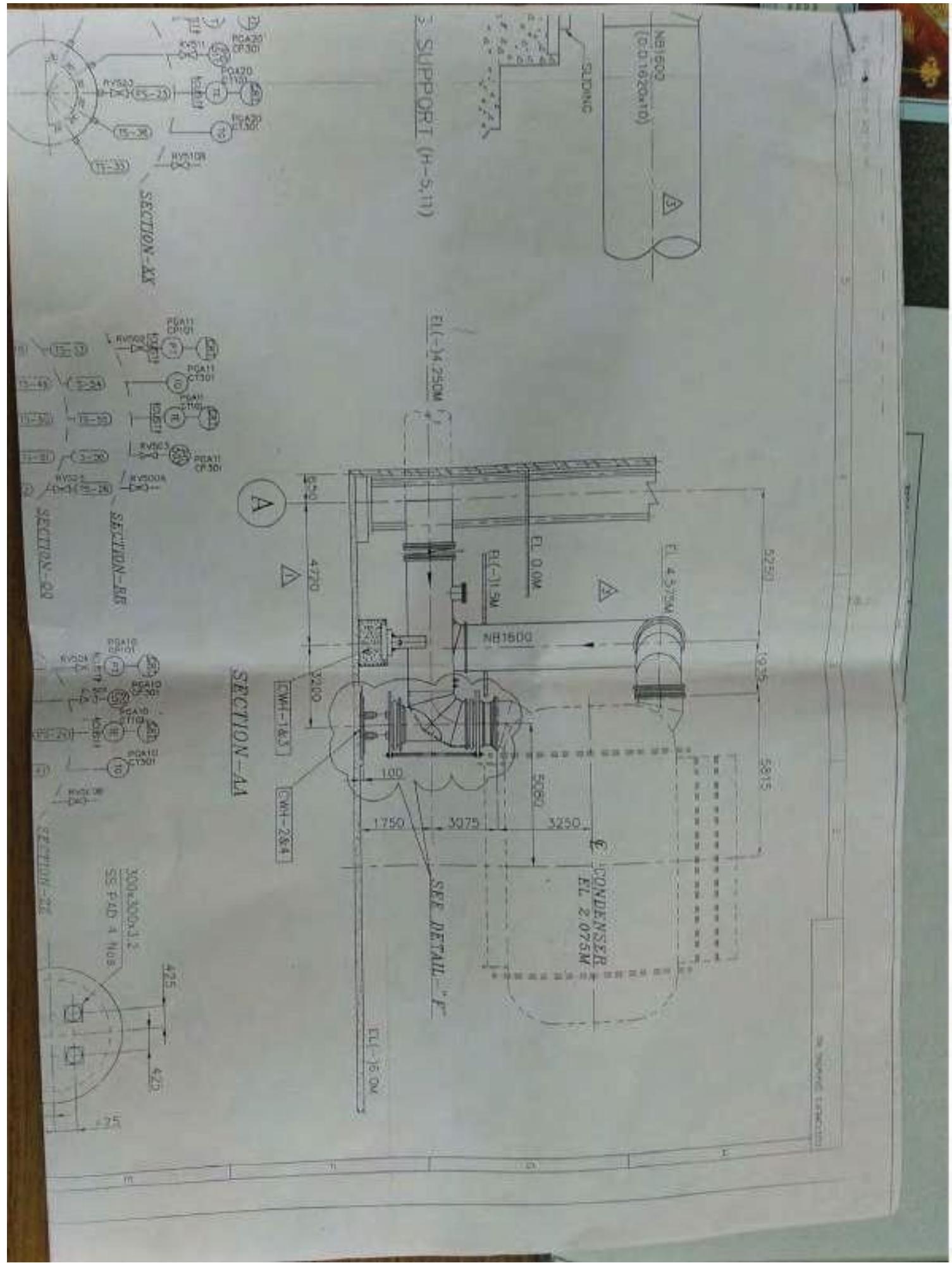
DETAILS - "F"  
SCALE - 1:50

REF ID: GSI-  
1

- 1 G.A. OF CONDENSER
  - 2 SITE LAYOUT AT 110' O.D.
  - 3 SITE LAYOUT AT 114' 5W
  - 4 E&I DRAWDINGS, WATER SYSTEM

**RAJASTHAN RAJYA VIDYUT UT PADAN NIGAM LIMITED**  
**KOTA THERMAL POWER STATION**  
 $1 \times 125 \text{ MW}$  (UNIT-6 STAGE-IV)

## ELEVATING WATER PIPING LAYOUT (STG-HALL)





## RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD.

Corporate Identity Number (CIN) - U40102RJ2005GCD16484  
Regd. Office & H.O.: Vidyut Bhawan, Janpath, Jyoti Nagar, Jaipur - 302005

### OFFICE OF THE SUPERINTENDING ENGINEER (R&M) KOTA SUPER THERMAL POWER STATION

Email: [mebip@gmail.com](mailto:mebip@gmail.com) Web Site: [www.rvunl.com](http://www.rvunl.com)

No. RVUNL/KSTPS/ SE(R&M)/ F. /D. 33

Dated : 15./04./2019

*(Signature)*  
The Chief Engineer (Civil-Environment),  
Rajasthan Rajya Vidyut Utpadan Nigam Ltd.,  
Vidyut Bhawan, Janpath, Jyoti Nagar,  
Jaipur-302005.

Subject: Comments on Technical Specifications of ETP & CW System for KSTPS, Kota.

Reference: Your email dated 01.03.2019

In continuation to our letter No. RVUNL/CE(KSTPS)/SE(R&M)/D.23 dated 11.04.2019, the comments of Sr.No.16 is modified as under:-

1. In existing CW Pump House of Unit # 6, the foundation of CW & ACW Pumps are as under:  
(a) CW Pumps - 02 Nos.  
(b) ACW Pumps - 02 Nos.
2. Identical types of CW and ACW Pumps should be supplied by the bidder, so that interchangeability and inventory will be reduced. The technical specification of CW & ACW Pumps alongwith motor etc. is enclosed as Annexure-I.
3. The performance of existing Cooling Tower of Unit # 6 is not upto the marks.

Therefore, bidder may be advised to take performance margin in Cooling Tower of Unit # 5.

*Ravinder S*  
15.4.19

(R.N. Gupta)

Superintending Engineer (R&M)  
KSTPS, RVUNL, Kota.

Copy submitted/forwarded to the following for information and necessary action please:-

1. The Chief Engineer (KSTPS), RVUNL, Kota.
2. The Addl.Chief Engineer (O&M), KSTPS, RVUNL, Kota.
3. The Dy. Chief Engineer (Mech. Maint./FH), KSTPS, RVUNL, Kota.
4. The Superintending Eningeer (Civil/EM/CA/C&I/Comm.), KSTPS, RVUNL, Kota.

*Ravinder S*  
15.4.19  
Superintending Engineer (R&M)  
KSTPS, RVUNL, Kota.

SPECIFICATION OF CW Pump Unit =6

<u>CW PUMP</u>		<u>Installed Qty</u>	<u>Required</u>
Make	KBL, Pune	3 NOS. (2R+1S)	2 Nos
Type	Vertical Turbine		
Model No.	BHQ-92 Single Stage		
Head in MWC	25		
Discharge M3/Hr.	16000		
SPEED	475 RPM		
Bearing Nos.	Tilted Pad Type		
Pump eff.	90.50%		

CW MOTOR

Make	CGL
FRAMe	VTPC 1700
Rating	1500.00 KW
Voltage	6600 V
Current	164 Amp/
Speed	495
Eff.	96.6

SPECIFICATION OF ACW Pump Unit =6ACW PUMP

Make	KBL, Pune	2 NOS. (1R+1S)	2 Nos
Type	Vertical Turbine		
Model No.	BHR-70M Single Stage		
Head in MWC	55		
Discharge M3/Hr.	3000		
SPEED	949 RPM		

ACW MOTOR

Make	CGL
FRAMe	VTPC 940
Rating	635 KW
Voltage	6600 V
Current	67 Amp/
Speed	989 RPM

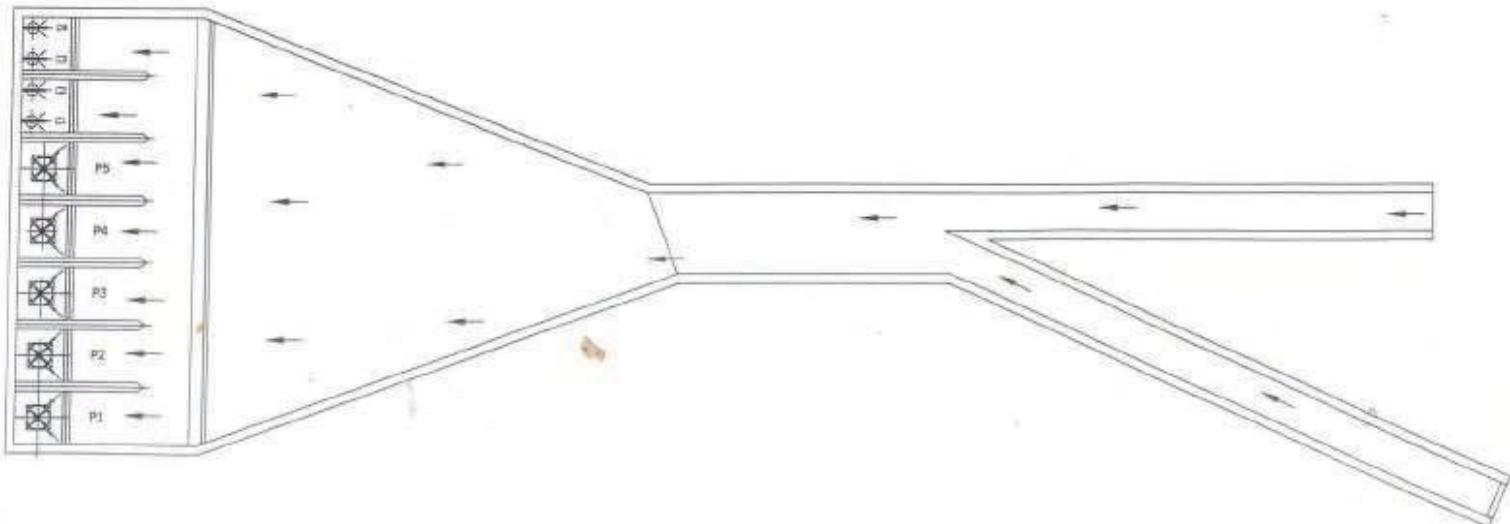
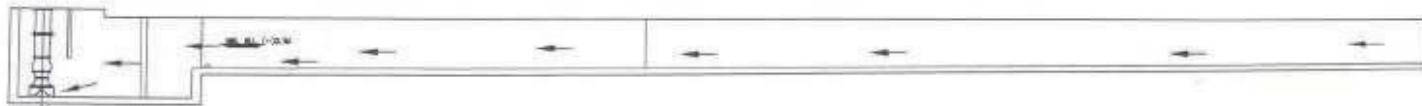
A  
SE(CAM)B  
XEN(ESP)Roshni  
XEN(CAM)

	1600 MM, Electrically operated Butterfly valve Fouress make for each CW pump
Discharge valve	700 MM , Electrically operated Butterfly valve Fouress make for each ACW Pump
Rubber Expansion Joint	D ; wren , Make Rejs. For each pump required.
Inter connection B. F valve for CW of UNIT =5 and 6	Size :- 1600 MM for CW PUMP and 700 MM for ACW PUMP
Inter connection B. F valve for ACW of UNIT =5 and 6	Electrically operated Butterfly valve Fouress Make required.
	Electrically operated Butterfly valve Fouress Make required

  
 B  
 XEPILBEP  
SEC(OM)

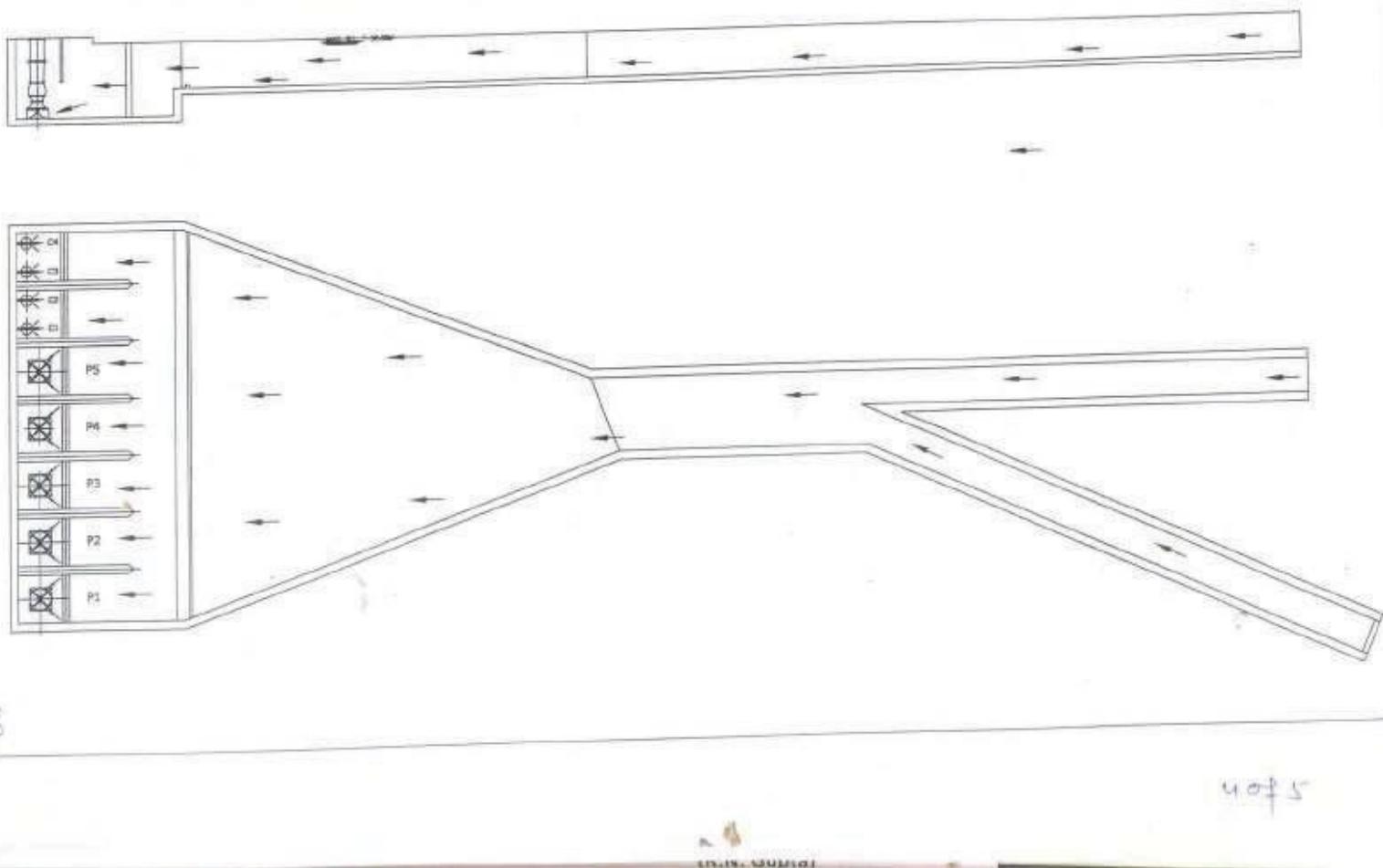

Existing  
 Installed CW Pump = 9 NPS  
 (2 RTU)  
 ACW & 2 nos (TR+1s)  
 5 CW PUMPS AND 4 ACW PUMPS WORKING AT 1.5F FLOW CONDITION AT MINIMUM WATER LEVEL  
 MODIFIED SUMP

Existing U#6, Fore bay,  
 Proposed  
 2 nos CW  
 2 nos ACW  
 ( Space is available for ACW & CW  
 in New ACW  
 Same type & cap. Building  
 of Pumps U#6

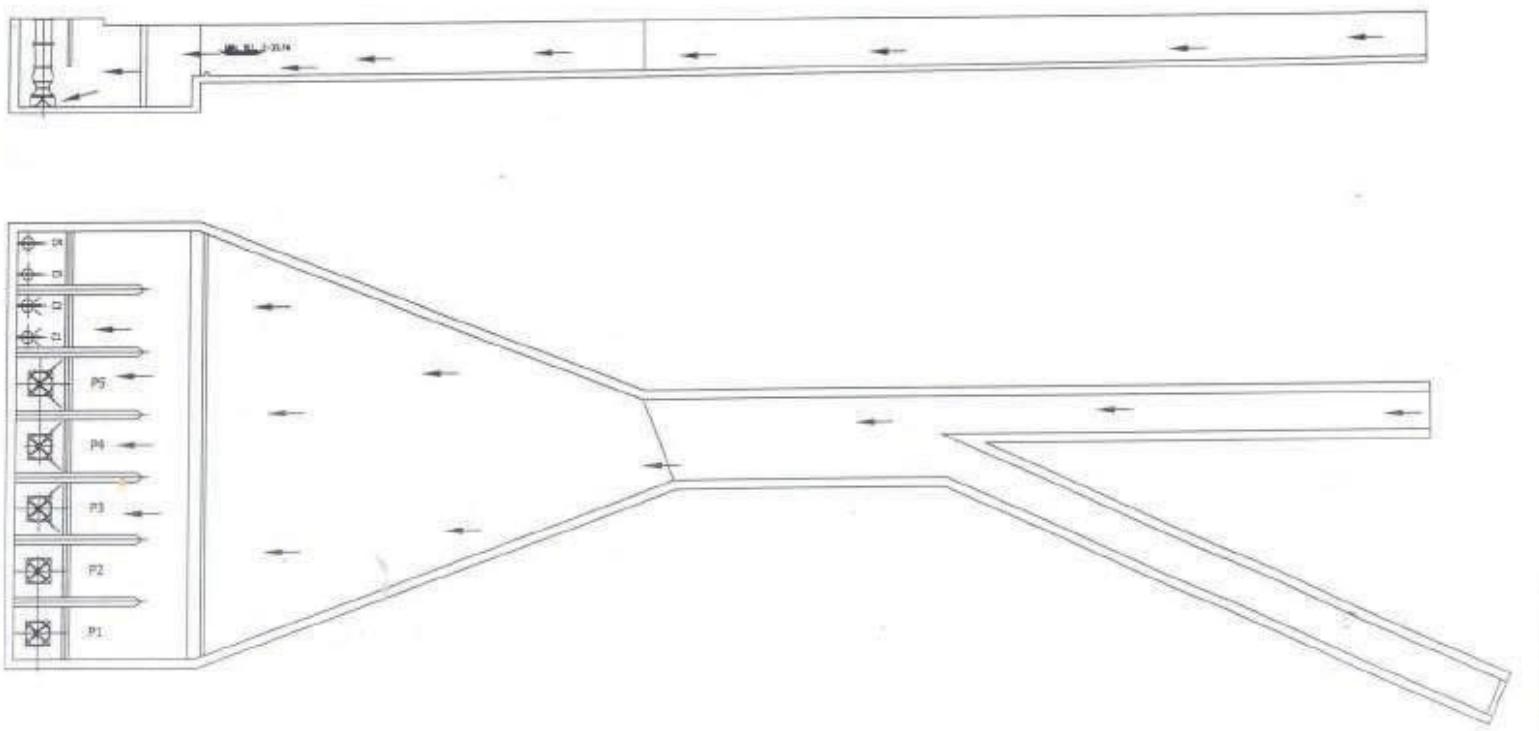


3 of 5

5 CW PUMPS AND 4 ACW PUMPS WORKING AT 1.5F FLOW CONDITION AT MAXIMUM WATER LEVEL  
MODIFIED SUMP



3 CW PUMPS AND 2 ACW PUMPS WORKING AT 1.5F FLOW CONDITION AT MINIMUM WATER LEVEL  
MODIFIED SUMP



5 of 5

**LEGEND**
 AIR-COOLING HEAT EXCHANGER

 AIR-COOLED COIL

 AIR-COOLED COIL WITH FAN

 AIR-COOLED COIL WITH FAN AND COIL

 AIR-COOLED COIL WITH COIL

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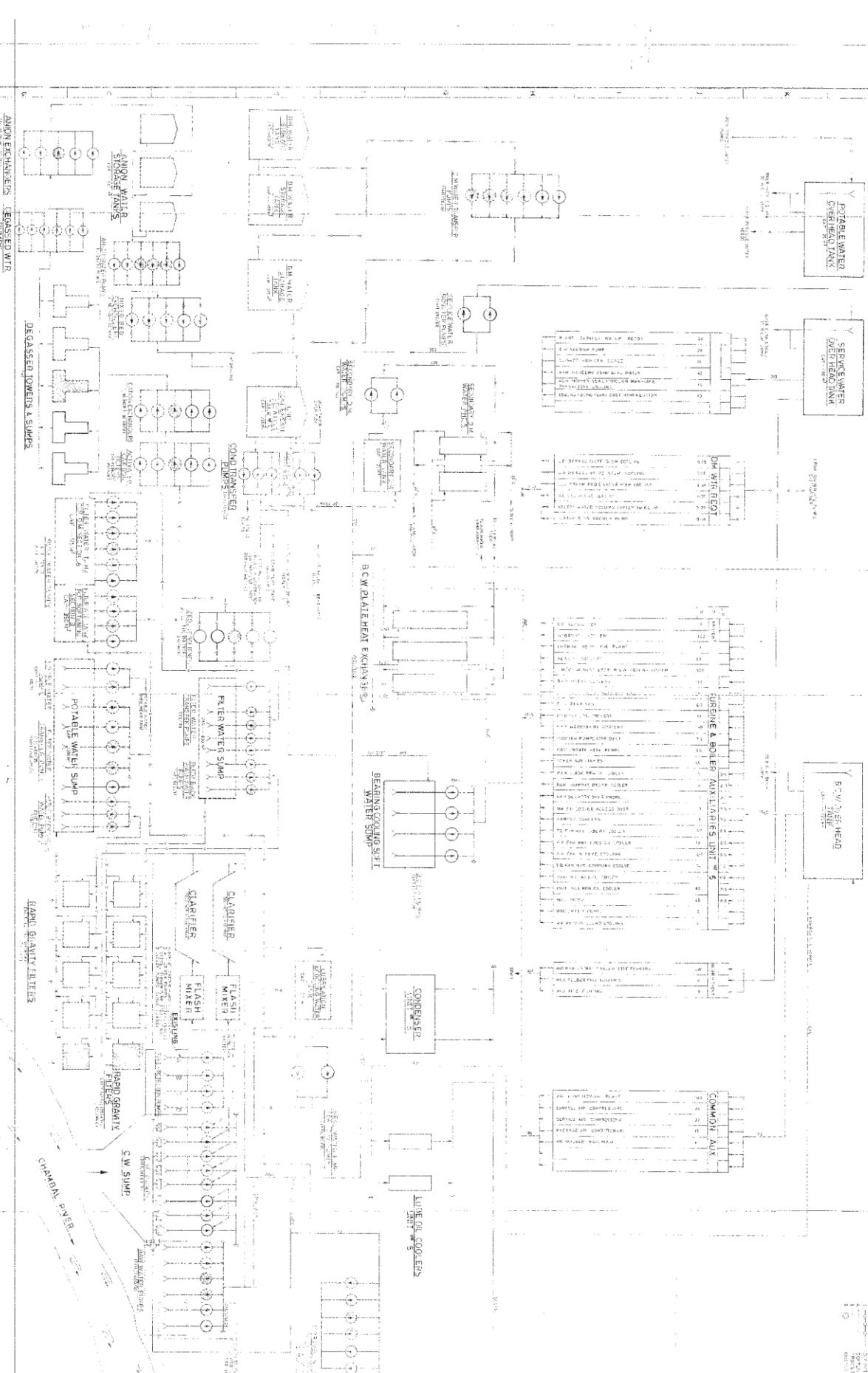
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## ANNUAL CHANNELS REVERSESWR

Piping

## REFERENCE DWGS.

NOTES

NOTICE

WATER

NEVER IN DOUBT ASK

DO NOT SCALE

DESTIN

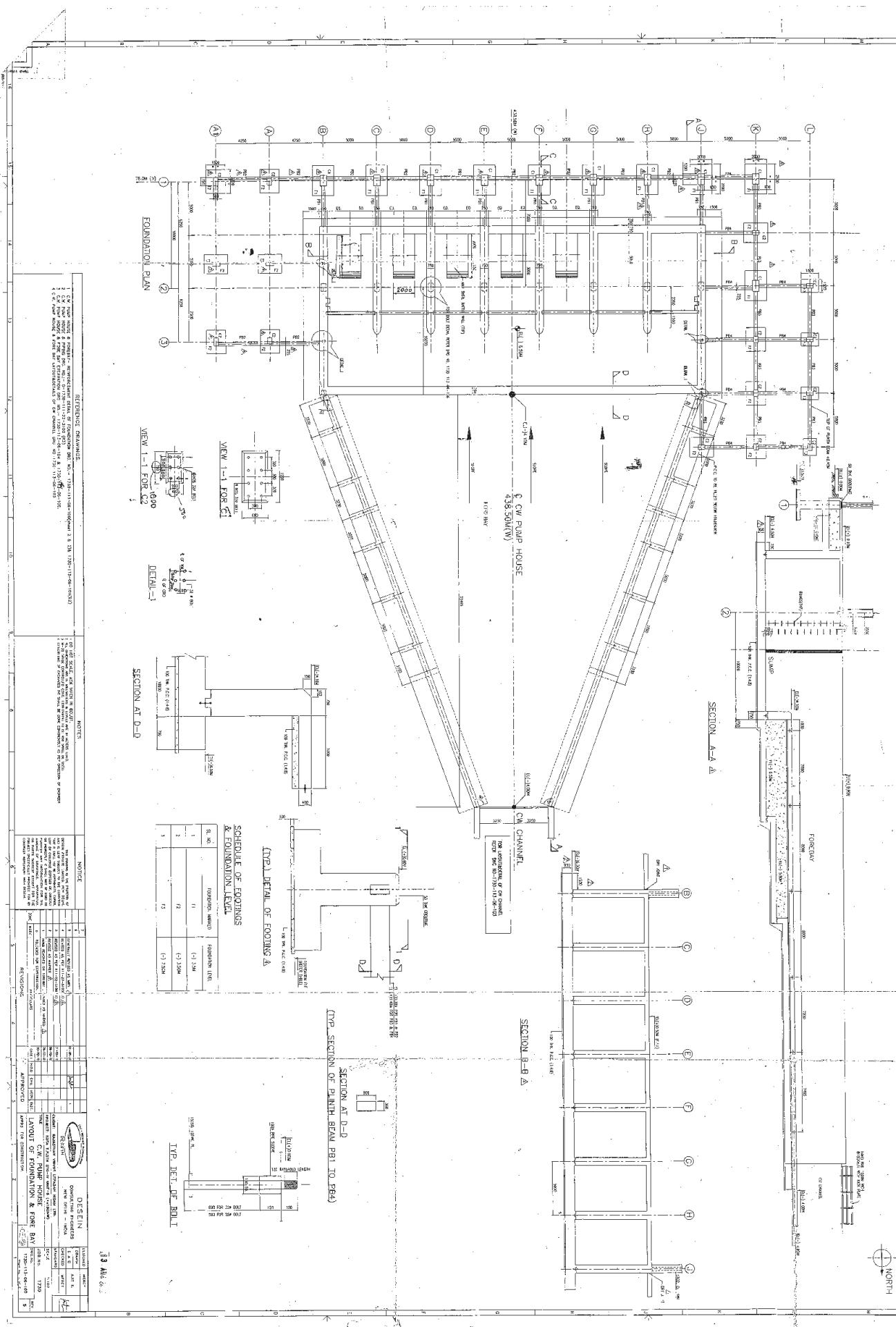
REVISIONS

APPROVED

SPEC

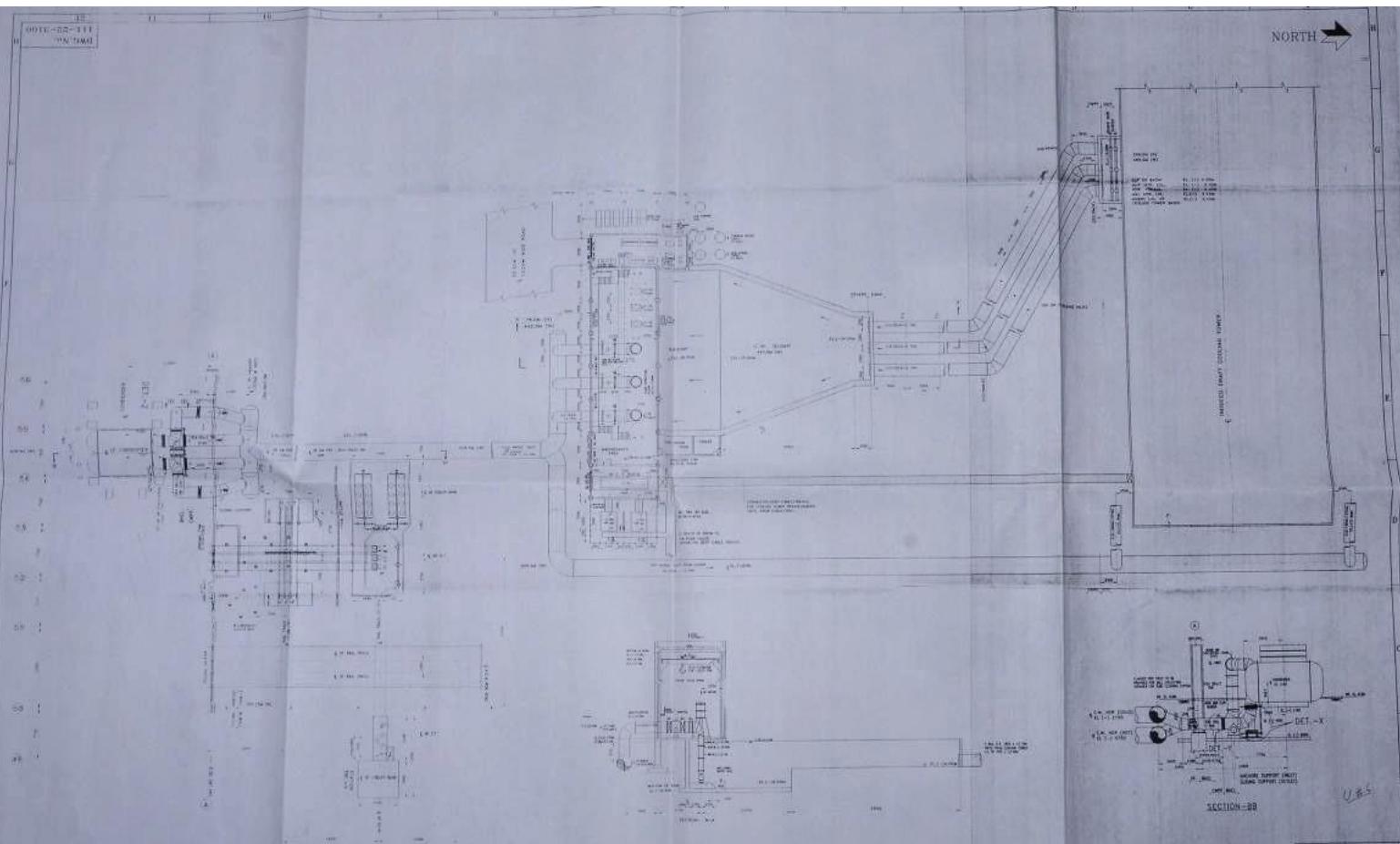
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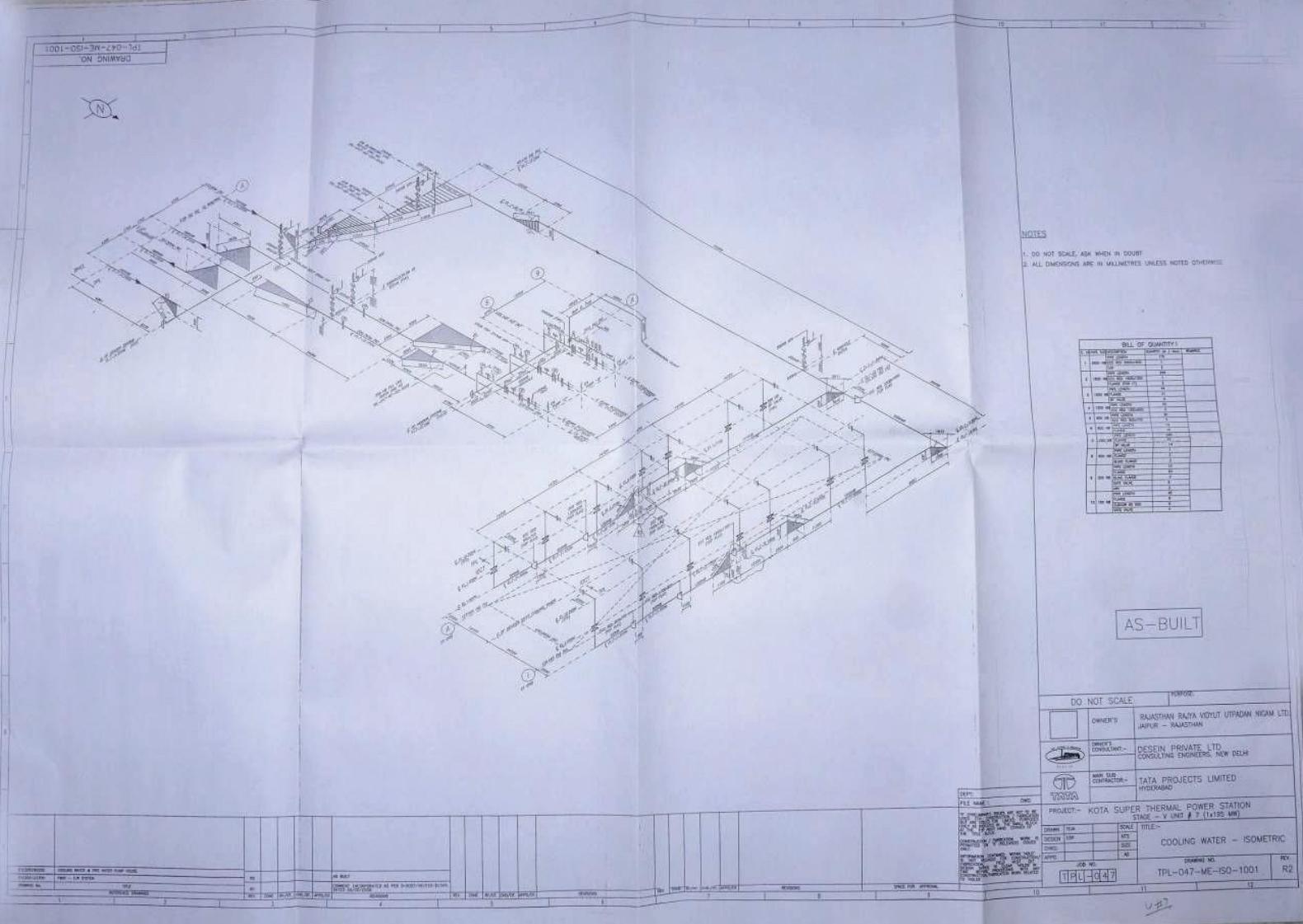


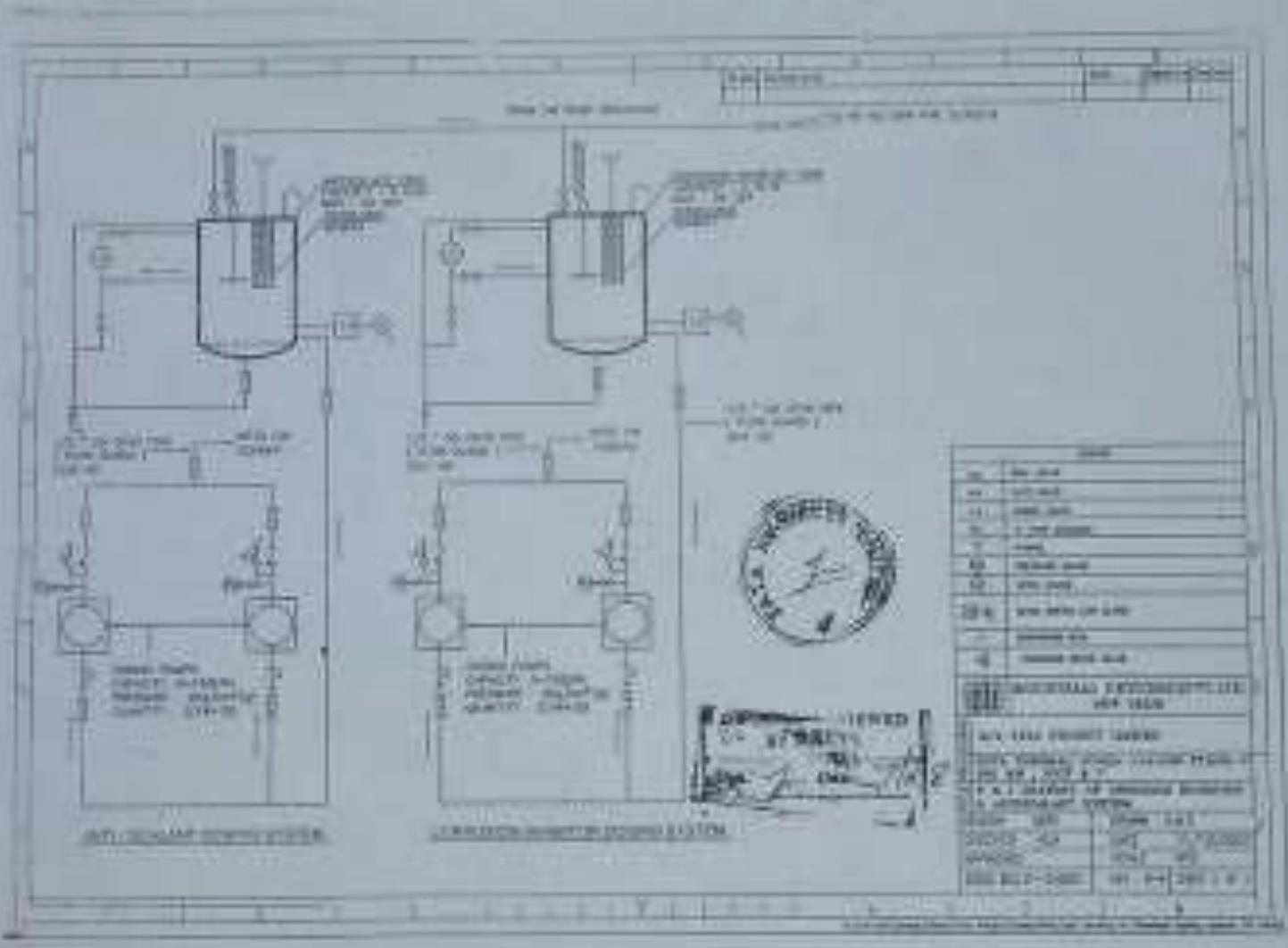


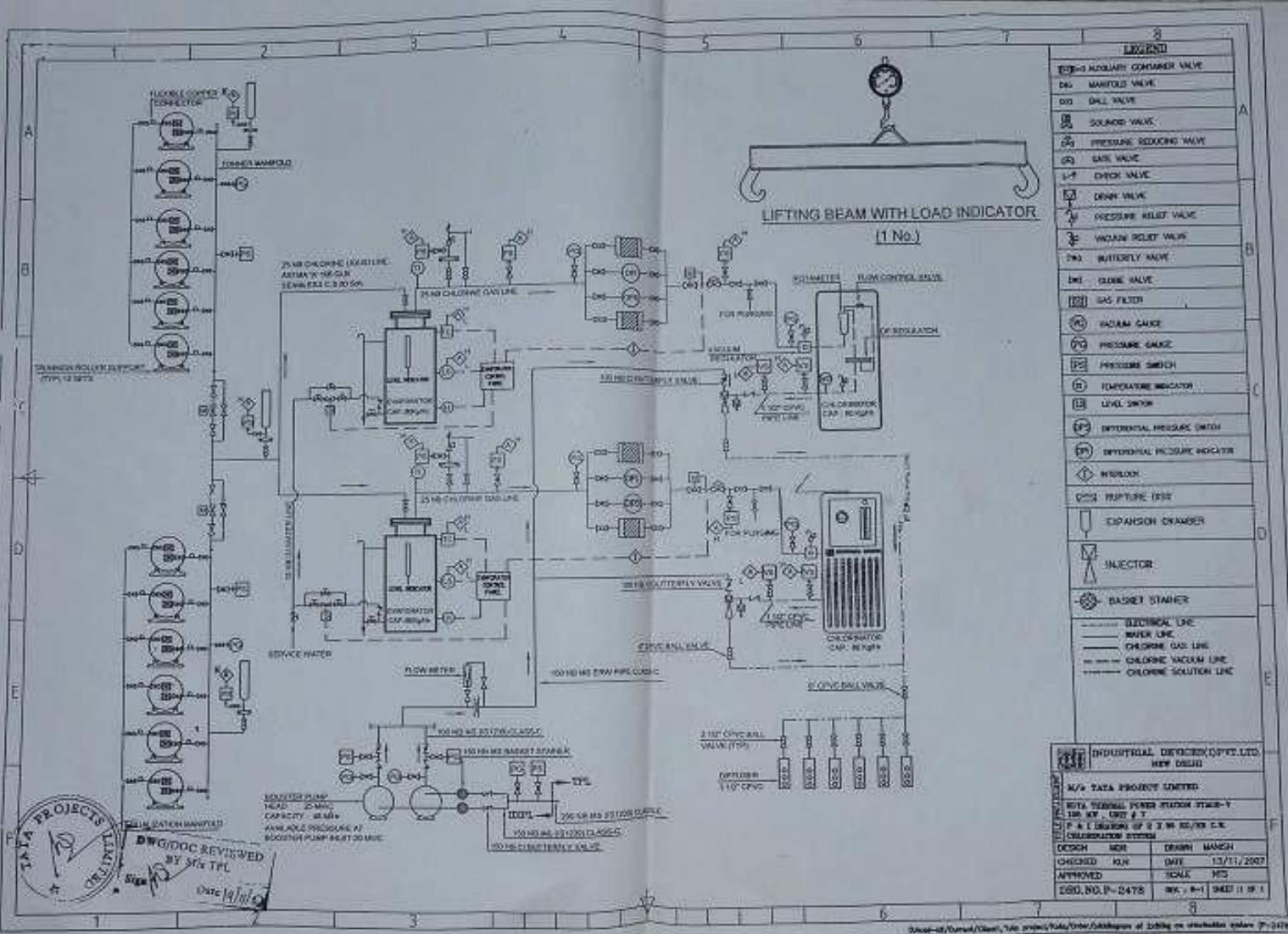


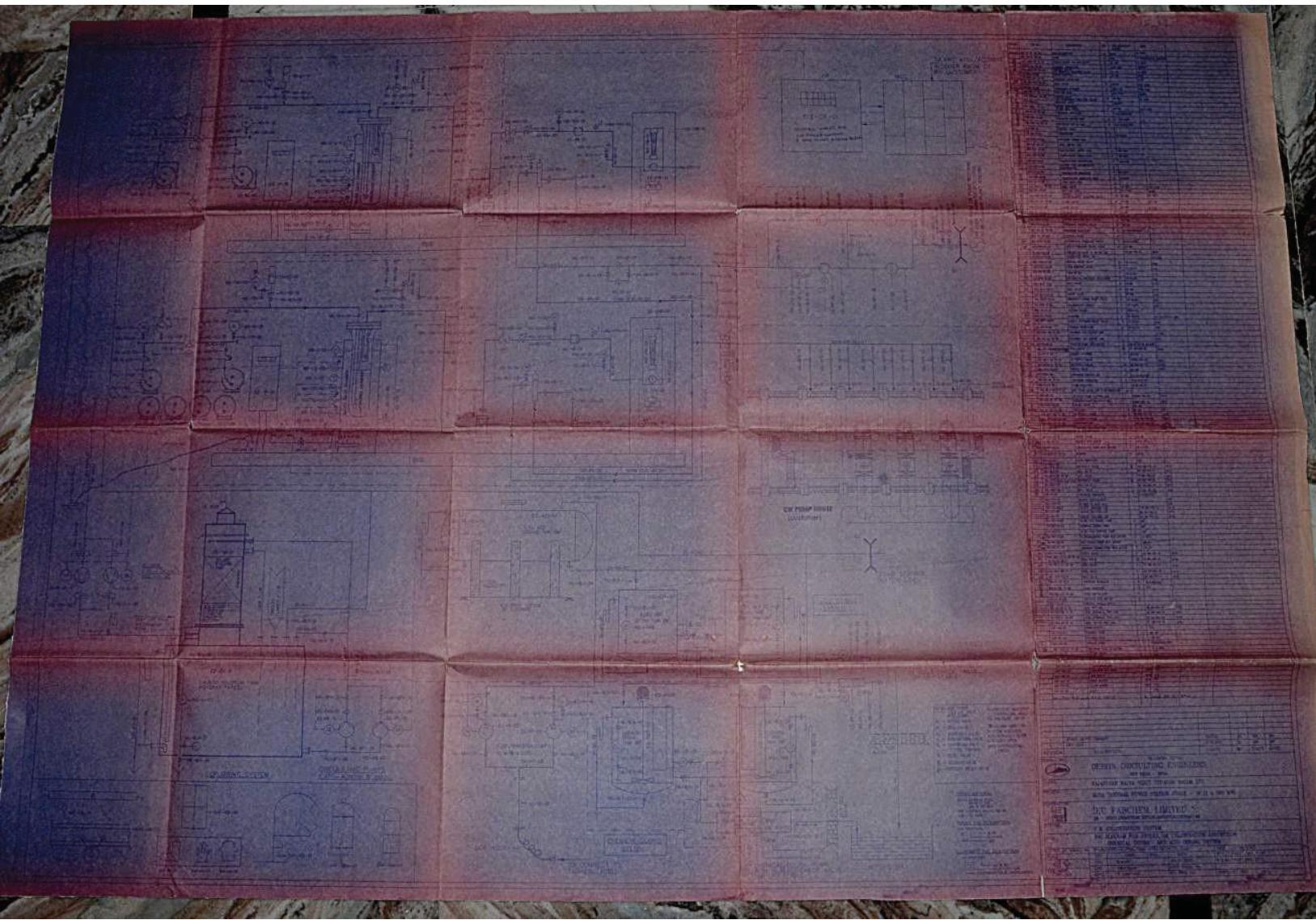


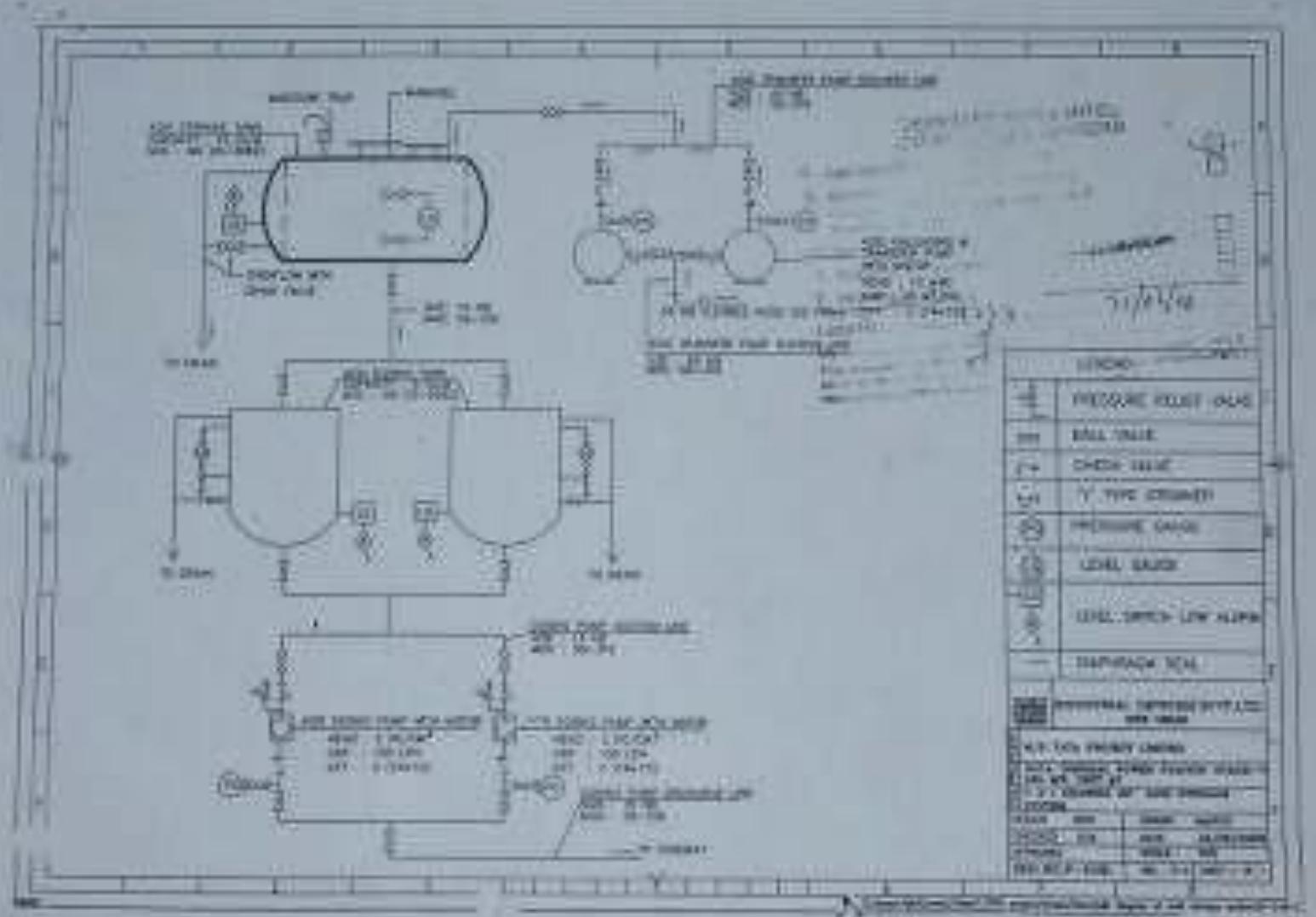




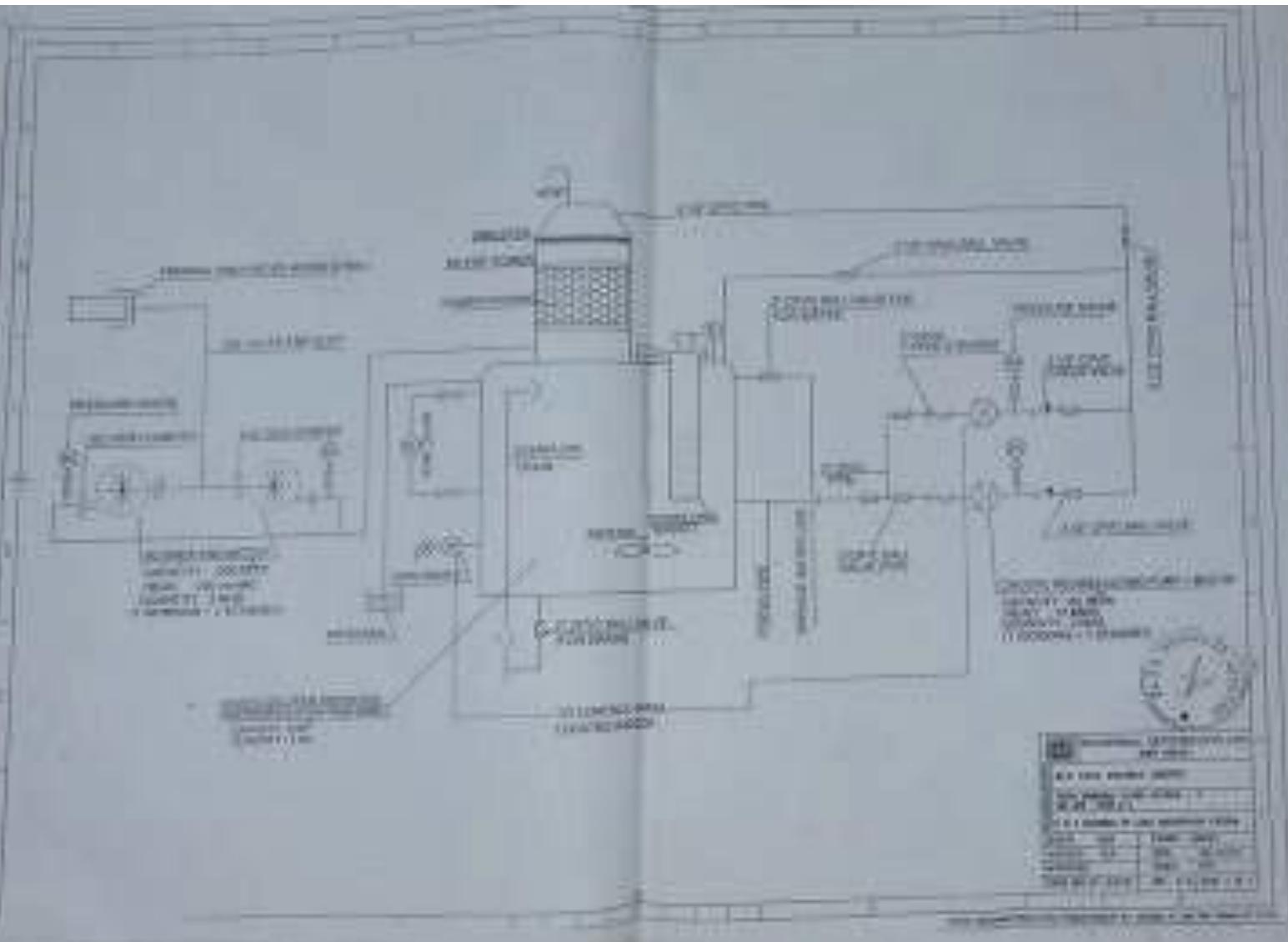




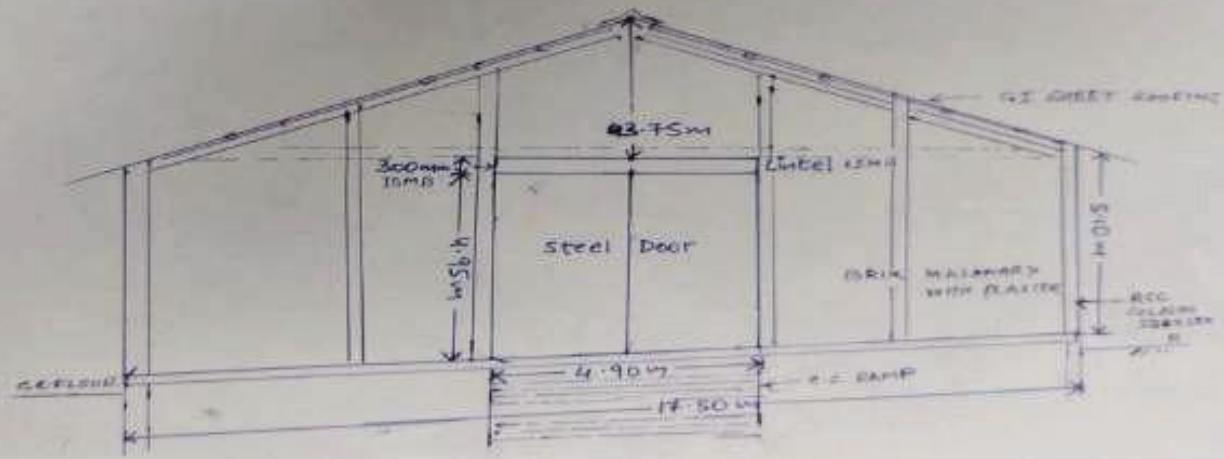




ITEM NO.	DESCRIPTION
1	PRESSURE RELIEF VALVE
2	BALL VALVE
3	CHECK VALVE
4	Y-TYPE STRAINER
5	PIPELINE VALVE
6	LEVEL GAUGE
7	ON/OFF SWITCH - LOW ALARM
8	SPRINGBACK VALVE
9	OPTIONAL: FIRE HYDRANT VALVE
10	FIRE HYDRANT
11	VALVE
12	CONTROLLER
13	PUMP CONTROL
14	LEVEL CONTROL
15	LOW HIGH
16	HIGH LOW



Front & Back View of STORE SHED AT KSTPS



No.25-11/6/2018-PG  
Government of India  
Ministry of Power  
Shram Shakti Bhawan, Rafi Marg, New Delhi – 110001  
Tele Fax: 011-23730284

Dated 02/07/2020

**ORDER**

Power Supply System is a sensitive and critical infrastructure that supports not only our national defence, vital emergency services including health, disaster response, critical national infrastructure including classified data & communication services, defence installations and manufacturing establishments, logistics services but also the entire economy and the day-to-day life of the citizens of the country. Any danger or threat to Power Supply System can have catastrophic effects and has the potential to cripple the entire country. Therefore, the Power Sector is a strategic and critical sector.

The vulnerabilities in the Power Supply System & Network mainly arise out of the possibilities of cyber attacks through malware / Trojans etc. embedded in imported equipment. Hence, to protect the security, integrity and reliability of the strategically important and critical Power Supply System & Network in the country, the following directions are hereby issued :-

(1) All equipment, components, and parts imported for use in the Power Supply System and Network shall be tested in the country to check for any kind of embedded malware/trojans/cyber threat and for adherence to Indian Standards.

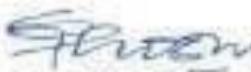
(2) All such testings shall be done in certified laboratories that will be designated by the Ministry of Power (MoP).

(3) Any import of equipment/components/parts from "prior reference" countries as specified or by persons owned by, controlled by, or subject to the jurisdiction or the directions of these "prior reference" countries will require prior permission of the Government of India.

(4) Where the equipment/components/parts are imported from "prior reference" countries, with special permission, the protocol for testing in certified and designated laboratories shall be approved by the Ministry of Power (MoP).

This order shall apply to any item imported for end use or to be used as a component, or as a part in manufacturing, assembling of any equipment or to be used in power supply system or any activity directly or indirectly related to power supply system.

This issues with the approval of Hon'ble Minister of State for Power and New & Renewable Energy (Independent Charge).

  
(Goutam Ghosh)  
Director  
Tel: 011-23716674

To:

1. All Ministries/Departments of Government of India (As per list)
2. Secretary (Coordination), Cabinet Secretariat
3. Vice Chairman, NITI Aayog
4. Comptroller and Auditor General of India
5. Chairperson, CEA
6. CMDs of CPSEs/Chairman of DVC & BBMB/MD, EESL/DG, NPTI/DG, CPRU/DG, BEE/
7. All ASs/JAs/EA, MoP

Copy:

1. PS to Hon'ble PM, Prime Minister's Office
2. PS to Hon'ble MOS(IC) for Power and NRE
3. Br. PPS to Secretary(Power)

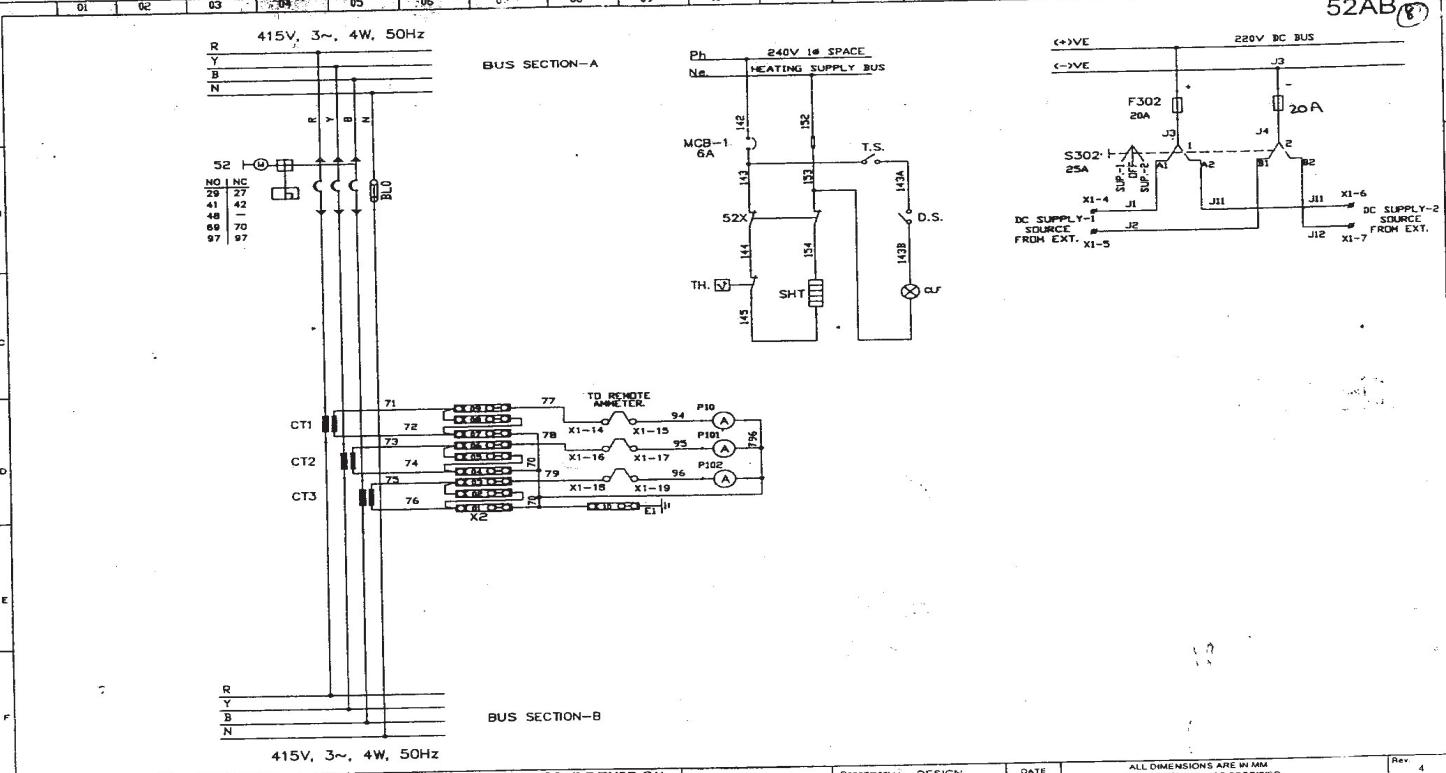
Description : MODULE TYPE -G1

Coupler

Customer : RAJASTHAN RAJYA VIDYUTH  
UTPADAN NIGAM LIMITED.

Project : 1 X 195 MW KOTA THERMAL  
POWER STATION STAGE-V UNIT # 7

LGA NO: 00000000000000000000000000000000		
PROJECT NUMBER: 00000000000000000000000000000000		
DESIGNER: RAJASTHAN RAJYA VIDYUTH UTPADAN NIGAM LIMITED		
IMPORTER: DESENIM PRIVATE LIMITED NEW DELHI		
MANUFACTURER: FATA PROJECTS LIMITED Rajputana Market, C-104, H-Block Sector-10, Faridabad, Haryana 121002 Telephones: 010 2622 3000		
ABB COMPRESSOR: ABB LIMITED FARIDABAD		
Project: 1 X 195 MW KOTA THERMAL POWER STATION STAGE - V UNIT # 7		
Date: 00/00/0000 Model No.: 00000000000000000000000000000000		
Prepared: D SINGH Checked: D JUMAR Approved: KESHAV		
Without Spec. No.: <input type="checkbox"/> Same Pl. Same No.: <input type="checkbox"/> Spec. Pl. Other No.: <input type="checkbox"/>		
Derived by: PS PT		Supersedes: Supersedes by:
		00000000000000000000000000000000

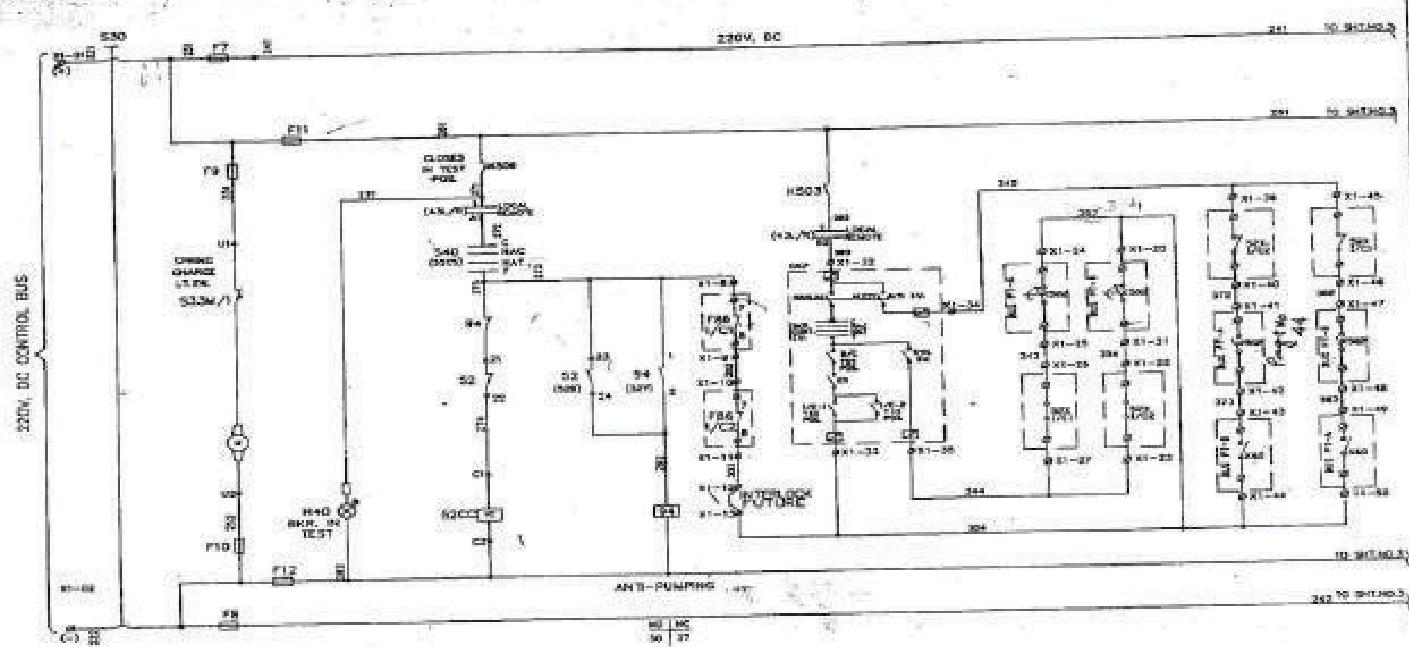


4 AS BUILT 02.09.08 CKT. DIAGRAM FOR EDO ACB (MODULE TYPE-G1)

Department:	DESIGN	DATE	Rev 4
Drawn by:	I.D.SINGH	06.02.2008 DRG-NR	Sheet 01/09

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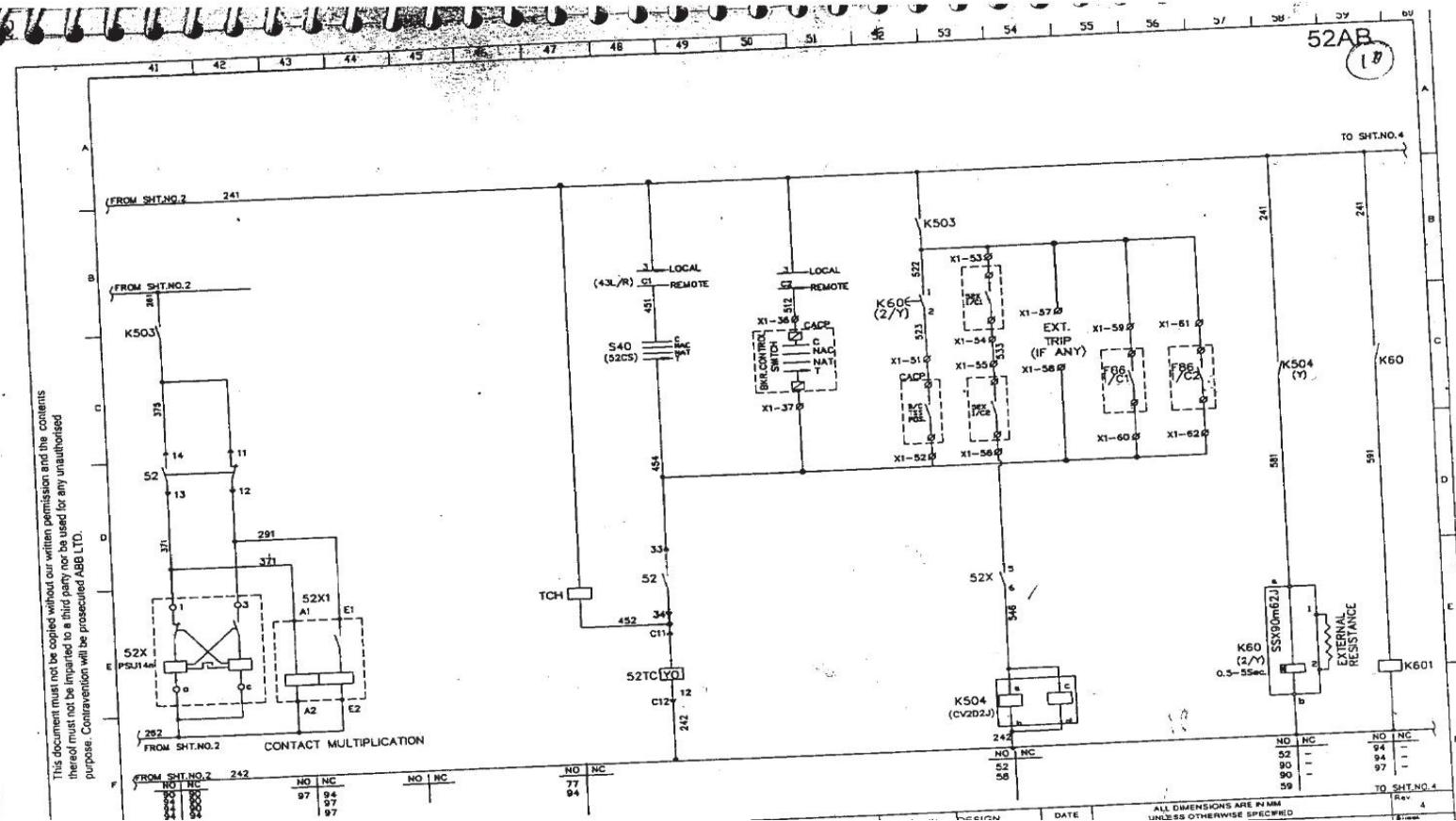
Ref. No.	Date	Description
1. Job No.	000000	Design: CIRCUIT DIAGRAM FOR ECO ACD (MODULE TYPE-03)
2. Job Address:	000000	Issuer: ESSCON PRIVATE LIMITED, NEW DELHI
3. Job Description:	000000	Reciever: KALASTHAN SAIFIA VIZIRUTH UTPADAN KOLAM LIMITED
4. Job Requirements:	000000	Location: KALASTHAN THERMAL POWER STATION STAGE-U UNIT #1
5. Date:	000000	Prepared by: ESSCON PRIVATE LIMITED

**ABB**

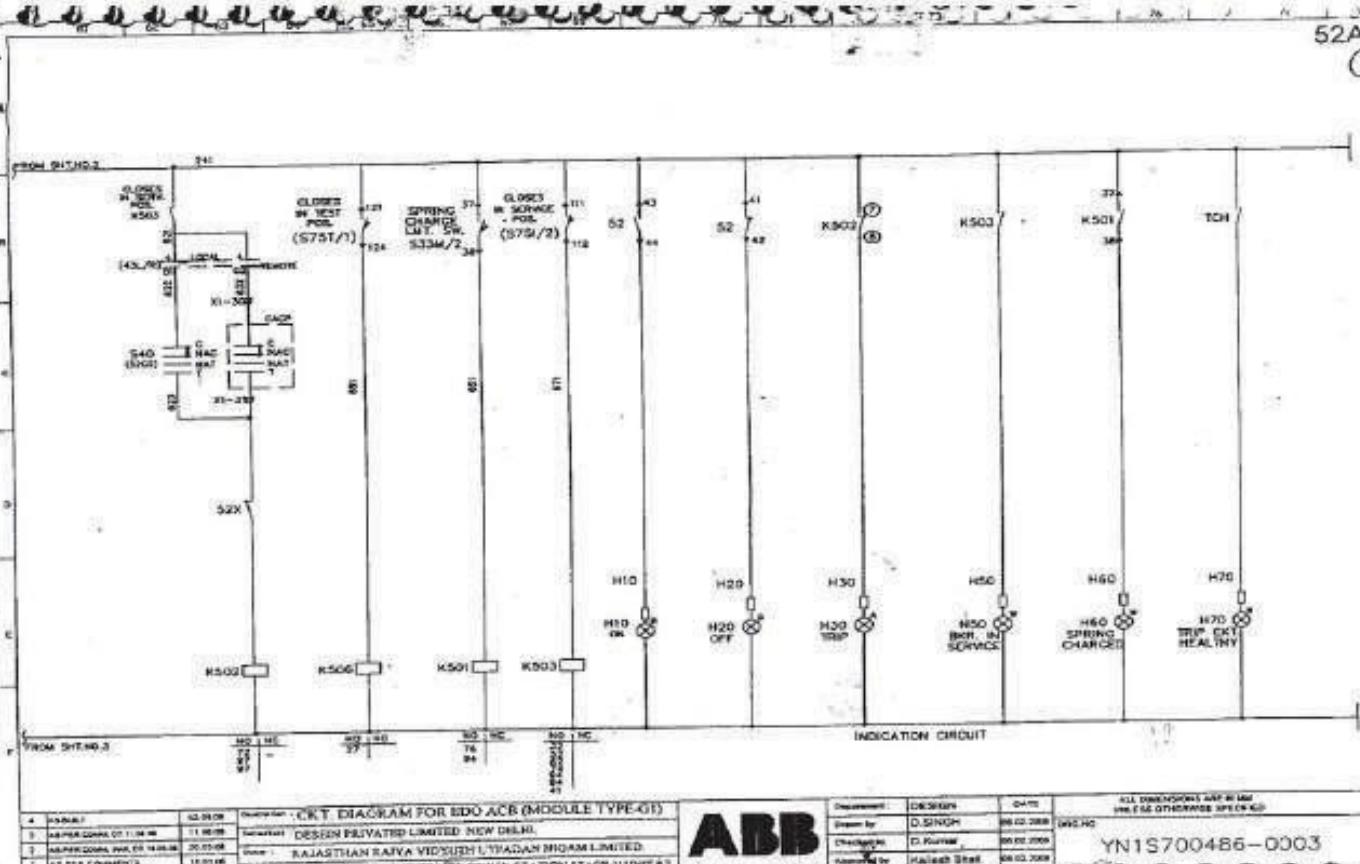
Designator	Design	Date	Serial No.
Prepared by	D SINGH	06.02.2006	000000
Checked by	D RAJPUT	06.02.2006	
Approved by	KAMAL SINGH	06.02.2006	

Y/N 15700486-0003

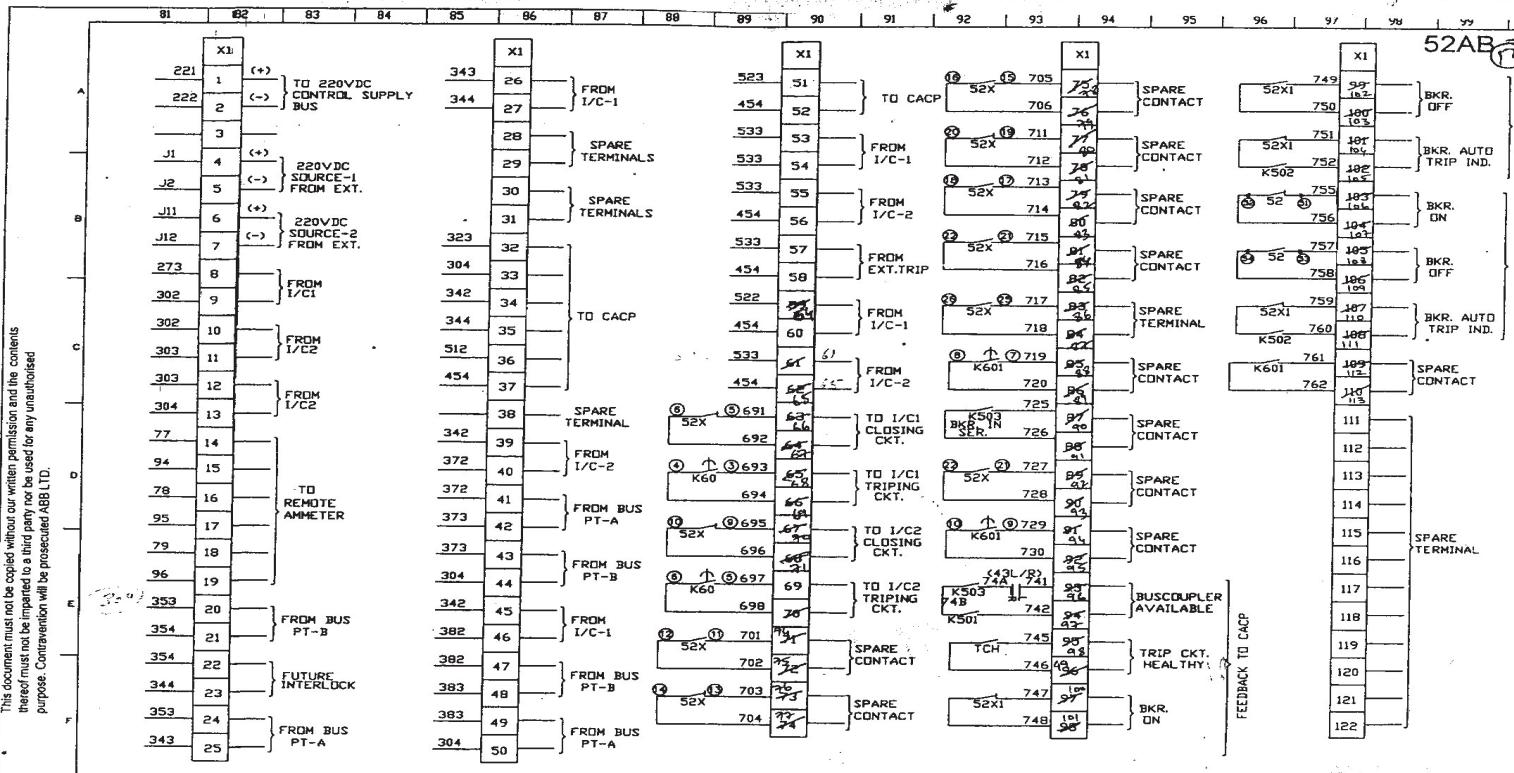
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4 AS BUILT 02.09.06 Description : CKT. DIAGRAM FOR EDO ACB (MODULE TYPE-G1)  
3 AS PER COMM. DT 11.06.06 11.06.06 Consultant : DESIGN PRIVATE LTD, NEW DELHI.

Department : DESIGN Date : 06.02.2008  
Drawn by : D.SINGH DSG NO : 1000

ALL DIMENSIONS ARE IN MM  
UNLESS OTHERWISE SPECIFIED

Rev. 4

KTPS

Rajee, Copy

Description : MODULE TYPE -B1 (52B)

Incomes

Customer : RAJASTHAN RAJYA VIDYUTH  
UTPADAN NIGAM LIMITED.

Project : 1 X 195 MW KOTA THERMAL  
POWER STATION STAGE-V UNIT # 7

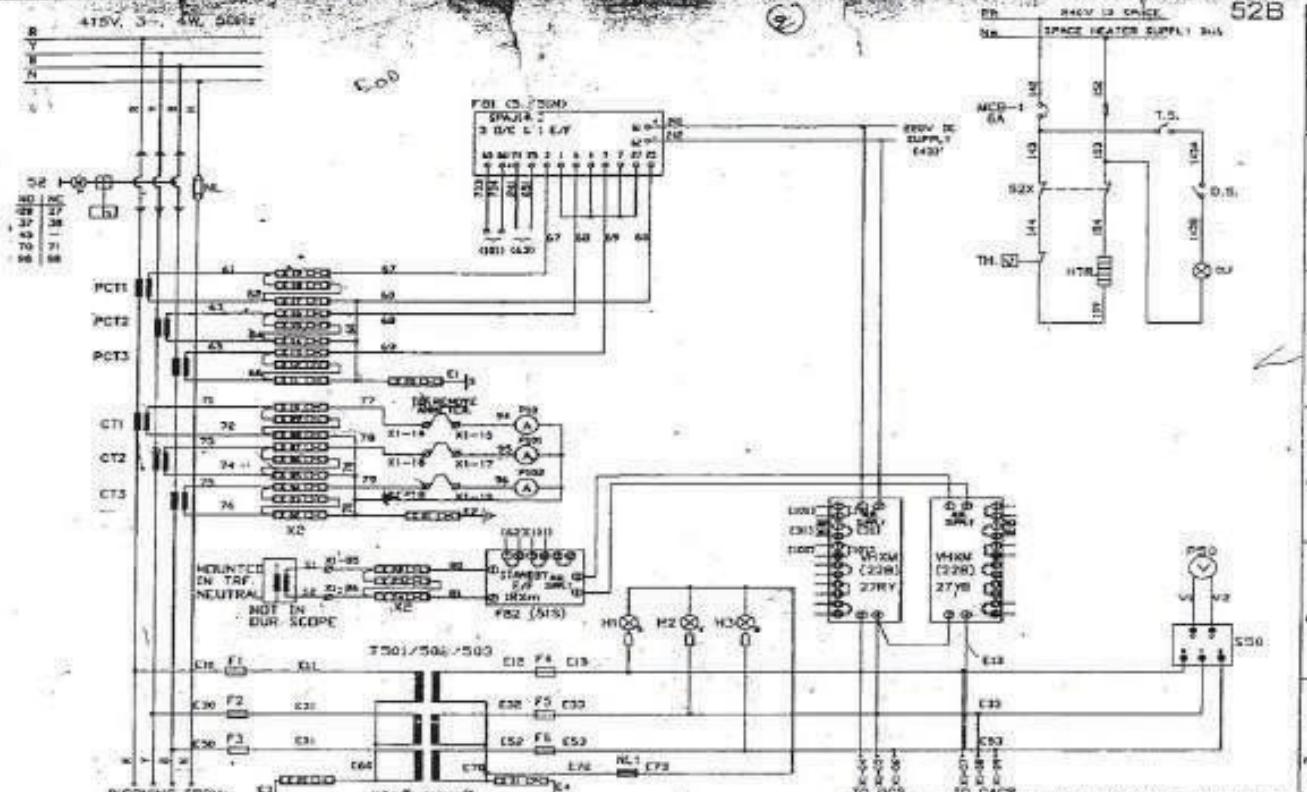
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750

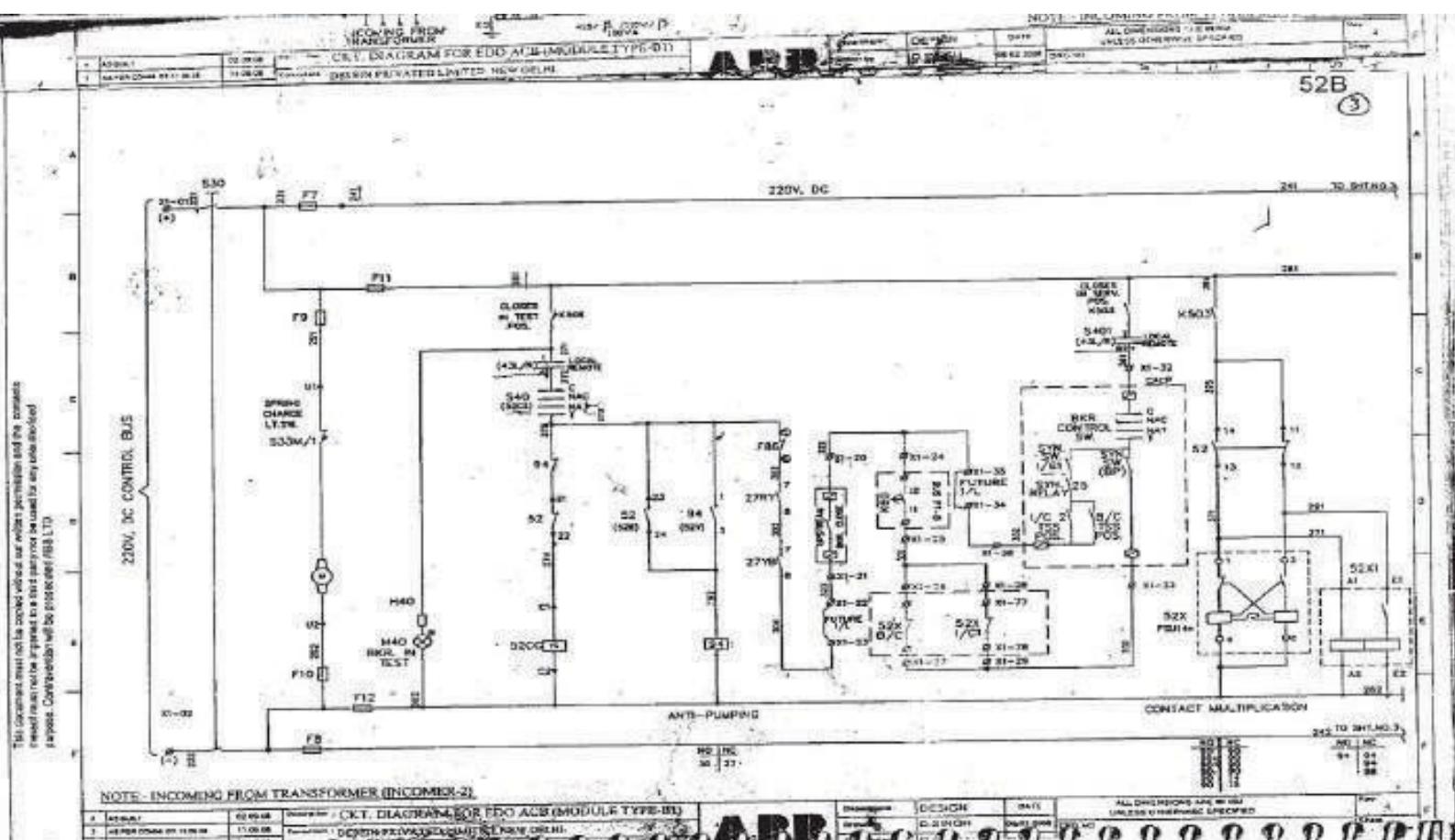
LW Soc heevel

LOA No: TPL TO ACP LOI NO: TPL/LOI/TP-44-17/PL-009, DPL 22/03/2003 TPL/PL/LOI/TP-044-073, DPL 14/03/2003		
	OWNER CONTRACTOR	RAJASTHAN RAJYA VIDYUTH UTPADAN NIGAM LIMITED
	DESIGN PRIVATE LTD NEW DELHI	TATA PROJECTS LIMITED Mithore Power Dholpur, Rajasthan President: Mr. Gopal Chandra Secretary: Mr. Rakesh Chandra Supervisor: Mr. Suresh Kumar
	SUB CONTRACTOR	ABB LIMITED FARIDABAD
Project: 1 X 195 MW KOTA THERMAL POWER STATION STAGE - V UNIT # 7		
Title: MODULE TYPE -B1 (52B)		
Scale: NTS		
Total Sh: 03cm		

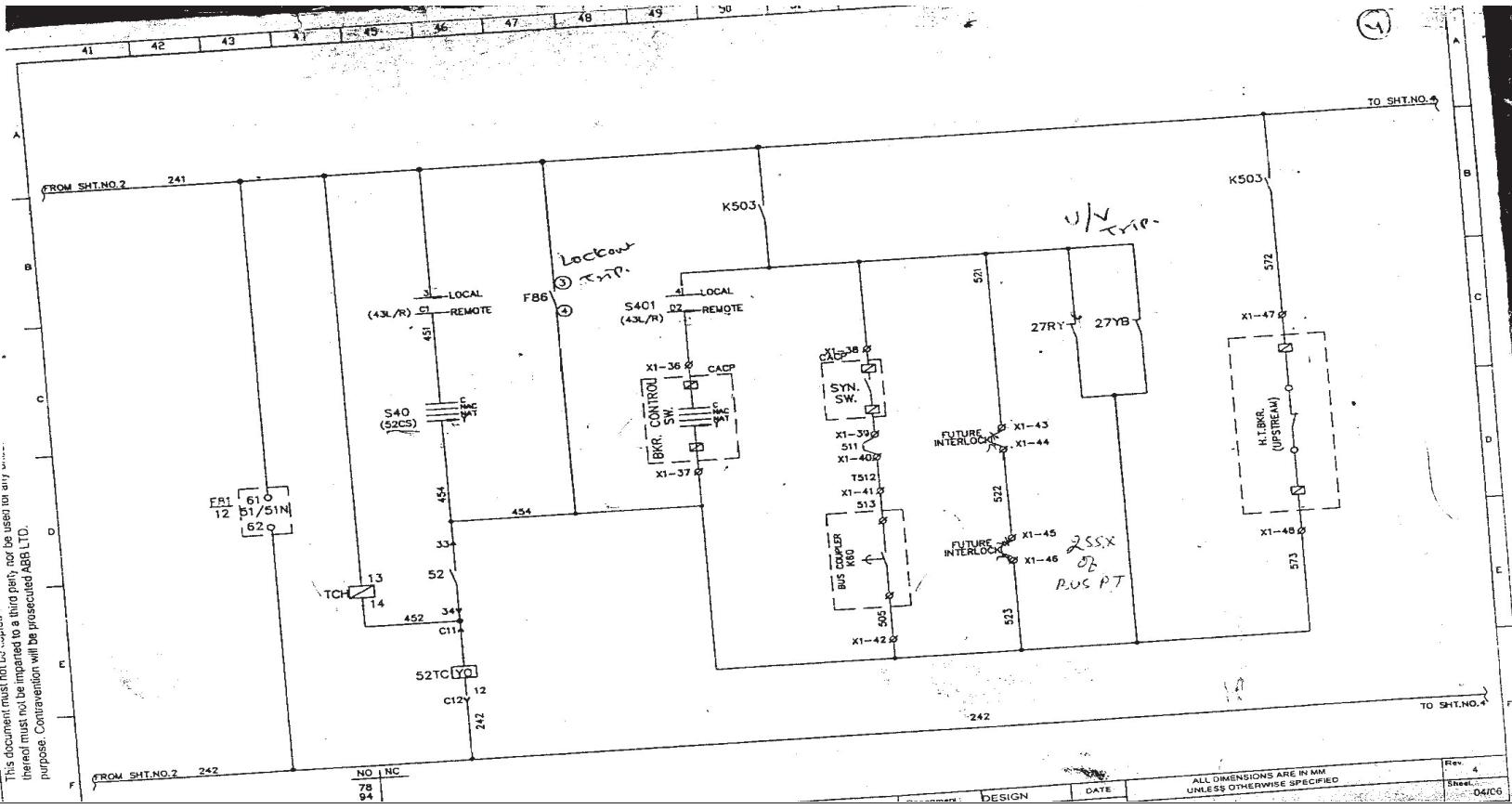
Prepared:	D.SINGH	Checked:	D.KUMAR	Approved:	K.C.BHATT
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Derived by:	<input checked="" type="checkbox"/>	Superseded by:	Supersedes by:		
DO	<input type="checkbox"/>				
B1	<input type="checkbox"/>				

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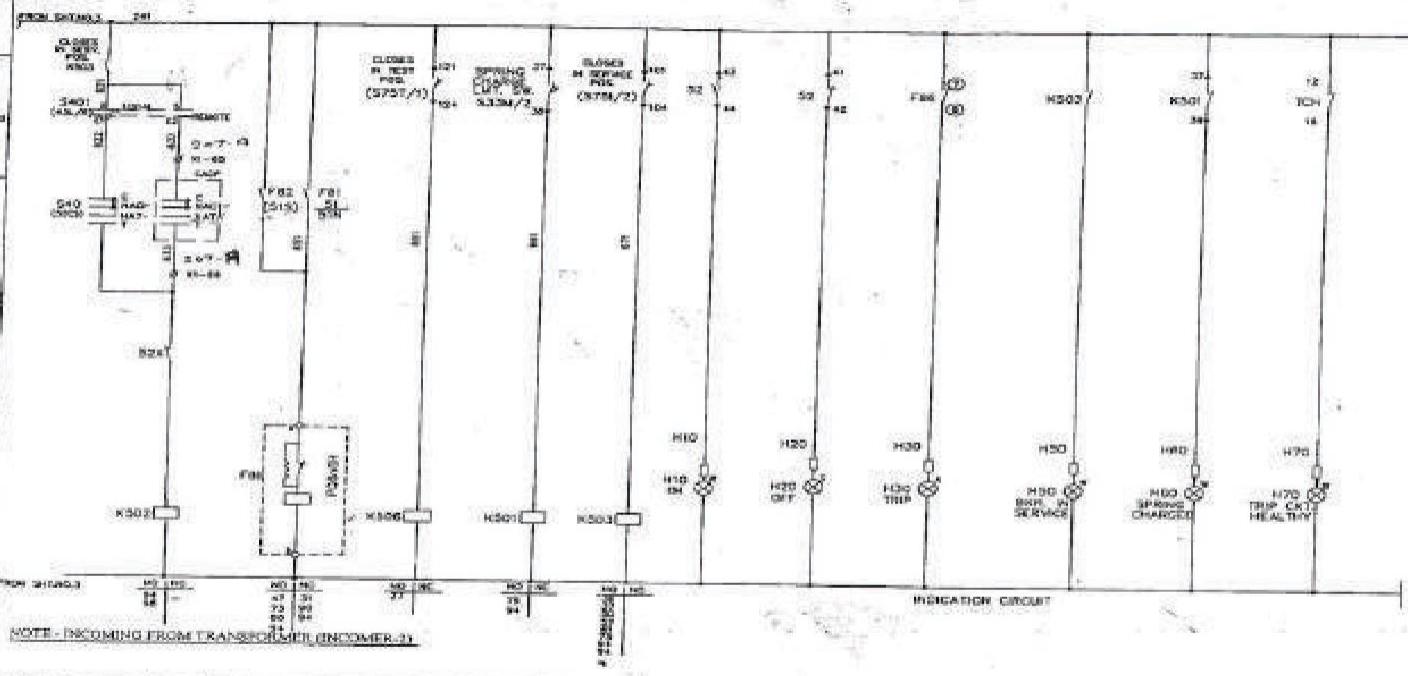




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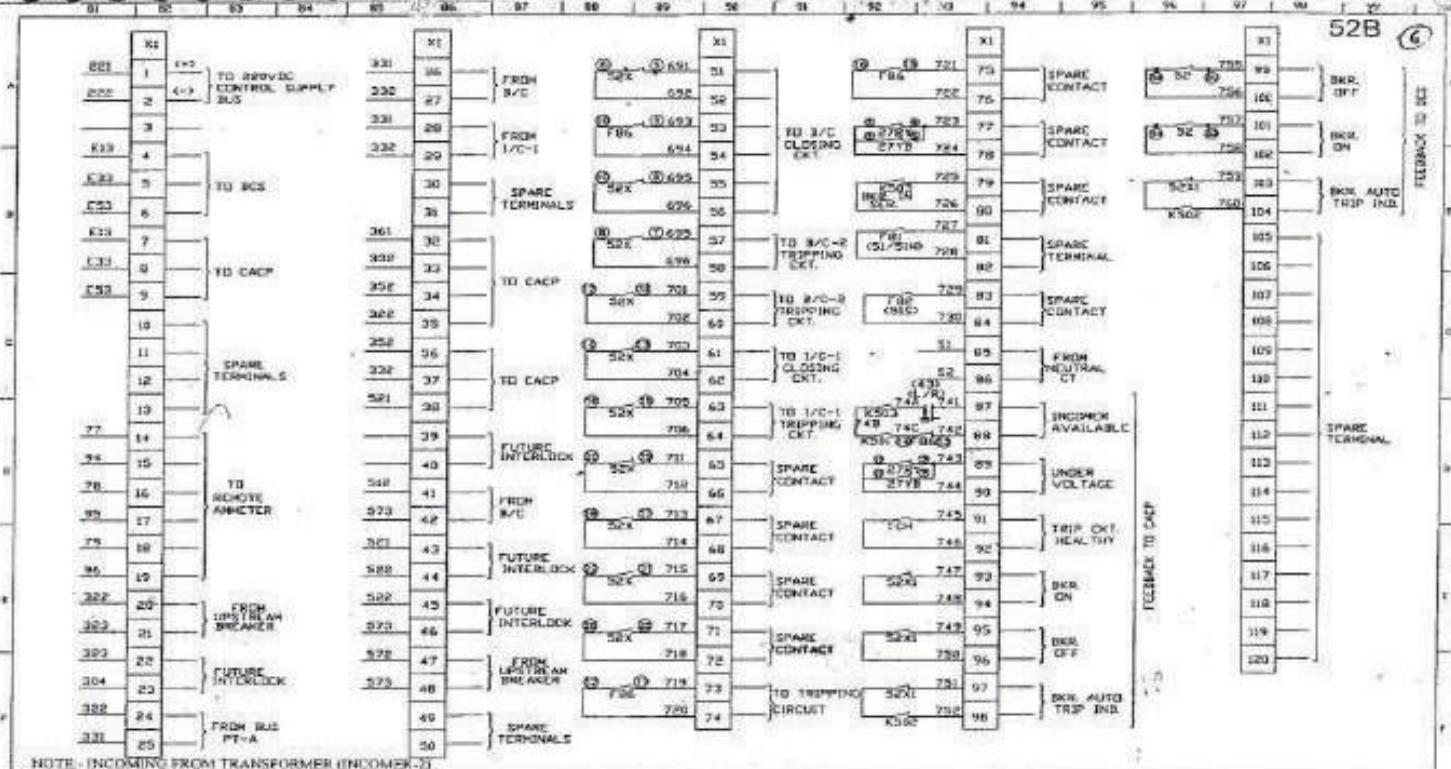
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2. AC FREQUENCY	50.00 Hz	Comments: EEC-DIAGRAM FOR EEC-ACB (MODULE TYPE-B1)
3. NO. OF PHASES AND POLARITIES	3+N	Comments: EEC-DIAGRAM FOR EEC-ACB (MODULE TYPE-B1)
4. NO. OF TRANSFORMERS	10.00 MVA	Comments: EEC-DIAGRAM FOR EEC-ACB (MODULE TYPE-B1)
5. No.	1	Comments: RAJASTHAN YOUTH UTADAN VIDYANIKAM LIMITED
6. Project Name	RAJASTHAN YOUTH UTADAN VIDYANIKAM LIMITED	Comments: RAJASTHAN YOUTH UTADAN VIDYANIKAM LIMITED

**ABB**

INVENTOR	DESIGNER	DATE	RELEASER	DATE	Page
D.Singh	2006/06/06	2006/06/06	D.Singh	2006/06/06	1
D.Singh	2006/06/06	2006/06/06	D.Singh	2006/06/06	2
D.Singh	2006/06/06	2006/06/06	D.Singh	2006/06/06	3

YN15700486-0001

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1. Institute	00:00:00	Assessor	CELT DIAGRAM FOR ESD ACB (MODULE TYPE B1)
2. Address/Name of the Person	11:00:00	Supervisor	DESIGN PRIVATE LIMITED- NEW DELHI
3. Qualification	01:00:00	Name	KARTHIK RAJEEV SUDHISH UTPAGAN NIGAM - STED
4. Address	01:00:00		



Requirement	Spec ID	ALL INFORMATION NOT IN THIS LEVEL-1 CLOTHESLINE SPECIFICATION	Spec ID
Other ID	01-HIGH	01-200001 (REV. 000)	
Created by	01-POLYMER	01-200001	
		REVISION 01 - DRAFT	

101

102

103

104

105

106

107

SCALE N.T.S.

ALL DIMENSION ARE IN mm.

S.K.

motors.

**Description : MODULE TYPE -K23 (DOL STARTER)**

**Customer : RAJASTHAN RAJYA VIDYUTH  
UTPADAN NIGAM LIMITED.**

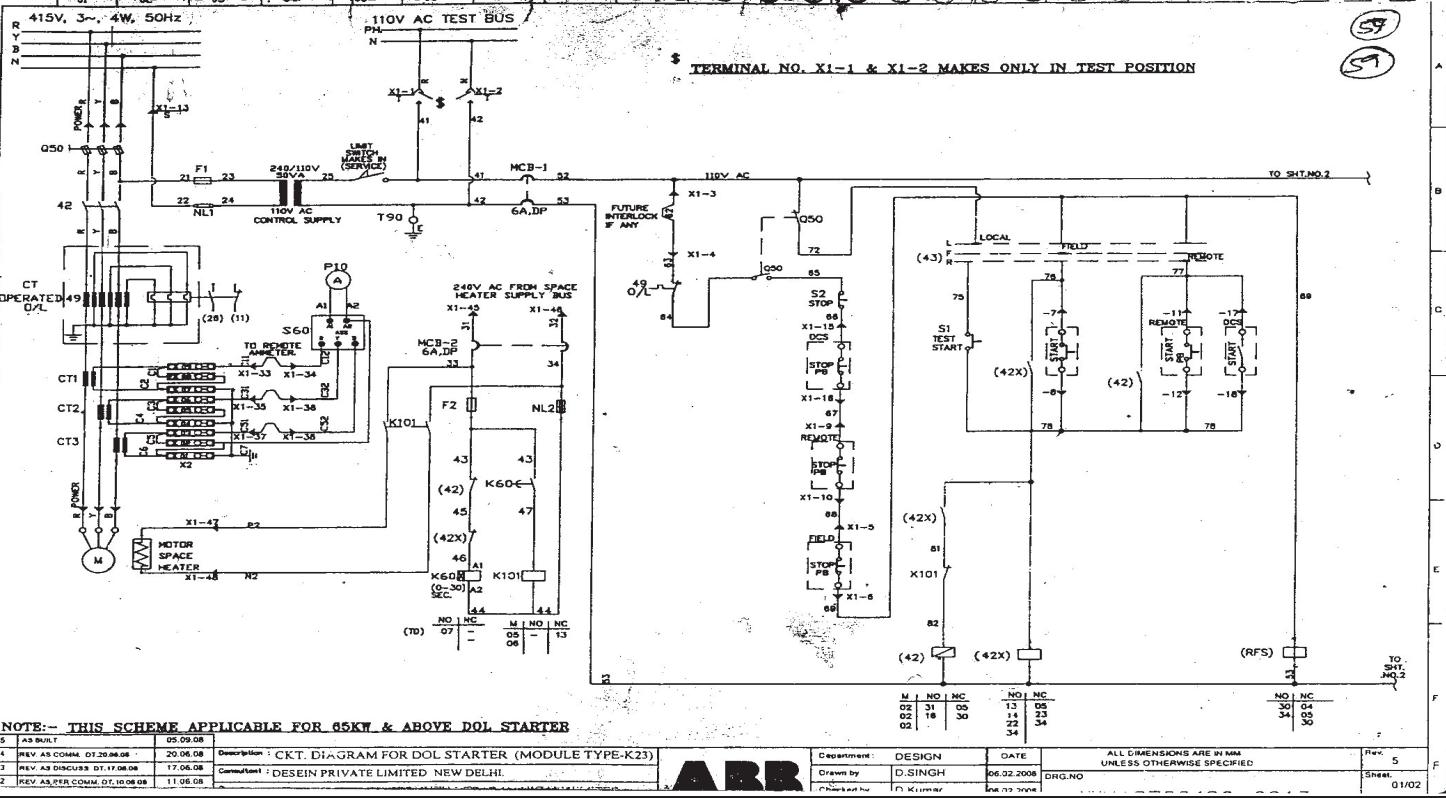
**Project : 1 X 195 MW KOTA THERMAL  
POWER STATION STAGE-V UNIT # 7**

NOTE:- THIS SCHEME APPLICABLE FOR 65KW & ABOVE DOL STARTER

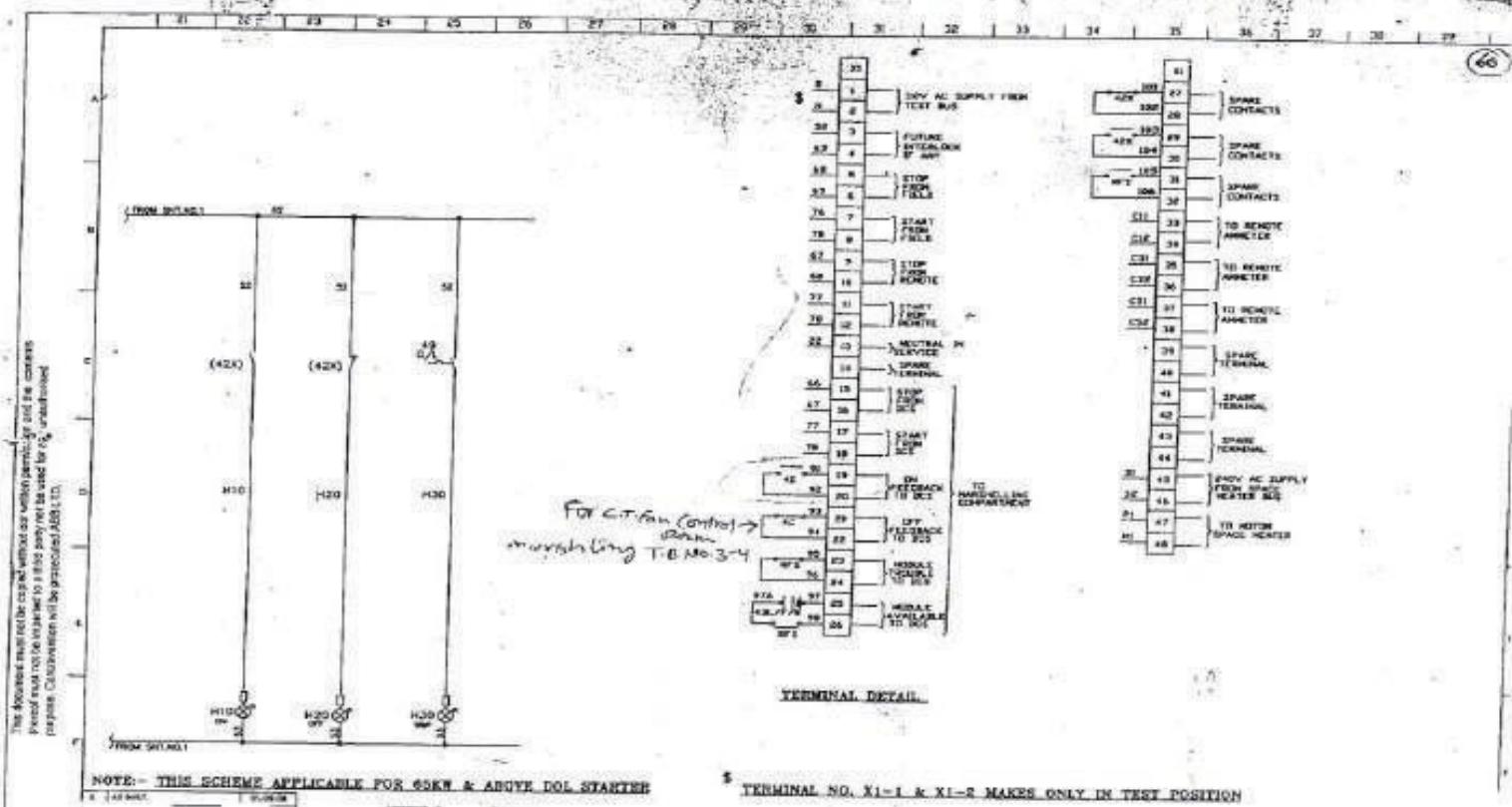
Prepared:	D.SINGH	Checked:	D.KUMAR	Approved:	K.C.BHATT
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Derived by:		Supersedes:		Supersedes by:	

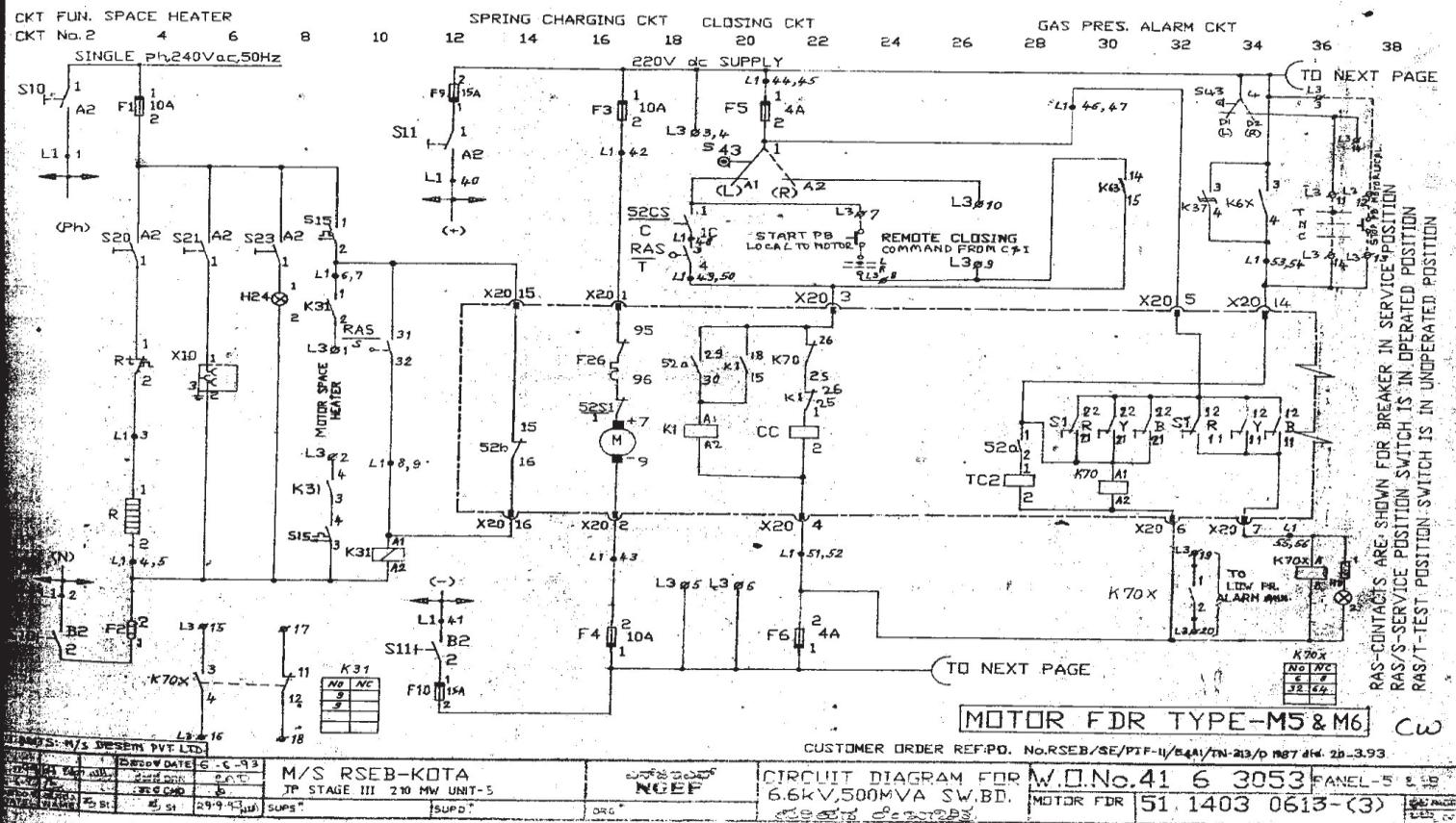
LOA No:	TPL TO ABB LOI NO: TPN/UTPA/AD/1P-048/25 dtd 11.1.2001
OWNER:	RAJASTHAN RAJYA VIDYUTH UTPADAN NIGAM LIMITED
OWNER CONSULTANT:	DESIGN PRIVATE LIMITED NEW DELHI
CONTRACTOR:	TATA PROJECTS LIMITED Opposite Wesley Co-ed. Jr. College Parasandher Road 300 003
SUB CONTRACTOR:	ABB LIMITED FARIDABAD
Project:	1 X 195-MW-KOTA THERMAL POWER STATION STAGE - V UNIT # 7

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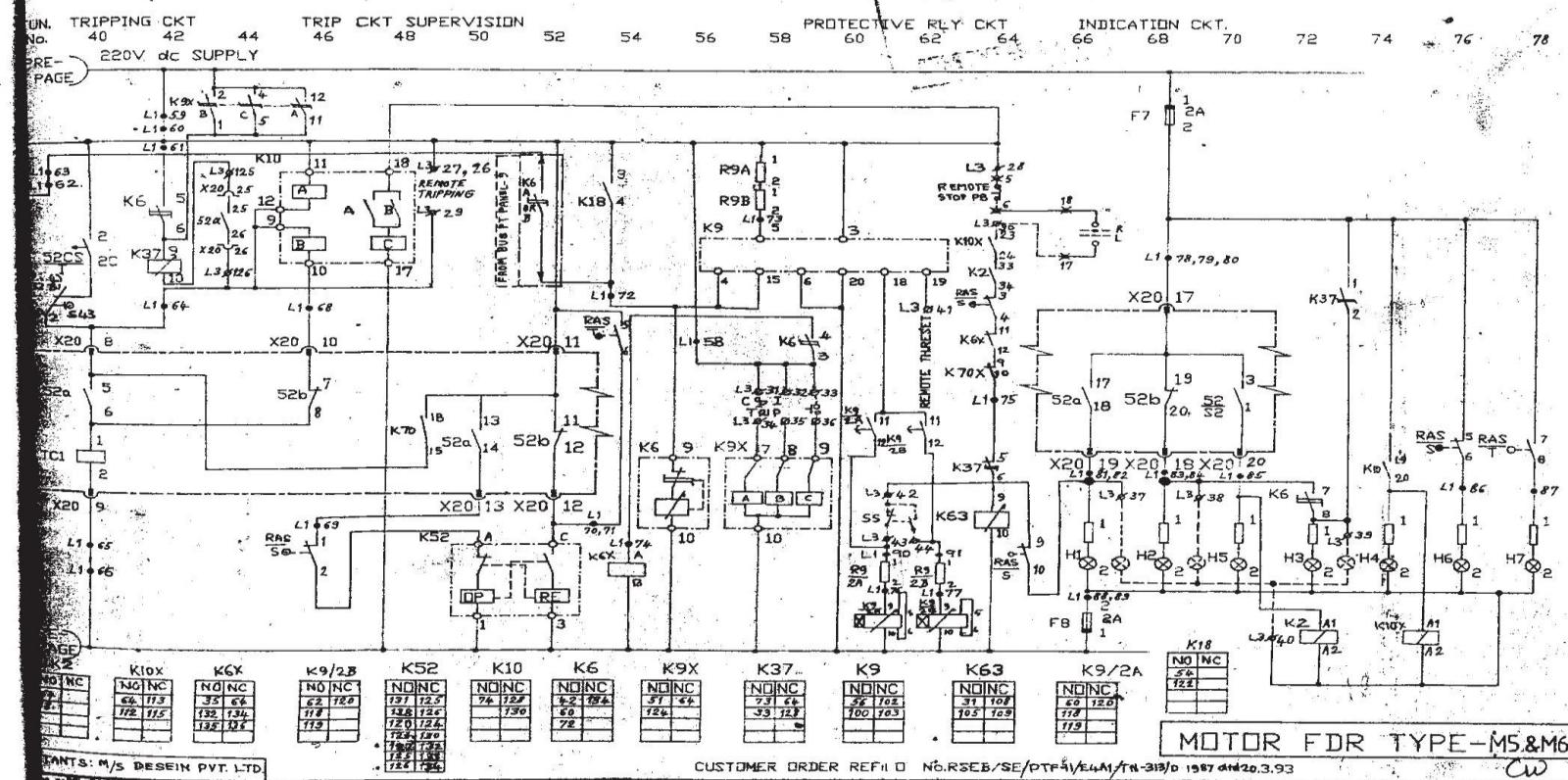


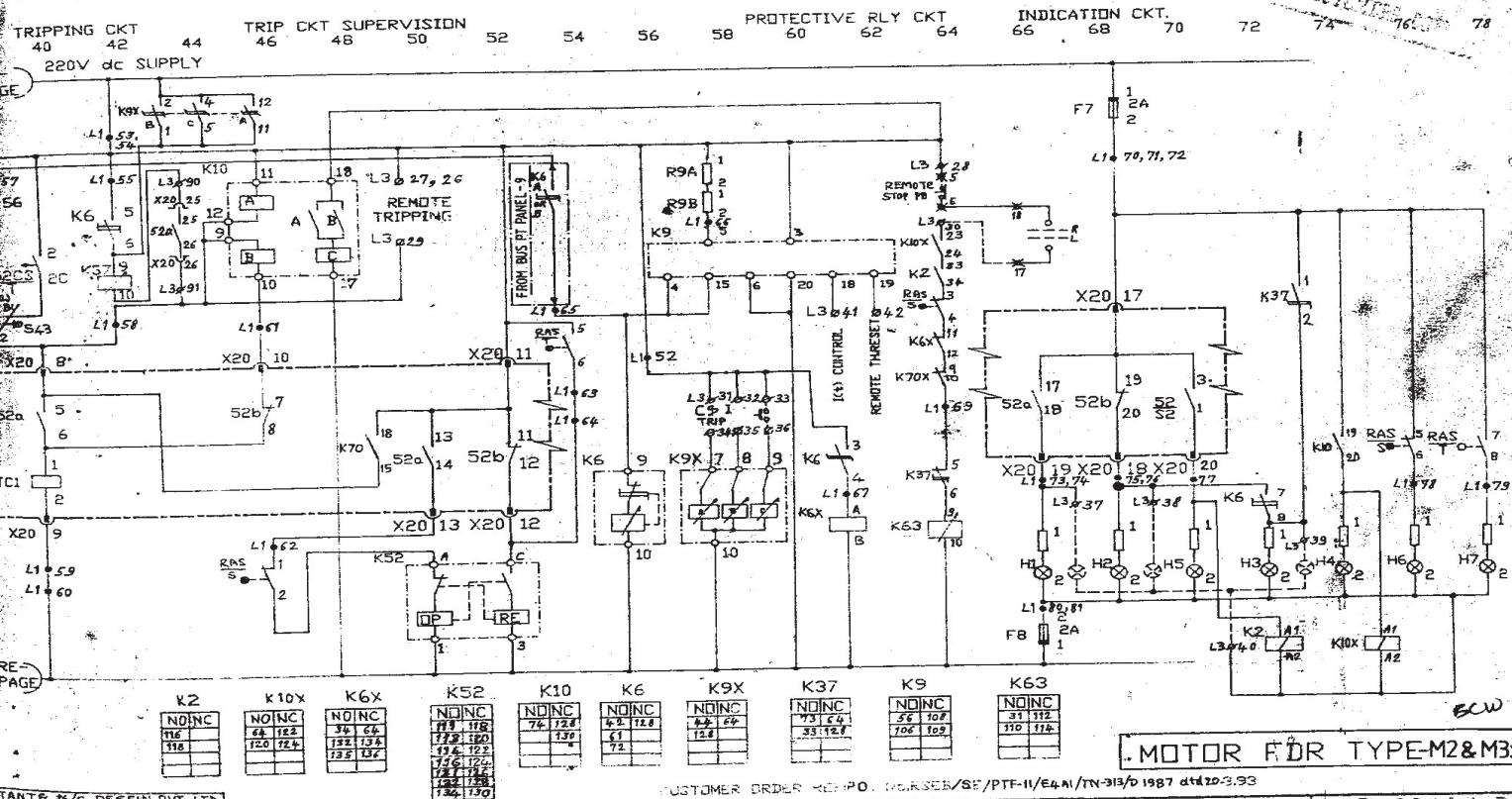


AS-CONTACTS ARE SHOWN FOR BREAKER IN SERVICE POSITION AS-T-SERVICE POSITION SWITCH IS IN OPERATED POSITION AS-T-TEST POSITION SWITCH IS IN UNOPERATED POSITION

Cw

51 55 III A





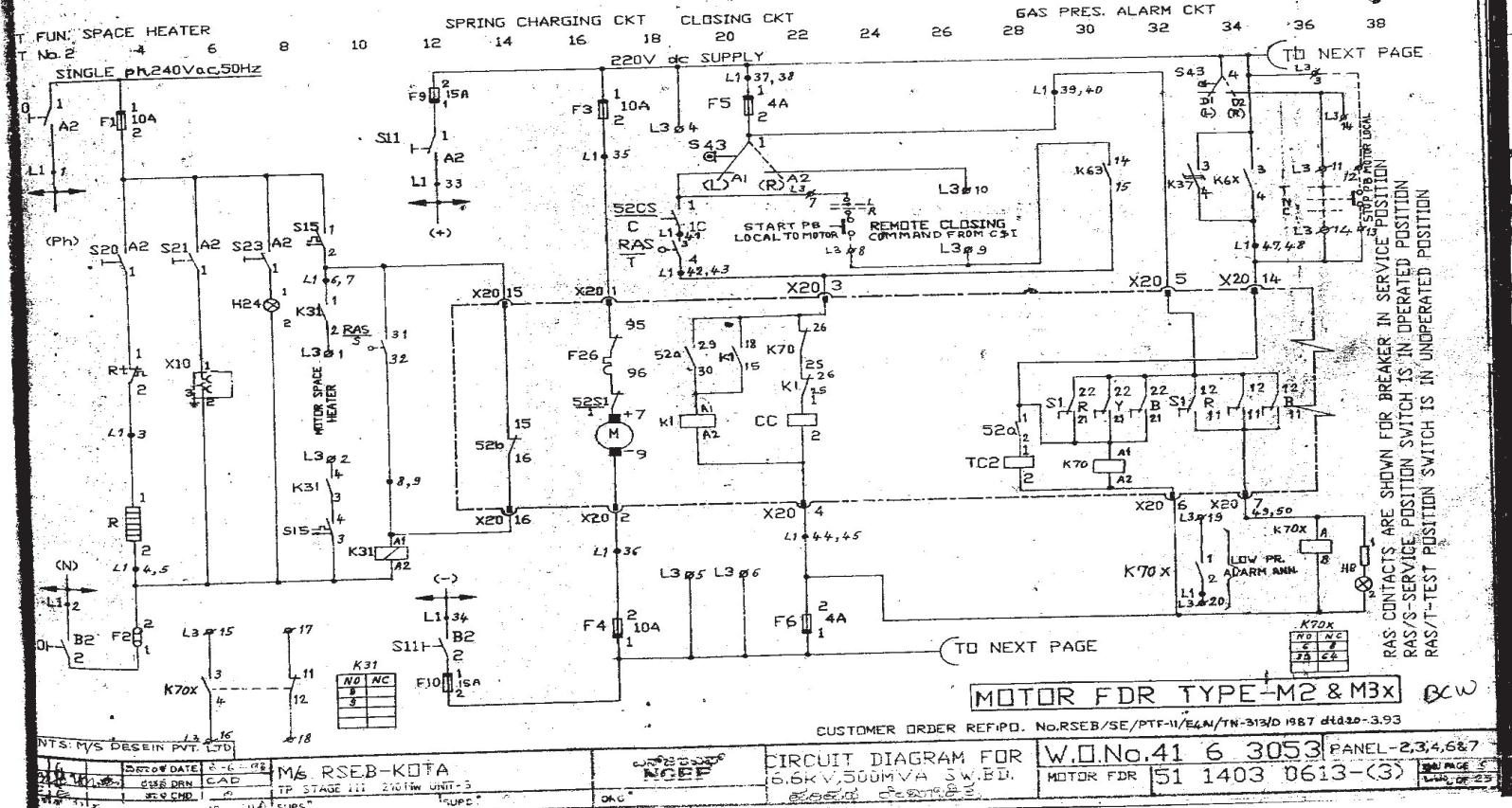
L T A N T & M Y S D E S I G N P V T . L T D .

CUSTOMER ORDER REPO. NO. 9255/SE/PIF-II/E4A/1/N-93/D 1987 QM-2-3-30

PANEL-2.3.4.6 & 7

CIRCUIT DIAGRAM  
5.6KV, 500MVA SW

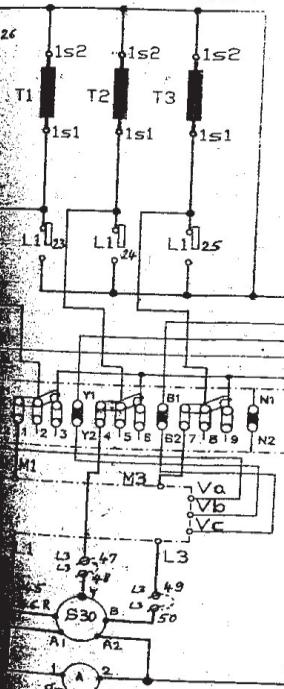
MOTOR FIR 151 1403 0613-(3)



FUNCTION METERING CORE  
No. 88 90 92 94

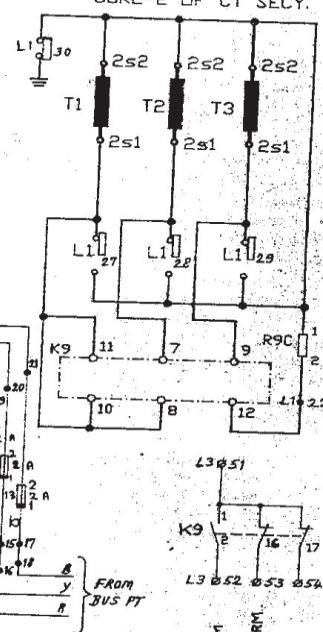
PROTECTION CORE  
96 98 100 102 104 106

CORE-1 OF CT SECY.

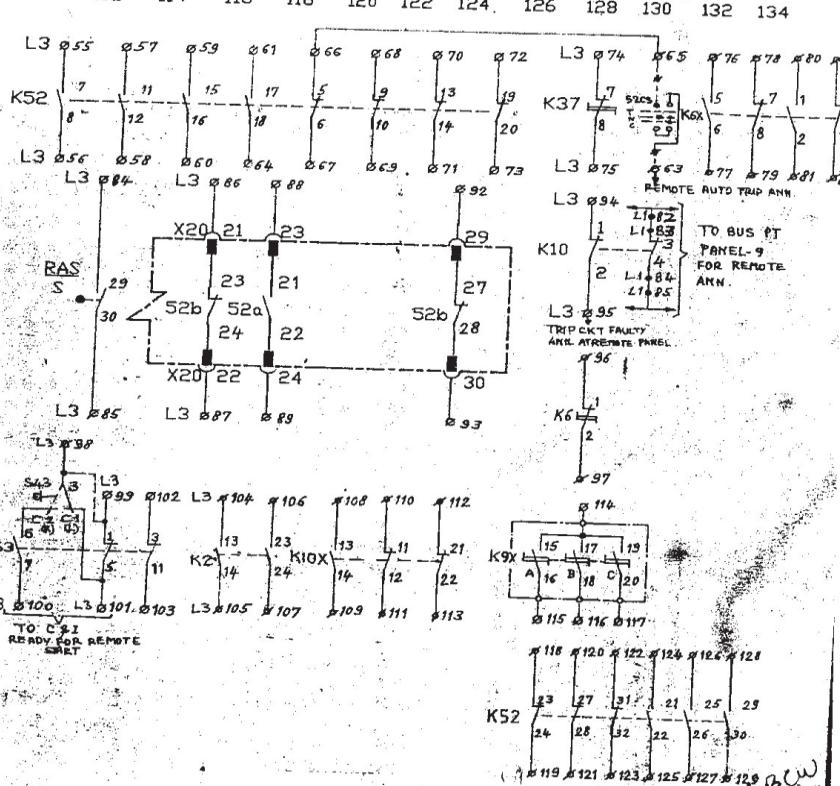


PROTECTION CORE  
108 110 112 114 116 118 120 122 124 126 128 130 132 134

CORE-2 OF CT SECY.



SPARE CONTACTS OF BKR, CONTACTORS, RELAYS



CUSTOMER ORDER REF ID. NO. NOSB/SE/PTF-II/E4A/TN 380/1987 DT 20.9.93

MOTOR FDR TYPE - M2 & M3

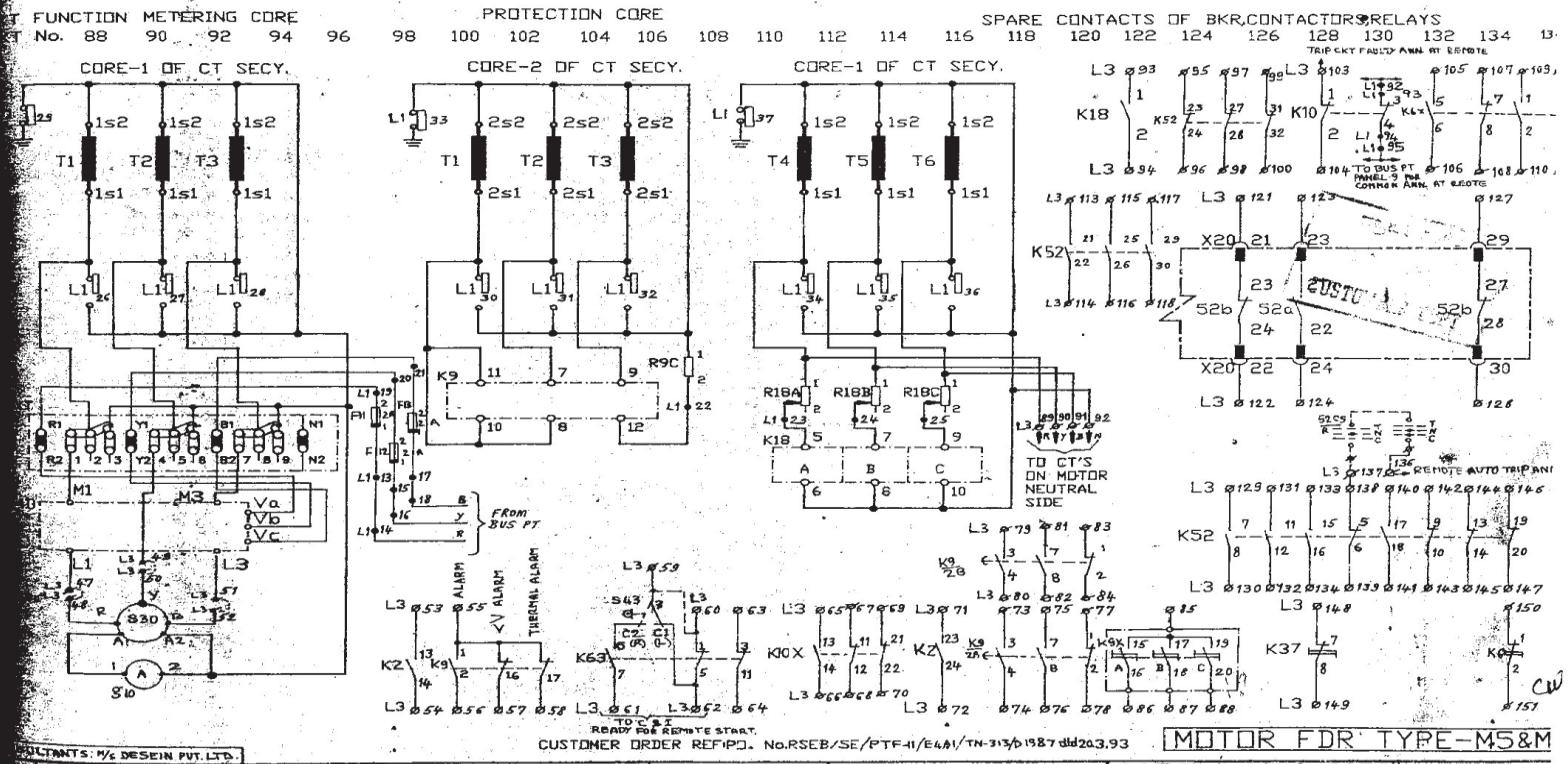
M/S DESEN PVT LTD

DATE 6-6-93  
DRAWN CAD  
REV CDR

M/S RS-B-KOTA  
TP STAGE III 210 MW

REF ID. NO. 10922226

CIRCUIT NO. 11M FOR W.O. NO. 416 31 PANEL 2,3,4,6



CONSULTANTS: M/S DESGIN PVT. LTD.

DESIGN NO:	DATE:	DESIGN DATE:
TDID 51	SI	6-93
TDID 51	SI	6-93

M/S RSEB-KOTA  
TP STAGE III 210 MW UNIT-5

NGEF

CIRCUIT DIAGRAM FOR  
6.6KV, 500MVA, SWBD.

W.O.No. 41 6 3053

PANELS & B

MOTOR FDR 51 1403 0613-(3)

CUSTOMER ORDER REF ID: NO.RSEB/SE/PTF-H/E4/1/TN-315/01587 dd203.93

**CW & ACW Pumps Details Unit # 6**

Sr. No.	Particulars of the Pump	Qty. Installed (Nos.)	Make	Bearing Nos.	Type	Model No.	S.No.	KW	Discharge M <sup>3</sup> /Hr	Head in MWC	RPM	Make of Motor	Sr. No. of Motor
1	CW Pump	3	KBL, Pune	Tilted Pad Type	Vertical Turbine	BHQ92 Single Stage	1525802004	1500	15500	25	476	CGL	VTPC 1700
2	ACW Pump	2	KBL, Pune	Tilted Pad Type	Vertical Turbine	BHR70M Single Stage	151360203	635	3000	55	949	CGL	VTPC 940

  
 XEN(CAM-I)