TINDIVANAM PHARMA PARK ASSOCIATION

Block – D1, Baid Metha Complex, No.16, Anna Salai, Little Mount, Saidapet, Chennai- 600 015

TENDER DOCUMENT

Tender Notice No. TPPA/CF Development/CETP/2024-25/01

Design, Engineering, Construction, Fabrication, Supply, Erection & Commissioning, and Testing of 250 KLD capacity Zero Liquid Discharge (ZLD) based Common Effluent Treatment Plant (CETP) on a Turn-key basis, including 12 months comprehensive Operation & Maintenance at TANSIDCO Pharma Industrial Park, Pellakuppam, Kollar & Venmaniyathur villages, Tindivanam Taluk, Villupuram District, Tamil Nadu.

Date of Release of Bid Document	03.11.2024
Pre-bid Meeting	18.11.2024
Last Date for Submission of Bid	03.12.2024
Date of Opening of Bid	03.12.2024

CONTENTS

TENDER NOTICE

M/s Tindivanam Pharma Park Association (TPPA)

Block – D1, Baid Metha Complex, No.16, Anna Salai, Little Mount, Saidapet, Chennai – 600 015

TENDER NOTICE
Reference No: TPPA/CF Development/CETP/2024-25/01

M/s Tindivanam Pharma Park Association invites bids from prospective bidders for the following work.

- Design, Engineering, Construction, Fabrication, Supply, Erection & Commissioning, and Testing of 250 KLD capacity Zero Liquid Discharge (ZLD) based Common Effluent Treatment Plant (CETP) on Turn-key basis, including 12 months comprehensive Operation and Maintenance

at TANSIDCO Pharma Industrial Park, Pellakuppam, Kollar & Venmaniyathur villages, Tindivanam Taluk, Villupuram District, Tamil Nadu. Tender documents can be obtained at the TPPA address in Chennai from 03.11.2024 to 03.12.2024 on payment of Rs.17,700/- or can be downloaded free of cost from the website www.tppa.in, www.tansidco.tn.gov.in & www.itcot.com. Contact details: R.Pradeep, Ph:+91 9003030898 E-mail – officetppa@gmail.com

Managing Director, TPPA

IMPORTANT NOTICE

The Tamil Nadu Transparency in Tenders Act, 1998 and The Tamil Nadu Transparency in Tender Rules, 2000 as amended, govern this tender procedure from time to time. In case of any conflict between the terms and conditions in the tender document and the Tamil Nadu Transparency in Tenders Act, 1998 and The Tamil Nadu Transparency in Tender Rules, 2000 the Act and Rules shall prevail.

Design, Engineering, Construction, Fabrication, Supply, Erection & Commissioning, and Testing of 250 KLD capacity Zero Liquid Discharge (ZLD) based Common Effluent Treatment Plant (CETP) on Turn-key basis, including 12 months of comprehensive Operation & Maintenance at TANSIDCO Pharma Industrial Park in Pellakuppam, Kollar & Venmaniyathur villages, Tindivanam Taluk, Villupuram District, T.N.

1. PREAMBLE

Micro, Small and Medium Enterprises (MSME) Department, Government of Tamil Nadu, under the Mega Cluster Development Scheme, through Tamil Nadu Small Industries Development Corporation (TANSIDCO), has established a Pharma Park with 46 industrial plots exclusively for Orange Category pharmaceutical formulation companies at TANSIDCO Pharma Industrial Park in Pellakuppam, Kollar & Venmaniyathur villages, Tindivanam Taluk, Villupuram District. 35 individual companies have been allotted plots in the Pharma Park to set up their formulation units.

The allottees of the Pharma Park have set up a Special Purpose Vehicle (SPV) in the name and style of "**Tindivanam Pharma Park Association (TPPA)**" which has all the member units as part of the SPV that would install, manage and administer the common facilities in the Pharma Park.

One of the important common facilities to be set up in the Pharma Park is the "Common Effluent Treatment Plant (CETP)", hereinafter referred to as "CETP" in this tender document.

The CETP has to be designed in a modular way and shall have a total installed capacity of 250 KLD (input basis). Being an Orange Category Pharma Park, the influent characteristics are not expected to be hard, and the treatment system has to be designed appropriately.

All member units of the park will have independent collection tanks at their premises from which the CETP will collect the influent/input water through a piped network. **This collection and pumping of the influent from member units and the associated infrastructure is NOT part of this tender.**

The CETP shall be installed within the Pharma Park in a designated area (refer Annexure-X, Section - 5) and shall be self-contained with its own utilities not limited to Electrical power, Steam, Cooling water and necessary civil infrastructure including buildings, civil structures, internal roads, etc.

The detailed specifications for each of the disciplines are provided in Annexure - X of this document.

Note: The specifications provided in Annexure - X of the Tender Document are only a tentative scheme detail, not an Engineering Design. Bidders are encouraged to provide their own best design options for the CETP on the lines proposed in the Process Flow Diagram with suitable optimum modifications and development as may be required to meet the desired output parameters.

2.	**SCOPE OF WORK**
2.1	**DESIGN, ENGINEERING, CONSTRUCTION, FABRICATION, SUPPLY, ERECTION, TESTING AND COMMISSIONING OF 250 KLD CAPACITY ZERO LIQUID DISCHARGE (ZLD) BASED COMMON EFFLUENT TREATMENT PLANT (CETP) ON TURN-KEY BASIS, INCLUDING 12 MONTHS COMPREHENSIVE OPERATION AND MAINTENANCE**

The scope of work would inter-alia involve the following:

Design, Engineering, Construction, Fabrication, Supply, Erection, Testing & Commissioning of 250 KLD capacity Zero Liquid Discharge (ZLD) based Common Effluent Treatment Plant (CETP) on Turn-key basis, including 12 months comprehensive Operation & Maintenance at TANSDICO Pharma Industrial Park, Tindivanam Taluk, Villupuram District.

a. Technical Specification of the CETP including design parameters, guarantee parameters, process flow diagram, plant sizing, details of mechanical components & civil structures required along with limiting parameters, piping & electrical works required are enclosed in Annexure - X of this Tender Document.

b. The 12-month comprehensive operation and maintenance (O&M) period for the CETP shall commence from the date of commercial operation (COD).

c. The maximum quantity of influent shall be considered at 50 KLD during the 12-month O&M period.

2.2 PRICE DISCOVERY FOR VARIOUS CAPACITIES OF OPERATION

The bidders are required to provide a fixed annual O&M cost for each of the following input capacity levels

% of Input Capacity per Annum	Price in Rs	Condition
10% (25 KLD)		• Bidders are required to submit their most competitive price, considering the operating capacity listed in the respective rows. • The submitted price should be an optimum balance of variable costs, such as power, fuel, consumables & other variable expenses and fixed costs, such as manpower, maintenance, profit margin & other fixed expenses. • Bidders are advised to provide a breakdown of these costs as per Annexure – XII.
20% (50 KLD)		
30% (75 KLD)		
50% (125 KLD)		
60% (150 KLD)		

- **The request for the operation and maintenance (O&M) costs for different input capacities is solely for the purpose of price discovery and understanding the operational modalities of various bidders. It will not be included in the evaluation of the price bids.**
- Bidders are required to provide a detailed breakdown of fixed and variable costs as per the template outlined in Annexure - XII.
- TPPA, in its own discretion may or may not engage the successful bidder to carry out the O&M beyond the 12-month O&M period.

3.	QUALIFICATION CRITERIA

Clause	Qualification Criteria	Documentary proof to be uploaded
3(a)	The Bidder should be a Registered Legal Entity in India and should have been in existence for the past five years as on the last date of submission of the Bid.	i. In case of Private/Public Limited Companies • Copy of Incorporation certificate issued by Registrar of Companies • Copy of Memorandum and Articles of Association ii. In case of Partnership, • Registered Partnership deed iii. In case of Proprietorship, • Copy of GST Registration certificate
3(b)	The Bidder should have undertaken and successfully completed similar works: a) One similar project of not less than 200 KLD common effluent treatment plant/ effluent treatment plant with successful Operation and Maintenance for at least one year during the last 5 years as on last date of tender submission or b) Two similar projects of not less than 100 KLD for each common effluent treatment plant/effluent treatment plant with successful Operation and Maintenance for at least one year during	List of projects carried out in execution of common effluent treatment plant/effluent treatment plant in the last five years as on last date of tender submission supported by Letter of Award / Work Orders, Work completion certificates or handing over certificates (As per Annexure-III) duly certified by the principal employer.

	the last five years as on last date of tender submission or c) Three similar projects of not less than 75 KLD for each common effluent treatment plant/effluent treatment plant with successful Operation and Maintenance for at least one year during the last five years as on last date of tender submission 'Similar Works' means completion of the project of Design and Construction of Common Effluent Treatment Plant / Effluent Treatment Plant along with Operation and Maintenance for at least one year during the last five years as on last date of tender submission.	
3(c)	The Bidder should have an average annual turnover of at least **Rs. 30.00 Crores** (excluding GST) in the last five financial years i.e., FY2019-20, FY2020-21, FY2021-22, FY2022-23 and FY2023-24.	• Audited Balance Sheet/ / certified copies of Balance Sheet, Profit & Loss statement along with schedules for the FY2019-20, FY2020-21, FY2021-22, FY2022-23 and FY2023-24 duly certified by the practicing Chartered Accountant. • Details of the Annual Turnover as per Annexure- IV.

3(d)	The Bidder should have a positive net worth as on March 31, 2024.	Net worth duly certified by Chartered Accountant along with UDIN as per Annexure – V.
3(e)	The Bidder should not have been blacklisted by SIDCO or any other Government agency / Central and State Public Sector Organizations.	i. Declaration for not having been blacklisted either by any other Govt. agencies as per Annexure-VI. ii. Further, if the Bidder is found to be blacklisted in India before award of the contract by any Government Agency, the bid will be rejected.

4.	**PERSON SIGNING THE BID**

The person signing the Tender document should be the duly authorized representative of the firm/ company, for which a certificate of authority should be submitted. The Power of Attorney /authority to the authorized signatory must be enclosed in detail.

5.	**LANGUAGE OF THE TENDER**

The Tender preparation as well as all correspondences and documents relating to the Tender, shall be in English language only. If the supporting documents are in a language other than English/Tamil, the notarized translated English version of the documents should also be enclosed. Bids received without such translation copy will be rejected.

6.	**PURCHASE / DOWNLOADING OF TENDER DOCUMENTS**

Tender Documents can be purchased on payment of Rs.17,700/- (Rupees Seventeen Thousand Seven Hundred only) including GST by Demand Draft in favour of Tindivanam Pharma Park Association payable at Chennai at Tindivanam Pharma Park Association, Block – D1, Baid Metha Complex, No.16, Anna Salai, Little Mount, Saidapet, Chennai from **03.11.2024 to 02.12.2024 between 10:00 AM to 05:00 PM.**

Alternatively, the Tender Documents can be downloaded from either www.tppa.in, www.tansidco.tn.gov.in or www.itcot.com free of cost from 03.11.2024 to 03.12.2024. For the downloaded Tender Document, the Bidder need not enclose the Tender Document cost but should give a declaration for not having tampered the Tender Document downloaded (as per Annexure - VII)

Purchased Tender documents are not transferable and will be accepted only by the parties who have purchased the documents from TPPA. The TENDER document submissions without duly signed documents/ drawings are considered as invalid submissions.

7.	**PREBID MEETING**

a. There will be a pre-bid meeting on 18.11.2024 at 11.00 A.M in the office of Tindivanam Pharma Park Association at Block – D1, Baid Metha Complex, No.16, Anna Salai, Little Mount, Saidapet, Chennai during which the prospective Bidders can get clarifications about the tender.
b. The Bidders interested in attending the Pre-Bid meeting may send an email, indicating their willingness along with their representative details i.e., Name, Designation, Phone Number & Email ID to officetppa@gmail.com atleast one day prior to the Pre-Bid meeting date. The link for the video conferencing will be sent to the designated representative by E-mail.

8.	**SITE VISIT**

The site of the proposed development is located at TANSIDCO Pharma Industrial Park at Pellakuppam, Kollar & Venmaniyathur villages, Tindivanam Taluk, Villupuram District, Tamil Nadu and may be inspected by the Bidder or his / her representative at his / her own cost, with prior intimation to the authorized representative of TPPA through an email to officetppa@gmail.com. In case of any queries related to the site inspection, Bidders may contact Mr R Pradeep, Mobile No: +91 9003030898. The Bidder should refer to the Site Plan and Location Map enclosed with the Tender document.(Annexure – X, Section - 5).

9.	**CLARIFICATION ON THE TENDER DOCUMENT**

Any discrepancies, omissions, ambiguities or conflicts in the tender document or any doubts as to their meaning and any request for clarification may be sent in writing to "The Chairman, Tindivanam Pharma Park Association, Block-D1, Baid Metha Complex, No-16, Anna Salai, Little Mount, Saidapet, Chennai" or through e-mail to officetppa@gmail.com as per Annexure-VIII. The Managing Director (MD), TPPA, will review the same and where the information sought is not clearly indicated or specified in the tender documents, will issue a clarifying bulletin to all those who have purchased the tender documents and will also upload such clarification on www.tppa.in, www.tansidco.tn.gov.in & www.itcot.com. The MD, TPPA will neither make nor be responsible for any oral instructions. Request for clarification should be brought to the notice of the MD, TPPA, in mail, before 48 hours of the opening of the tender.

10.	**AMENDMENT OF TENDER DOCUMENT**

TPPA, whether on its own initiative or because of a query, suggestion or comment of an Applicant or a Respondent, may modify the tender document by issuing an addendum or a corrigendum at any time before the opening of the tender. Any such addendum or corrigendum will be communicated through mail to all the Bidders who had purchased the tender documents and will be uploaded in www.tppa.in, www.tansidco.tn.gov.in & www.itcot.com and the same will be binding on all Applicants or Bidders, as the case may be.

11.	**EARNEST MONEY DEPOSIT**

The Tender should be accompanied by an Earnest Money Deposit (EMD) to the value of Rs.20,00,000/- (Rupees Twenty Lakh only), including GST, in the form of Demand Draft (DD) in favour of Tindivanam Pharma Park Association payable at Chennai. EMD should be in the name of the Bidder/ Firm. Bidders are to provide their GST Registration details.

a. EMD in any other form will not be accepted.

b. EMD will be retained in the case of the successful Bidder and will not earn any interest. It will be dealt with, as provided in the terms and conditions of the tender. The EMD will be returned to the unsuccessful Bidders.

c. Any request of the Bidder, under any circumstances, claiming exemption from payment of EMD will be rejected and their Cover II price offer will not be opened.

The amount remitted towards EMD is liable to be forfeited in case the Bidder fails to execute the contract or after acceptance of the offer by TPPA or fails to sign the contract or to remit the Performance Security within the stipulated time.

12.	**SUBMISSION OF TENDER UNDER TWO COVER SYSTEM**

Sealed Tenders should be addressed to The Managing Director, Tindivanam Pharma Park Association, Block – D1, Baid Mehta Complex, No.16, Anna Salai, Little Mount, Saidapet, Chennai, and superscribing the **Name of the Tender** on the top left-hand corner of the cover and the name of the Bidder on the bottom left-hand corner of the cover and should be submitted in physical form till 03.12.2024, 3.00 PM. **Tenders should be submitted in person only**.

The Tender will be a Two Cover System,

A. Cover – I (Technical Bid)

Should consist of the Pre-qualification criteria, conditions of the contract and technical specifications along with EMD. Technical bids should be submitted in the original.

Cover – 1 should contain the above in sub-covers as listed below.

- **Sub Cover – 1** – EMD (Demand Draft in Original)
- **Sub Cover – 2** – Signed copy of the Tender Document with all annexures and supporting documents
  a. All Tender drawings obtained from TPPA should be duly signed in original and affixed with the seal of the Bidder along with the submission of the Tender Documents.
  b. Bidder should submit the required EMD in separate sealed envelopes duly superscribed on the Sub Cover – 1 of the Envelope viz. "EMD" along with Cover – 1. The Tenders received without EMD will be summarily rejected.

c. If the Technical bid shows any indication of the quoted price directly or indirectly, the bid will be rejected summarily.

d. If due to any exigency, the due date for submission and opening of tender is declared a closed holiday, in such a case, the tenders will be opened on the next working day at the same time or any other day/time as intimated by TPPA.

B. Cover – II (Price Bid)

i. Should consist of **Price Bid as per Part – 2** of the Tender Document. Price bid should be submitted in the original. In case of any discrepancy between the price quoted in words and in figures, lowest of the two will be considered.

ii. The price bid consists of two components. The bidders should offer their rates for the following

1. Design, Engineering, Construction, Fabrication, Supply, Erection, Testing & Commissioning of 250 KLD capacity Zero Liquid Discharge (ZLD) based Common Effluent Treatment Plant (CETP) on Turnkey basis including 12 months comprehensive Operation & Maintenance.
    i. Bidders to consider a maximum of 20% of the total capacity as the influent during the 12-month O&M period.
2. The bidder shall provide a fixed annual O&M cost for each of the following input capacity levels.

% of Input Capacity per Annum	Price in Rs
10% (25 KLD)	
20% (50 KLD)	
30% (75 KLD)	
50% (125 KLD)	
60% (150 KLD)	

- The request for the operation and maintenance (O&M) costs for different input capacities is solely for the purpose of price discovery and understanding the operational modalities of various bidders. The

requested costs will not influence or be included in the evaluation of the price bids.

iii. The rate quoted by the bidder shall be kept firm for a period specified in the tender from the date of opening of the tender. The bidder should keep the Price firm during the entire period of Contract including extension of time if any. Escalation of rate will not be permitted during the said periods whether extended or not for reasons other than increase of taxes payable to the Governments in India within the stipulated delivery period.

Cover – I and Cover – II should be kept together in a separate sealed cover superscripted as **"Tender for Design, Engineering, Construction, Fabrication, Supply, Erection, Testing & Commissioning of 250 KLD capacity Zero Liquid Discharge (ZLD) based Common Effluent Treatment Plant (CETP) on Turn-key basis, including 12 months of comprehensive Operation & Maintenance at TANSIDCO Pharma Industrial Park, Pellakuppam, Kollar & Venmaniyathur Villages, Tindivanam Taluk, Villupuram District"** and addressed to **The Managing Director, Tindivanam Pharma Park Association, Block – D1, Baid Mehta Complex, No.16, Anna Salai, Little Mount, Saidapet, Chennai** with the name and address of the Bidder at the left side corner of the cover. Tender submitted in unsealed cover would be summarily rejected.

13.	**VALIDITY**

The prices quoted in the Tender should be valid for acceptance by TPPA for a minimum period of 120 days from the date of opening of the Tender. Escalation in the rates will not be entertained under any circumstances.

14.	**BID DUE DATE**

a. Bid and Enclosures of Bid should be submitted on or before the Bid Due Date i.e., 03.12.2024, 3.00 PM in the manner and form as detailed in this Tender Document.

b. TPPA may, in its sole discretion, extend the Bid Due Date by issuing and addendum in accordance with Clause 10.

c. If due to any exigency, the due date for submission and opening of tender is declared a closed holiday, in such case the tenders will be opened on the next working day at the same time or any other day/time as intimated by TPPA.

15.	**LATE BIDS**

Bid received physically by TPPA after the specified time on the Bid Due Date will not be opened and will be summarily rejected.

16.	**MODIFICATION / SUBSTITUTION / WITHDRAWAL OF BIDS**

a. No Bid should be modified, substituted or withdrawn by the Bidder on or after the Bid Due Date & Time.
b. Any alteration/modification in the Bid or additional information supplied subsequent to the Bid Due Date, unless the same has been expressly sought for by TPPA, will be disregarded.

17.	**REJECTION OF BIDS**

a. Notwithstanding anything contained in this Tender Document, TPPA reserves the right to reject any Bid and to annul the Bidding Process and reject all Bids at any time without any liability or any obligation for such acceptance, rejection or annulment, and without assigning any reasons, therefore. In the event that TPPA rejects or annuls all the Bids, it may, in its discretion, invite all eligible Bidders to submit fresh Bids hereunder.
b. TPPA reserves the right not to proceed with the Bidding Process at any time, without notice or liability, and to reject any Bid without assigning any reasons.

18.	**OPENING AND EVALUATION OF THE TECHNICAL BID**

The Tenders will be opened in the presence of committee authorized by TPPA on 03.12.2024 at 3:30 PM.

Evaluation of Technical Bid would involve three stages as follows.

i. **First Stage**:

a. The Sub Cover - 1 containing the EMD. If EMD is not submitted or is deficient, the tender will be summarily rejected.

ii. Second Stage:

a. Evaluation will be done on the Technical Bid to assess whether the bid meets the qualification criteria stipulated in Clause – 3.

b. The committee reserves the right to disqualify any of the tender in case the Committee is not satisfied with the documents furnished, including the past performances.

c. Any adverse / not satisfactory remarks on the performance from the clients of previous contracts will entail disqualification of the tender and price bids will not be opened.

iii. Third Stage

a. The Bidders who meet the pre-qualification criteria will be called for a technical presentation before the technical committee formed by TPPA. Date and time of the technical presentation (PowerPoint presentation) shall be intimated to the qualified Bidders in Stage – 1 & 2 through email to their registered email id and mobile number submitted by the bidder in the tender document.

b. The criteria for evaluation of technical bid are as under:

<table>
<tr><th>Part</th><th>Parameter</th><th>Score Details</th><th>Maximum Total Score</th></tr>
<tr><td>1.</td><td>The Bidders satisfying Qualification criteria as per the Clause 3(c) of the Tender document</td><td><table><tr><th>Capacity In KLD</th><th>No of project(s)</th><th>Score</th></tr><tr><td>200</td><td>1</td><td rowspan="3">40</td></tr><tr><td>100</td><td>2</td></tr><tr><td>75</td><td>3</td></tr></table></td><td>40</td></tr>
<tr><td>2.</td><td>Additional Experience
Apart from satisfying the Qualification Criteria as per Clause 3(c), additional experience in undertaking and successful completion of Common Effluent Treatment Plant with a minimum capacity of 75 KLD along with Operation and Maintenance for at least one (1) year in the last five years</td><td><table><tr><th>No of Project(s)</th><th>Score</th></tr><tr><td>1</td><td>10</td></tr><tr><td>2 and above</td><td>20</td></tr></table></td><td>20</td></tr>
<tr><td>3.</td><td>Experience in Supply, installation, and commissioning of at least one (1) 1 TPH Steam generation boiler along with required Indian Boiler Regulation (IBR) steam piping & approvals in said CETP/ ETP projects</td><td><table><tr><th>No of Project(s)</th><th>Score</th></tr><tr><td>1</td><td>3</td></tr><tr><td>2 and above</td><td>5</td></tr></table></td><td>5</td></tr>
<tr><td>4.</td><td>Experience in Supply, installation and commissioning of atleast one 500 or above kVA-11 kV/415V Transformer, HT Yard, MV panels, DG Set with CEIG approvals in said CETP/ETP projects</td><td><table><tr><th>No of Project(s)</th><th>Score</th></tr><tr><td>1 and above</td><td>5</td></tr></table></td><td>5</td></tr>
<tr><td>5.</td><td>Technical Presentation</td><td>• Technology proposed
• Qualification and experience of the execution team</td><td>30</td></tr>
</table>

		• Plans for O&M and cost incurred • Timeline for completion	
		GRAND TOTAL	**100**

c. Only Bidders whose Technical Proposals get an overall score of 70 (Seventy Only) and above shall be declared as technically qualified.

d. The Bidders declared as technically qualified will be informed the date of opening of the Price bid through E-mail.

19. EVALUATION OF THE PRICE BID

a. The price bid will be evaluated in accordance with the Tamil Nadu Transparency in Tenders Act, 1998 read with the Tamil Nadu Transparency in Tenders Rules, 2000.

b. The evaluation of the price bid will be carried out as given below.

Rate quoted for Design, Engineering, Construction, Fabrication, Supply, Erection, Testing & Commissioning of 250 KLD capacity Zero Liquid Discharge (ZLD) based Common Effluent Treatment Plant (CETP) including 12 months of comprehensive Operation & Maintenance

c. The Bidder who has quoted the lowest price as clause 19 (c) will be adjudged L1.

d. The request for the operation and maintenance (O&M) costs for different input capacities is solely for the purpose of price discovery and understanding the operational modalities of various bidders. The requested costs will not influence or be included in the evaluation of the price bids.

20. CLARIFICATION ON THE PRICE BID

a. Information relating to the evaluation of bids and recommendation of Contract award, will not be disclosed to Bidders or any other persons not officially concerned with such process until information on Contract award is communicated to the successful Bidder.

b. Any attempt by a Bidder to influence TPPA in the evaluation of the bid or contract award decisions may result in the rejection of the Bid.

c. To assist in the examination, evaluation, and comparison of the Technical and Price bid, and qualification of the Bidders, TPPA may, as its discretion, ask any Bidder for a clarification of the bid, giving a reasonable time for a response. Any clarification submitted by a Bidder that is not in response to a request by TPPA will not be considered. TPPA's request for clarification and the response should be in writing. No change in the substance of the Technical bid or prices in the Price bid, including any voluntary increase or decrease in the prices, shall be sought, offered, or permitted.

d. If the Bidder does not provide clarifications of the bid by the date and time set in the TPPA's request for clarification, the bid may be rejected.

e. If a Technical bid is not substantially responsive to the requirements of the Tender Documents, it will be rejected by TPPA and may not subsequently be made responsive by correction of the material deviation, reservation, or omission.

21.	**AWARD OF CONTRACT**

a. The Bidder (L1) will be invited for price negotiations for further reduction of the rate.

b. Upon finalization of the negotiated rate, TPPA will issue the Letter of Award (LoA) to the successful Bidder.

22.	**PERFORMANCE SECURITY**

i. Design, Engineering, Construction, Fabrication, Supply, Erection, Testing & Commissioning of 250 KLD capacity Zero Liquid Discharge (ZLD) based Common Effluent Treatment Plant (CETP), including 12 months comprehensive Operation & Maintenance.

a. At the time of signing of the Contract, the successful Bidder should furnish the Performance Security in accordance with the Conditions of the Contract, to ensure due performance of the contract, Performance Security is to be given in the form of Demand Draft/ Bank Guarantee from any Nationalized Bank /Scheduled Bank in favour of TPPA by the successful Bidder.

b. Performance Security shall be 10% of the work order value (inclusive of GST) minus EMD already remitted along with the Tender, in the form of a Demand Draft/ Bank

Guarantee with a valid period mentioned below in favour of TPPA payable at Chennai in the name of the Bidder/ Firm from any Nationalized Bank / Scheduled Bank to be given within 15 days from the date of issue of work order before execution of the contract.

c. 100% of Performance Security will be released upon the expiry of the defect liability period as per Clause 26.
d. TPPA will en-cash the Performance Security as compensation for any loss resulting from the Contractor's failure to complete his / her obligations under the Contract.

23.	**SIGNING OF CONTRACT**

a. The successful Bidder should execute the contract as may be drawn up to suit the conditions on a non-judicial stamp paper of value, as prescribed in law, and shall pay for all stamps and legal expenses incidental thereto. In the event of failure to execute the contract, within the time prescribed, the Performance Security/EMD amount remitted by the Bidder will be forfeited besides cancellation of the Tender.

b. If the contract is not executed as per the agreed terms and conditions, TPPA will hold full authority to cancel the tender or take any such action that will be deemed fit to the occasion at the risk and cost of the successful Bidder. Such cancellation will entail the forfeiture of Performance Security/EMD.

c. In the event of non-performance of the contractual provisions and if the selected Bidder has not fulfilled the contractual obligation with TPPA in any manner during the currency of the contract or also found on a later date, TPPA reserves the right to disqualify such Bidder from participating in future tenders or blacklist the Bidder up to a maximum period of 3 years.

24.	**RETENTION MONEY**

Retention Money will be 5% against each bill. The same will be released upon successful COD and completion of O&M period of 12 months and handing over of all the works certified by TPPA / Consultants appointed by TPPA.

25. ISSUE OF WORK ORDER

After payment of the Performance Security and successful execution of the contract, the work order will be issued by TPPA. The Bidder should complete the works as per the schedule given in Clause 27.

26. DEFECT LIABILITY PERIOD AND ITS RECTIFICATIONS

a. Defect Liability period will be twelve months from the date of COD. Any defect arising in the work during the set period due to faulty workmanship and faulty materials should be rectified by the contractor at his / her own cost.

b. If the contractor has not corrected a Defect pertaining to the Defect Liability Period to the satisfaction of the Engineer-in-charge of TPPA, within the time specified by the Engineer-in-charge, the Engineer-in-charge will assess the cost of having the Defect corrected, and the cost of correction of the Defect shall be recovered from the Performance Security or any amount due or that may become due to the contractor and other available securities.

27. TIMELINE

a. The Design, Engineering, Construction, Fabrication, Supply, Erection & Commissioning, and Testing of 250 KLD capacity Zero Liquid Discharge (ZLD) based Common Effluent Treatment Plant (CETP) should be completed within a period of 12 months. The completion of the project includes a 12-month period of Operation & Maintenance (O&M) work from the date of successful completion of erection & commissioning stage and subsequent handover of the CETP to TPPA. The project schedule is provided as follows.

S. No	Description	Timeline
1.	Commencement of work	T
2.	Completion of 10% of the Contract Value	T + 2 months
3.	Completion of 25% of the Contract Value	T + 4 months
4.	Completion of 40% of the Contract Value	T + 6 months
5.	Completion of 60% of the Contract Value	T+ 8 months
6.	Completion of 75% of the Contract Value	T+10 months

7.	Completion of 90% of the Contract Value i.e. COD	T+12 months
8.	Completion of 12 months Operation & Maintenance work	T + 24 Months

b. If the contract is not completed within the stipulated time or extended time, TPPA will hold full authority to cancel the tender or take any such action that will be deemed fit to the occasion at the risk and cost of the successful Bidder. Such cancellation will entail forfeiture of Performance Security.

28. FORCE MAJEURE

a. The Bidder shall not be liable for penalty or termination for default if and to the extent that it's delay in performance or other failure to perform its obligations under the Contract is the result of an event of Force Majeure.

b. For purposes of this clause, "Force Majeure" means an event beyond the control of the Bidder and not involving the Bidder/ fault or negligence, and not foreseeable. Such events may include, but are not restricted to, acts of the TPPA in its capacity as a buyer, wars or revolutions, terrorist attacks, fires, floods, epidemics, quarantine restrictions and freight embargoes.

c. If a Force Majeure situation arises, the Bidder shall promptly notify the TPPA in writing of such condition and the cause thereof. Unless otherwise directed by the TPPA in writing, the contractor shall continue to perform its obligations under the Contract as far as is reasonably practical and shall seek all reasonable alternative means for performance not prevented by the Force Majeure event.

29. MOBILIZATION ADVANCE

TPPA will make an advance payment ("Mobilization Advance") on request from the successful Bidder, equal to 10% of the contract value (including GST) against the Bank Guarantee for mobilization expenses.

The mobilization advance will be recovered in equal installments against the payments made to the contractor before the payment reaches 80% of the total Contract Value.

30. PAYMENT TERMS

i. Design, Engineering, Construction, Fabrication, Supply, Erection, Testing & Commissioning of 250 KLD capacity Zero Liquid Discharge (ZLD) based Common Effluent Treatment Plant (CETP), including 12 months comprehensive Operation & Maintenance.

TPPA will make an advance payment ("Mobilization Advance") on request from the successful Bidder, equal to 10% of the contract value (including GST) against the Bank Guarantee for mobilization expenses. The mobilization advance will be recovered in equal instalments against the payments made to the contractor before the payment reaches 80% of the Contract value.

The payment will be made only after receipt of approval from the TPPA / Consultant appointed by TPPA and the following terms shall prevail.

Sl No	Milestone / Item Description	Percentage of Total contract value
1	Submission of all Basic Engineering drawings and documents and site mobilization	5%
2	30% completion of civil works related to all civil tanks in the CETP project	5%
3	Supply of all major mechanical items like evaporators, strippers, RO plant, ATFD	15%
4	Supply of other mechanical items like pumps, filters, tanks, agitators, aerators	5%
5	Supply of all mechanical bulk items like pipes, fittings, valves and control panel	5%
6	60% completion of civil works pertaining to Item 2 above	5%
7	Supply of Utility items like Boiler, Chimney, Boiler BOP, Cooling tower, pumps etc	7.5%
8	Supply of Electrical major items like Transformer, DG set, MV Panel	7.5%
9	Supply of Utility related piping bulk items and electrical-related bulk items like cables, cable trays, lighting etc	5%
10	90% completion of civil works pertaining to Item 2 above	5%
11	Completion of piping works pertaining to CETP including utilities	5%
12	Completion of electrical, instrumentation works in CETP and main Electrical works	5%

13	Transformer chagrining from TNEB after getting CEIG approval	2.5%
14	Startup of Boiler after IBR approvals	2.5%
15	Successful completion of CETP plant with guarantee runs	5%
16	Submission of As-built drawings/ documentation including O&M manual	5%
17	Quarterly payment for Operation & Maintenance during the 12-month period	10%
A retention amount equivalent to 5% of the running account (RA) bill value shall be deducted from all RA bills submitted. The retention money shall be released as per Clause 24 of this tender document.		

ii. The payment will be made by means of RTGS / NEFT in favor of the Contractor.

iii. TPPA reserves the right to recover any dues from the Contractor, which are found later during audit/excess payment after the final settlement is made to them. The Contractor is liable to pay such dues to the TPPA immediately on demand without raising any dispute/protest.

iv. Payment for 12 months comprehensive Operation and Maintenance (O&M)

a. Payment for comprehensive Operation and Maintenance shall commence from the successful COD of the CETP as per Clause 27 a S.No.7.

b. Payment for comprehensive Operation and Maintenance (O&M) will be made every quarter after satisfactory completion of maintenance for respective quarters certified by the agency identified by TPPA.

c. Upon successful completion of the O&M period of 12 months, 100% of the Performance security collected as per Clause 22 will be released.

31.	**PRICE ESCALATION**

Price Escalation is not applicable to the contract.

32.	**PENALTY FOR DELAY IN COMPLETION**

Failure to complete the contract within the stipulated period will attract a penalty at a rate of 0.5% of the contract value per week or part thereof subject to a maximum of 5% on the full contract value. Delay on the part of TPPA should be intimated and sorted out immediately without affecting the progress of works by all means. The penalty levied on the Contractor

is however subject to modification at the discretion of TPPA for valid reasons, which are to be recorded.

33.	TERMINATION OF CONTRACT

TPPA reserves the right to terminate the contract at any time during the validity period on account of non-fulfilment of the contract or any of the reasons.

In the case of O&M, TPPA reserves the right to terminate the contract at any time during the O&M period upon the non-fulfilment of the O&M contract or any other reasons.

34.	TENDER CONDITIONS

a. TPPA reserves the right to relax or waive or amend any of the tender conditions.

b. Any notice regarding any problems to the Bidder should deemed to be sufficiently served, if given in writing at his / her usual or last known place of business.

c. During discussion and instruction, TPPA may disclose information of confidential and proprietary nature relating to its know-how, operations, etc. to the Bidder. Such information will be considered confidential.

d. After acceptance of the tender by TPPA, the Bidder will have no right to withdraw his / her tender.

e. The contractor, who is engaging labourers for the work, is solely responsible for any untoward occurrences to the labourers while carrying out the work and any payment of compensation to such labourers. The contractor should abide by all Government Orders issued from time to time in respect of labour regulations.

f. The site will be handed over to the contractor after the signing of the Contract. **All approvals related to the work, i.e. pollution control board approvals towards the CTO and other relevant approvals are under the scope of the contractor.**

g. The Contractor should make its own arrangements for the labour accommodation.

h. The successful bidder shall provide training on the operational modalities of the CETP to TPPA officials during the O&M period.

i. Any notice regarding any problems to the Bidder shall be deemed to be sufficiently served, if given in writing at his usual or last known place of business.

j. **Factory Inspection Requirements**

1. Scope of Inspection

All equipment, materials, and instrumentation specified in the contract that require factory inspection must be thoroughly tested and inspected at the manufacturer's premises before shipment. This includes functional, performance, and calibration tests to ensure compliance with the technical specifications outlined in the contract.

2. Notification of Inspection

The Contractor shall notify TPPA/ PMC in writing at least 7 days prior to the proposed inspection date. This will allow adequate time for both parties to arrange for their representatives to be present at the factory for inspection and testing.

3. Presence of TPPA/ PMC

All tests and inspections must be carried out in the presence of authorized representatives of the TPPA/ PMC. Their attendance ensures that all specified tests are properly executed and that the equipment conforms to the required standards.

4. Test Reports and Documentation

Upon completion of factory inspection, the Contractor shall provide detailed test reports and any relevant certificates, including calibration certificates, for approval by the Client and Consultant. No equipment shall be dispatched from the factory without prior written approval based on successful inspection outcomes.

5. Non-Compliance

Should any equipment or materials fail to meet the required standards or specifications, the Contractor shall take corrective action, at no additional cost to the Client, and arrange for a re-inspection to be conducted.

35.	**FRAUD AND CORRUPT PRACTICES**

The Bidders and their respective officers, employees, agents and advisers should observe the highest standard of ethics during the Bidding Process and after the issue of the LoA and during the subsistence of the Contract. Notwithstanding anything to the contrary contained herein, or in the LoA or the Contract, TPPA may reject a Bid, withdraw the LoA, or terminate the Contract, as the case may be, without being liable in any manner whatsoever to the Bidder, if it determines that the Bidder, directly or indirectly or through an agent, engaged in corrupt practice, fraudulent practice, coercive practice, undesirable practice or restrictive practice in the Bidding Process. In such an event, TPPA shall be entitled to forfeit and appropriate the Performance Security, as the case may be, as Damages, without prejudice to any other right or remedy that may be available to TPPA under the Bidding Documents and/ or the Contract, or otherwise.

Without prejudice to the rights of TPPA under Clause (32) hereinabove and the rights and remedies which TPPA may have under the LoA or the Contract, or otherwise if a Bidder or Contractor, as the case may be, is found by TPPA to have directly or indirectly or through an agent, engaged or indulged in any corrupt practice, fraudulent practice, coercive practice, undesirable practice or restrictive practice during the Bidding Process, or after the issue of the LoA or the execution of the Contract, such Bidder shall not be eligible to participate in any tender or RFP called for by TPPA for a period of 2 (two) years from the date such Bidder, or Contractor, as the case may be, is found by TPPA to have directly or indirectly or through an agent, engaged or indulged in any corrupt practice, fraudulent practice, coercive practice, undesirable practice or restrictive practices, as the case may be.

For the purposes of this Clause (35), the following terms shall have the meaning hereinafter respectively assigned to them:

a. **"corrupt practice"** means (i) the offering, giving, receiving, or soliciting, directly or indirectly, of anything of value to influence the actions of any person connected with the Bidding Process (for avoidance of doubt, offering of employment to or employing or engaging in any manner whatsoever, directly or indirectly, any official of TPPA who is or has been associated in any manner, directly or indirectly, with the Bidding Process or the LoA or has dealt with matters concerning the Contract or arising therefore,

before or after the execution thereof, at any time prior to the expiry of one year from the date such official resigns or retires from or otherwise ceases to be in the service of TPPA, shall be deemed to constitute influencing the actions of a person connected with the Bidding Process), engaging in any manner whatsoever, whether during the Bidding Process or after the issue of the LoA or after the execution of the Contract, as the case may be, any person in respect of any matter relating to the work or the LoA or the Contract, who at any time has been or is a legal, financial or technical adviser of TPPA in relation to any matter concerning the work;

b. **"Fraudulent practice"** means a misrepresentation or omission of facts or suppression of facts or disclosure of incomplete facts, in order to influence the Bidding Process.
c. **"Coercive practice"** means impairing or harming, or threatening to impair or harm, directly or indirectly, any person or property to influence any person's participation or action in the Bidding Process.
d. **"Undesirable practice"** means (i) establishing contact with any person connected with or employed or engaged by TPPA with the objective of canvassing, lobbying or in any manner influencing or attempting to influence the Bidding Process; or (ii) having a Conflict of Interest; and
e. **"Restrictive practice"** means forming a cartel or arriving at any understanding or arrangement among Bidders with the objective of restricting or manipulating a full and fair competition in the Bidding Process.

36	**DISPUTE RESOLUTION BOARD**

A Dispute Resolution Board (DRB) shall be formed in order to resolve the disputes that may arise during the currency of the contract. The members of the DRB shall be nominated by TPPA and the bidder and the list of members will be finalized by TPPA. If any party is not satisfied with the decision of the DRB, the issue shall be referred for Arbitration.

37.	**ARBITRATION**

a. In case of any dispute in the bid, including interpretation if any on the clauses of the bid or the agreement to be executed, the matter, if not resolved through amicable settlement, shall be referred to arbitration by an arbitral tribunal constituted in accordance with Clause 37(b). Such arbitration shall be proceeded as per the

provisions of the Arbitration and Conciliation Act, 1996 or under any statute in force at that point of time

b. There shall be an arbitral tribunal comprising three arbitrators, of whom each Party shall select one, and the third arbitrator shall be appointed by the two arbitrators so selected and in the event of disagreement between the two arbitrators, the appointment shall be made in accordance with the Rules.

c. The venue of the Arbitration shall be at the Head office of Thnidivanam Pharma Park Association. The decision of the arbitral tribunal shall be final and binding on both the parties to the Arbitration.

d. The arbitral tribunal may with the mutual consent of the parties, extend the time for making the award. The award to be passed by the arbitral tribunal is enforceable in the Court at Chennai city only.

38.	**JURISDICTION OF THE COURT**

Any dispute arising out of non-fulfilment of any of the terms and conditions of this Tender / Contract or any other dispute arising out of the arbitration award will be subject to the jurisdiction of the Courts in the City of Chennai only.

We agree to the above terms and conditions.

SIGNATURE OF THE BIDDER:
(WITH SEAL)
DATE:

NAME IN BLOCK LETTERS:

DESIGNATION:

ADDRESS:

Annexure – I

Covering letter for submission of Part - I

Date:_____

From,

Name:
Address:
Ph:
Fax:
E-mail:

To,

The Managing Director,
Tindivanam Pharma Park Association,
Block – D1, Baid Metha Complex,
No.16, Anna Salai, Little Mount,
Saidapet, Chennai.

Sir,

Sub : Submission of Tender for Selection of contractor for Design, Engineering, Construction, Fabrication, Supply, Erection, Testing & Commissioning of 250 KLD capacity Zero Liquid Discharge (ZLD) based Common Effluent Treatment Plant (CETP) on Turn-key basis, including 12 months comprehensive Operation and Maintenance at TANSIDCO Pharma Industrial Park in Pellakuppam, Kollar & Venmaniyathur villages, Tindivanam Taluk, Villupuram District -Part - I - Reg.

Ref: Your Tender Notice .....

1. I/We …… having examined the details given in the Invitation to Bidders, we hereby submit the following information and relevant documents.

   a. I/We hereby certify that all the statements, information and data provided in the enclosed Annexure I to XII and accompanying statements are true and correct to the best of my / our knowledge.

   b. I/We …….. have read the instructions appended with the Prequalification documents and I/We understand that any contract made between ourselves

and TPPA, on the basis of the information given by me/us is liable to be cancelled if any false information is detected at a later date.

c. I/We …… have also no objection if enquiries are made on all the projects and works listed by me/us in the accompanying sheets or any other enquiry on the information furnished herewith in the accompanying sheets.

d. I/We have furnished all information and details as asked for and have no further pertinent information to provide.

e. I/We hereby submit the certificates in support of my / our suitability, technical know-how and capability for having successfully completed the works during the last five years.

f. I/We hereby also agree that the decision of the TPPA in the Qualification and selection of Contractors will be final and binding upon me/us.

g. I/We hereby agree TPPA reserves the right to qualify any contractor to cancel the exercise without assigning any reason for doing so, or to incur any liability to any part whatsoever.

h. I/We hereby agree not to withdraw from the contract after issue of Letter of Award / Work Order and before signing the contract. Incase if, I/We withdraw before signing the contract, I/We hereby agree for the forfeiture of the Earnest Money Deposit as per the Tender condition.

i. The documents as requested in the Qualification Criteria are enclosed herewith.

I/We hereby agree to as a Bidder to all the terms and conditions of the Tender.

Yours faithfully,

SIGNATURE OF THE BIDDER
(With Seal and Address)

ANNEXURE – II

Structure and Organization of Bidder

Sl.No.	Details required	To be filled by the Bidder
1	Name of the Bidder	
1A	Legal Status	Sole Proprietorship / Partnership / Company
2	Nationality of Bidder	
3	Establishment of the Company	
	i) Year	
	ii) Location	
4	The Bidder is a Company	Yes / No
	(Please enclose attested copy of Registration / Incorporation under appropriate laws of the Bidder's Country	Enclosed / Not enclosed
5	Address of the Bidder	
i)	Registered Office Address	
	Telephone Number	
	Fax Number	
	E-mail Address	
	Web site	
ii)	Local office address:	
	Telephone Number	
	Fax Number	
	E-mail Address	
iii)	Office address through which this work will be handled and name of the Officer-in-charge	
	Telephone Number	
	Fax Number	
	E-mail Address	
6	Details of the Board of Directors	
	i) Name of the Director	
	ii) Qualification	
	iii) Organization	
	iv) Office Address	
	v) Telephone Number	
	vi) Fax Number	
	vii) E-mail Address	

Sl.No.	Details required	To be filled by the Bidder
7	Enclose Company's Organization Chart showing the structure of the Organization including the names of the Directors / Chief Executive Officer and position of Officers	Enclosed / Not enclosed
8	Number of years of experience and other Details	
9	Area of business activities other than construction works, if any (If yes please furnish specific information)	Yes / No
10	Whether registered with any Government / Public Sector Undertaking / Local bodies like CPWD / MES / PWD or equivalent applicable in the Bidder's Country. If yes, please furnish details of Class and Type of Registration	Yes / No
11	Please give at least three references of Clients (Engineers, Engineering Consultants or top Officials of Organization) for whom you may have executed construction works of importance and similar nature from whom TPPA, can verify	1. Name : Designation: Company : 2. Name: Designation: Company: 3. Name: Designation: Company:
12	Any special information, which you may like to provide	
		Signature of the Bidder
	Place :	Common Seal of the Company
	Date :	Office Address

ANNEXURE – III

Details of Similar Projects Carried out in last Five Years

S No	Project Name	Name of Client	Description of the Work	Project capacity in KLD	Value of Contract in Rs Crores	Completion time as stated in the work Order (Months)	Actual completion time (Months)	Extension of Time (EoT), if any, with/ without fine	Total Payment Received in Rs Crores

SIGNATURE OF THE BIDDER
(With seal and Address)

Note:

1. The Bidder should enclose a copy of the work order and completion certificates in support of the project experience for each of the projects mentioned above.
2. Project Experience without work orders and Completion Certificates will not be considered for evaluation.
3. Completion Certificates issued by the Executive Engineer and above will be considered for evaluation in case of projects executed for Government Entities
4. In the case of projects Executed for the Private Sector, Certificates signed by the Officials representing Senior Management will only be considered.
5. Similar projects will be as per the eligibility criteria mentioned in the Tender Document.

ANNEXURE – III - A

Details of Works in Hand

Sl. No.	Client with Address	Description of the work	Project capacity in KLD	Value of contract in Rs Crores	Completion time as stated in the Contract	Percentage completion	Remarks / Status

SIGNATURE OF THE BIDDER
(With seal and Address)

Note:

1. The Bidder should enclose the copy of the work order in support of the project experience for each of the projects mentioned above.

ANNEXURE - IV

Financial Capacity

A. Name of the Bidder					
B. Financial Information of the previous 5 years (in Rs Crores)	2019-20	2020-21	2021-22	2022-23	2023-24
C. Turnover					

Note:

1. The above details should be certified by a practicing Chartered Accountant.
2. Copies of the Financial Statement, Audited Balance Sheets should be provided for the last five financial years as above.

For (Name of Accounting Firm)

Name of Partner Chartered Accountant Membership Number

(Rubber

Stamp)

ANNEXURE – V

Networth Certificate

(on the Letterhead of Registered/ Practicing Chartered Accountant)

This is to certify that the Net worth of M/s. …… is Rupees ……. only as on _____. It is further certified that the computation of Net worth, based on my/ our scrutiny of the books of accounts, records and documents, is true and correct to the best of my / our knowledge and as per information provided to my / our satisfaction.

Place:

Date:

For (Name of Accounting Firm)
Name of Partner Chartered Accountant Membership Number
(Rubber Stamp)

SIGNATURE OF THE BIDDER
(With seal and Address)

ANNEXURE - VI

Declaration for not Blacklisted.

CERTIFICATE

Date…….

Certified that M/s. ……/ the firm /company or its partners/shareholders had not been blacklisted by TANSIDCO / any Government Agencies.

SIGNATURE OF THE BIDDER
(With seal and Address)

ANNEXURE - VII

Declaration Form

Date…….

a) I/We …….. having our office at …….. do declare that I/We have carefully read all the conditions of tender for the Tender floated vide tender Ref. No._____ for Design, Engineering, Construction, Fabrication, Supply, Erection, Testing & Commissioning of 250 KLD capacity Zero Liquid Discharge (ZLD) based Common Effluent Treatment Plant (CETP) on Turn-key basis, including 12 months comprehensive Operation and Maintenance at TANSIDCO Pharma Industrial Park in Pellakuppam, Kollar & Venmaniyathur villages, Tindivanam Taluk, Villupuram District and will complete the entire contract within schedule fixed and as per the all tender conditions.

b) I/We have downloaded the tender form from the internet site www.tppa.in/ www.tansidco.tn.gov.in/ www.itcot.com and I /We have not tampered/modified the tender forms in any manner. In case, if the same is found to be tampered/modified, I/ We understand that my/our tender will be summarily rejected, and full Earnest Money Deposit will be forfeited, and I /We am/are liable to be banned from doing business with TPPA or prosecuted.

SIGNATURE OF THE BIDDER
(With seal and Address)

ANNEXURE – VIII

Clarifications on Tender Document

BIDDER'S REQUEST FOR CLARIFICATION			
Name and Address of the Organization submitting the request		**Name and position of the person submitting the request**	**Contact Details of the Organization/ Authorized Representative**
			Tel:
			Fax:
			Email:
S. No	**Reference (s) (Section, Page)**	**Content of Tender requiring clarification**	**Points of clarification required**
1			
2			
3			

SIGNATURE OF THE BIDDER
(With seal and Address)

ANNEXURE – IX

CHECKLIST

S.No	Description	Submitted	Page No.(see Note below)
	COVER – 1- TECHNICAL BID		
	SUB COVER – 1		
1	EMD	Yes / No	
	SUB COVER – 2		
1	Copy of Incorporation Certificate issued by Registrar of Companies / Partnership Deed	Yes / No	
2	Copy of GST Registration Certificate	Yes / No	
3	Copy of Pan Card along with IT returns for the last five preceding financial years.	Yes / No	
4	Annual Reports / Audited Financial Accounts of the Bidder for the last five financial years preceding the Bid Due Date.	Yes / No	
5	Signed copy of Technical Specifications as per Annexure – XII	Yes / No	
6	Covering letter as per Annexure - I	Yes / No	
7	Structure and Organization of Bidder as per Annexure – II	Yes / No	
8	Details of Similar Projects carried out in the last five years as per Annexure – III	Yes / No	
9	Details of Work in Hand as per Annexure – III- A	Yes / No	
10	Financial Eligibility along with all relevant documents as per Annexure – IV	Yes / No	
11	Net worth Certificate as per Annexure - V	Yes / No	
12	Letter of Undertaking for not blacklisted as per Annexure – VI	Yes / No	
13	Declaration of not tampered the Tender Document as per Annexure – VII	Yes / No	
14	Clarification on Tender Document as per Annexure - VIII	Yes / No	
15	Additional Information if any	Yes / No	
	COVER – 2 (PRICE BID)		
1	Price Bid as per Annexure – XI		
2	Cost Break up of Operation & maintenance as per Annexure – XII	Yes / No	

Notes:-

1. All the statements, copies of the certificates, documents etc., should be given page numbers on the right corner of each certificate, which will be indicated in last column against each item. The statements furnished should be in the formats appended to the Tender document.

2. The information should be filled-in by the Bidder in the checklist and Annexure – I to XII, for the purposes of verification as well as evaluation of the Bidder's compliance to the qualification criteria as provided in the Tender document.

3. All copies of the supporting documents submitted by the Bidder should be duly attested by Notary Public/ Gazetted officer.

SIGNATURE OF THE BIDDER
(With seal and Address)

ANNEXURE - X

TECHNICAL ASPECTS

SECTION - 1

INDEX

SECTION - 1

Project Introduction

The CETP shall be designed in a modular way and will have a total installed capacity of 250 KLD (input basis). Being an orange category pharma park, the influent characteristics are not expected to be harsh and the treatment system to be designed appropriately.

All member units will have an independent collection tank at their premises from which the CETP will collect the influent through a piped network. This collection and pumping of the influent from member units and its associated infrastructure is NOT part of this tender.

The CETP shall be installed within the Pharma park in a designated area (refer Annexure-X) on the Northwest part of the park.

The CETP shall be self-contained with its own Utilities not limited to Electrical power, Steam, Cooling water and necessary civil infrastructure including buildings, civil structures and internal roads, etc.

The detailed specifications minimum to be followed for each of the sections are provided in the following pages.

Bidder to note that this specification is not an Engineering Design and bidders are encouraged to provide their own best design options for the CETP on the lines proposed in the PFD with suitable optimum modifications and development as may be required.

SECTION - 2

Basis of Design

1. Proposed CETP shall be designed as a ZLDF (ZERO Liquid discharge facility) and equipped to handle 250KL per day on a 100% capacity utilisation basis.
2. Since the member units are essentially Finished dosage manufacturing companies (orange category), the effluent from these units is not proposed to be segregated as Lean and strong waste and will be taken as a single stream through a common pipeline to the CETP.
3. Based on general experience, the following parameters are proposed as the limiting specifications for member units for discharging into the common CETP pipe network. In case some parameters are to be treated (like pH), the member units shall install the required facility within their premises.

#	Description	UOM	Limit
1	pH		6 to 8
2	TDS	PPM	NMT 5000
3	COD	PPM	NMT 5000
4	BOD	PPM	NMT 100
5	TSS	PPM	NMT 1000
6	Oil & Grease	PPM	Traces
7	Ammonia	PPM	50

A differential pricing based on limiting parameters shall be fixed for member units for discharging their effluents to the CETP.

4. Proposed system capacity as follows:
    i. Effluent to be handled – 250 KLD.
    ii. Biological treatment – 1000 KL (Approximate 04 days storage)
    iii. MEE – 75 to 100 KLD
    iv. ATFD – to be decided by the vendor

5. Pre-treatment and Biological treatment:
    a. Neutralisation (pH Correction)
    b. Skimmer (Removal oil & grease)
    c. Polymer addition for flocculation
    d. Aeration (For reduction of COD & BOD)
    e. Sludge separation - Primary and secondary Clarifiers.
    f. Separation by Decanter or Filter press.

g. Secondary aeration – Reduction in COD and BOD
h. TDS reduction by Wastewater RO system in two to three stages.
i. Permeate recovery from RO system.
j. Activated carbon and PSA treatment for the Permeate water.

High TDS treatment:

b. RO reject feed to MEE (Multiple effect evaporator)
c. MEE effluent concentrate to ATFD
d. Salt disposal from ATFD
e. Condensate recovery from MEE
f. Permeate water from RO and MEE condensate shall be recycled for Units Utility and CETP cooling tower.

6. Proposed Utilities support for the Operation of CETP:
   i. Steam Boiler – 2MT/hr 02 Nos. Dual fired (F Oil and CNG/LPG)
   ii. Diffused aerators or Air Blowers
   iii. Cooling towers
   iv. Air compressors for Instruments
   v. Decanters or Filter press.
   vi. Transformer Yard and Power distribution panels for CETP
   vii. Associated Pumps and piping.

7. Proposed stage wise storage tanks:
   a. Oil skimming and Equalisation tanks
   b. Neutralisation tank
   c. Clarification tank
   d. Aeration tank 1
   e. Primary clarifier
   f. Aeration tank 2
   g. Secondary clarifier
   h. Treated effluent tank.
   i. RO Permeate tank.
   j. RO rejection tank
8. Each member unit in the proposed layout shall adhere to the following inputs:

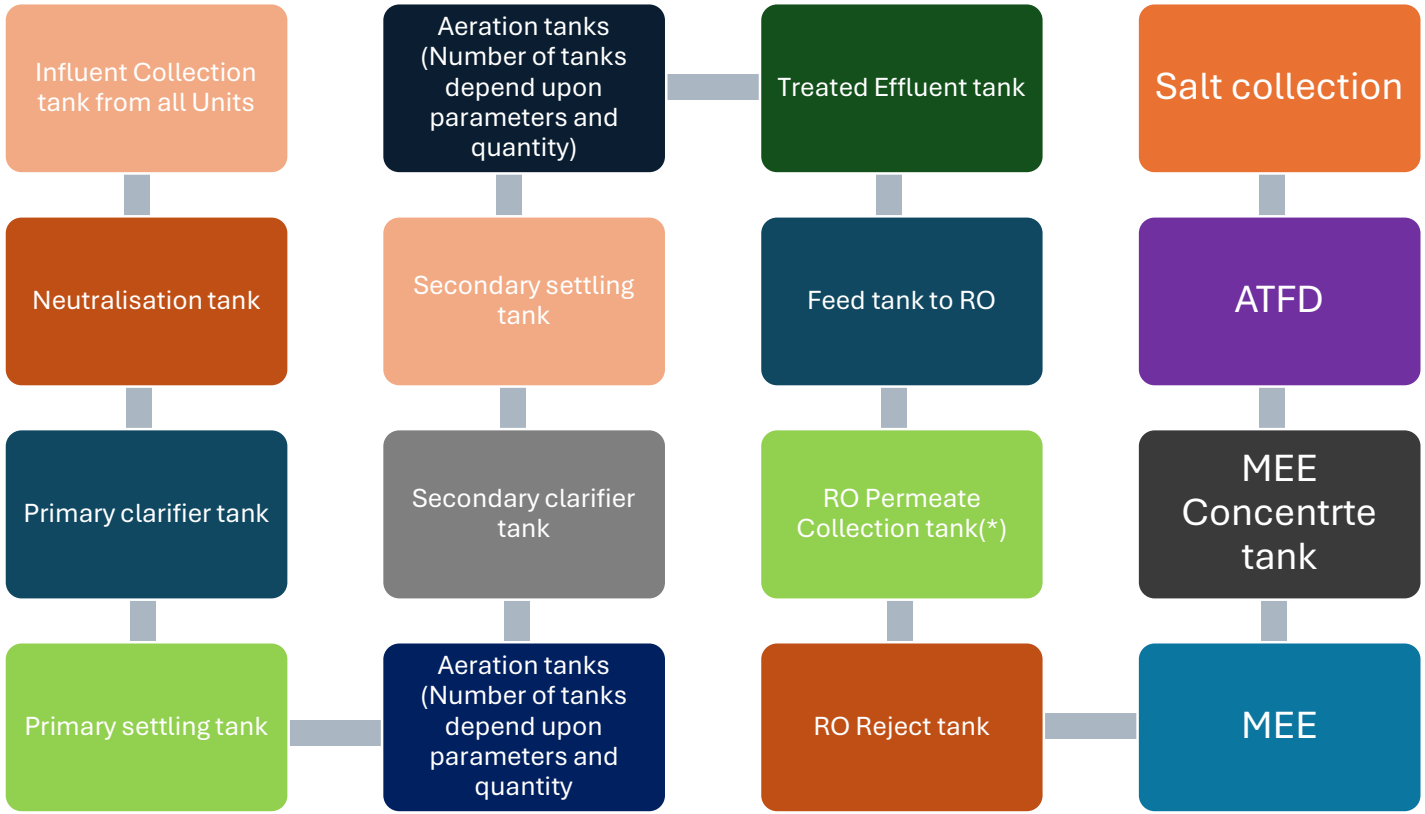
a. Effluent to be collected and pumped to a designated tank within the premises.
b. Effluent parameters shall adhere to the given CETP guidelines prior to discharge.
c. Each unit shall be equipped with Online sensors with digital display for pH, TDS, and COD and the same can be connected with CETP system for unit wise monitoring and traceability.
d. Each unit can discharge effluent to CETP maximum of 10 to 12KLD.
e. Each Unit can accommodate 10KLD of recovery water for their Utilities. (Cooling tower and Hot water systems)(To discuss feasibility of this)
f. Each Unit shall have designated tanks for Effluent and sewage.

9. Recovered water for recycling : (Proposed Guarantee parameters of CETP bidder)

Sr.no	Description	UOM	Parameter
1	pH		6 to 7
2	TDS	PPM	NMT 300
3	TSS	PPM	NMT 50
4	COD	ppm	Less than 100
5	BOD	ppm	Less than 10

10. The CETP shall have its own Boiler house, Fuel storage, Electrical PCC and MCC rooms and substation (if required) and a small office to manage the infrastructure.
11. Bidder shall include all civil, mechanical, electrical, instrumentation and associated piping, cabling, panel works as part of this tender.
12. The Waste Water Treatment System shall fully comply with all requirements and limits specified in Environmental (Protection) Rules, 1986, along with all latest amendments to it, requirements and stipulations of the Central Pollution Control Board (CPCB), Ministry of Environment and Forests (MOEF); Government of India and Tamilnadu Pollution Control Board (TNPCB) for the project, and any other central or local statutory requirements regarding environmental pollution and its abatement.
13. Latest versions of all Codes and standards shall be used.
14. A proposed Block Flow Diagram is attached for reference

Flow Chart:



(*) RO permeate shall be good quality water that can be recycled. MEE distillate water can also be considered for recycling.

SECTION - 3

DESIGN CRITERIA AND PROPOSED SCHEME

GENERAL

This specification intends to cover design, engineering, manufacture, fabrication, assembly, inspection & testing at vendor's & sub-vendors' works, painting, forwarding, supply and delivery at the site including start-up and commissioning spares, mandatory spares, properly packed for transportation, loading/unloading/handling and storage at site, in site transportation, assembly, erection and commissioning, trial run, preparation and submission of drawing/documents including "As Built" drawings, site testing, carrying out performance guarantee tests at site and handover in flawless operating condition to end customer the entire **COMMON CETP** as per the details in different sections/ volumes of this specification for 250 KLD PLANT.

PROCESS

As explained in the design basis chapter, the influents to CETP will be coming through a piped network and will conform to the following specifications.

#	Description	UOM	Limit
1	pH		6 to 8
2	TDS	PPM	NMT 5000
3	COD	PPM	NMT 5000
4	BOD	PPM	NMT 100
5	TSS	PPM	NMT 1000
6	Oil & Grease	PPM	Traces
7	Ammonia	PPM	50

A typical Process Flow Diagram is attached as Annexure – X as a proposed scheme for treatment. Bidders are encouraged to provide their scheme which would be an optimum design to treat the above influent. The treated effluent shall conform to the following specifications. The usage of this treated water is proposed currently within the CETP premises in the cooling tower and for gardening purposes. A future plan to supply this back to member units will be evaluated at a later stage.

Sr.no	Description	UOM	Parameter
1	pH		6 to 7
2	TDS	PPM	NMT 300
3	TSS	PPM	NMT 50
4	COD	ppm	Less than 100
5	BOD	ppm	Less than 10

Plant sizing

The nominal installed capacity of the plant shall be 250 KLD. However, we would like to have a modular approach to this as we do not expect all the member units to become functional at once and the capacity could be much smaller in the first year and then gradually increase to higher loads.

Due to this, we would like the plant to be designed for various sections as follows:

Civil collection tanks and accessories	125 KLD x 2 modules (equivalent)
Biological treatment section	To match accordingly
RO Treatment plant	2 equal-sized modules based on design material balance to be developed by the bidder
Evaporation section	2 equal sized modules based on design requirements
ATFD	Same as the evaporation section
Boiler	2 equal sized boilers (FO/Gas based)
Electrical Power	One single installation to meet the entire plant requirements

CIVIL WORKS

All civil works pertaining to the CETP project shall be in the scope of the bidder. Brief list of civil/structural works is provided below. Bidder to verify the list and provide final list of buildings and civil works which will form part of the commercial tender. The civil works shall include design and detailed engineering and also getting necessary statutory approvals for the construction and providing completion certificate from competent authority for records.

List of Civil Works :

Direct CETP related :

1. Equalisation Tank (4 Nos.)
2. Neutralisation Tank
3. Aeration Tanks
4. Clarifier Tanks(if provided in civil)
5. Pump foundations
6. Civil foundation for evaporator, ATFD structure
7. Structural works for evaporator, ATFD, others
8. Civil building for housing the RO plant and Control room
9. Pipe rack foundations and structures
10. All structural supports for interconnecting piping
11. All civil foundations for any other plant and machinery not listed above

Other Civil works :

12. Boiler House, Boiler foundation, Boiler fuel oil storage tank foundation, Chimney foundation
13. Cooling tower basin, foundation for cooling tower pumps and pipe supports
14. Foundation and covered structure for air compressor, air dryer, etc
15. Foundation for air receiver tank
16. Piping structure foundations
17. HT and Transformer yard
18. Transformer foundation and plinth
19. MV Panel room (with cable cellar room as per CEIG norms)
20. DG set plinth
21. Cable tray support structures and foundations
22. Development of roads and pathways within the CETP plant, Utility area and Electrical yard
23. Toilet building (can be made part of Item 8)

MECHANICAL

Broad scope of supply (Mechanical) for this package is detailed below. This is an indicative list; Bidder shall prepare detailed list with brief specifications and submit along with the bid.

- ✓ Oil skimmer system
- ✓ Chemical dosing system (Acid/Alakali/Flocculant etc)
- ✓ Agitators (for neutralisation tank)
- ✓ All transfer pumps with drive (with installed stand by)
- ✓ Clarifiers
- ✓ Air diffusers
- ✓ Multiple effect evaporator (Either TVR or MVR) (Vendor to provide justification for selection)
- ✓ ATFD
- ✓ RO Plant
- ✓ Storage tanks for various streams with suitable MOC
- ✓ Manual Hoist for lifting motors etc

Further the below points shall be considered to be part of the scope of work.

- o All necessary drains, vents, and sampling points, with valves, as specified and as required.
- o Hangers and supports as per the requirement.
- o All the interconnecting piping between different sumps and equipment as per your design PID
- o During detailed engineering, bidder to furnish complete and detailed scheme in all respects including all valves, equipment's etc. for smooth, safe, efficient and trouble free operation of the plant meeting the specification requirement and also considering the applicable statutory requirement.
- o Necessary piping, fitting, valves, drains, vents, sampling etc. required for the complete CETP including pipe racks, U-Clamps, nuts, bolts, gaskets etc shall be in bidder's scope.
- o All insert plates, rung ladder, nuts and bolts, and flanges and matching counter flanges wherever applicable.
- o All handrails for all the sumps, Clarifiers, Other open tanks, stairs, ladders, open balconies etc shall be in the scope of the bidder

- Embedment plates with lugs shall also be provided by bidder as per system requirement.

- All channels & brackets, mounting plates as required for mounting of motors, pumps, stirrers, tank etc shall be in bidder's scope.

- Start-up and commissioning spares as required to be supplied as part of the main plant.

- Mandatory spares and 2 year operational spares to be indicated by bidder and provided with separate price.

- All special tools necessary for proper maintenance or adjustment of the equipment packed in permanent box. Operating platforms, permanent ladders (not rugs), supports and other structural works for each tanks, valves etc. to facilitate accessibility for operation and maintenance.

- All necessary structural steel for pipe supporting structure, platforms, walkways / pathways and access stairs, mechanical plant and equipment, mechanical services and pipe work associated with CETP.

- Finish paints for touch up painting of equipment after erection at site. Bidder shall also provide one final coat additionally of same DFT as specified in tender specification at site after completion of erection of each equipment / item.

- All pipes, fittings etc required for hand railing, platforms, and ladders shall be in the scope of bidder.

- All handrails shall be of 32 mm nominal bore MS pipes (medium class) as per IS: 1161 galvanised using 750 gm/sq. m of zinc. Hand railing shall be a two- rail system with the top rail 1000 mm above the walkway surface and the intermediate rail 450 mm below the top rail. Handrail post spacing shall be limited to 1500 mm as far as possible but can be proportioned to the length of the opening. In such a case spacing shall not exceed 1850 mm center to center of posts. Hand railing shall be shop fabricated for specific locations and field welded or bolted to the erected structural steel. Railings shall be provided with 100 mm wide and 8 mm thick MS strip at bottom as toe guard all along the length of railing in horizontal plane. For RCC stairs, hand railing with 20 mm square MS bar balustrade with suitable MS flat and Aluminium / Teakwood handrail shall be provided, unless specifically mentioned otherwise.

- Monitoring gadgets, instruments and equipment required for commissioning & maintenance (till PG test and plant handover).

- Permanent ladder (not rungs) for approaching the top of tanks, valves, all steel inserts with lugs, plates, bolts, nuts, sleeves, edge angles and all other embedding components etc as required to grout in civil works and to support/hold the equipment being supplied under this specification for opening/maintenance purpose.

- Wrapping, coating and protection of the entire buried pipe shall be as per IS 10221 or AWWA C 203-93.

- Any item/work either supply of equipment or erection material which have not been specifically mentioned in but are necessary to complete the woks for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification and shall be in bidder's scope without any commercial, technical and delivery implication to TPPA.

- All required elbow, tee, pipe fittings etc. required for erection of the complete system including piping shall be in bidder's scope. Bidder to provide the detailed BOQ during detail engineering.

- Bidder shall perform the guarantee parameters as per specification requirement to the satisfaction of TPPA. The exact modalities of verifying guarantee for the parameters indicated in the specification shall be finally as agreed with TPPA during detailed engineering & mutually agreed.

- All the first fill and one Year's topping requirements of consumable such as greases, oil, lubricants, servo fluids/control fluids etc. which will be required to put the equipment covered under the scope of specifications, into successful commissioning / initial operation and to establish completion of facilities shall be in bidder's scope. Suitable standard lubricants as available in India are desired.

- All blank flanges/counter flanges, isolations valves, tees etc. to interconnect the pipes at all terminal points.

- One set of all special tools & tackles of reputed make necessary for proper maintenance or adjustment of the equipment being supplied by the bidder, packed in permanent box.

- One (1) Number weighing scale (Digital Platform scale 0 – 500 kg)

PIPING

All the piping as listed below shall be in bidder's scope. The below indicated pipes shall be designed, supplied, erected, laid and tested by the bidder. Elbows, tees, flanges, hangers and supports, embedment plates with lugs etc. required for the below given piping shall also be provided by the bidder. All pipes shall be above ground on pipe rack and

there will be no underground piping unless absolutely necessary to accommodate site constraints.

All piping within the CETP area and between each sump and equipment/ terminal points etc.

Inlet and outlet pipes for each sumps, pits, pumps, other equipment, etc. with pipe connections to the respective sumps, pits, equipment as indicated in the PFD

Steam piping (IBR and Non-IBR), Cooling water piping, Air and Service water piping as applicable as per the Terminal Points.

In addition, any additional piping and associated accessories required to complete the system shall be in bidder's scope.

IBR approval for Steam piping shall be in bidders scope

Bidder to estimate pipe quantities based on his proposed layout for the CETP

ELECTRICAL WORKS :

Broad scope of supply (Electrical) for this package is detailed below. This is an indicative list; Bidder shall prepare detailed list with brief specifications and submit along with the bid. Scope shall include getting necessary approvals and Bidder shall employ a suitable A grade contractor for the works. Tentative Electrical Load is estimated as 300-400 KVA. Bidder shall reverify based on his design of equipment and reconfirm during pre-bid meeting.

- ✓ HT Yard and breakers
- ✓ Transformer (11 KV/ 415 V)(3 Phase system)
- ✓ PCC Panel
- ✓ DG set
- ✓ Bus ducts
- ✓ APFC panel
- ✓ Lighting panel
- ✓ MCC panel for the plant
- ✓ Cables, cable trays, supports
- ✓ Push button stations
- ✓ Entire area lighting
- ✓ Earthing and Lightning protection
- ✓ Power wiring (single phase) for building lighting and AC loads

INSTRUMENTATION & CONTROLS

The bidder shall propose completely automated plant and shall design, supply and erect complete instrumentation system for remote operation of the plant from control room. The minimum scope shall include :

- ✓ Field manual instruments like pressure, level and temperature gauges
- ✓ Control valves and On-off valves
- ✓ Transmitters
- ✓ Switches (pressure, flow, level etc)
- ✓ Flow meters
- ✓ PLC/SCADA
- ✓ Cables, cable trays, supports
- ✓ Software
- ✓ UPS
- ✓ Junction boxes
- ✓ Pneumatic stations
- ✓ Pneumatic tubing

Bidder shall provide detailed Control philosophy, control system architecture and instrument index along with the bid.

GENERAL SCOPE OF SERVICES

The bidder's scope also includes following services for scope under this specification:

- o Design, basic and detailed engineering of entire CETP.
- o Unloading, Storage, handling and transportation at site.
- o All civil works as listed above and as per plant requirements.
- o Pre- Commissioning work such as flushing, hydraulic testing etc. Necessary consumables and instrumentation as required for inspection and testing at works as well as at site including pre-commissioning activities shall be arranged by the successful bidder at their own cost.
- o Erection and Commissioning of entire CETP.
- o Arrangement of all lubricants, instruments, reagents for carrying out trial run, commissioning and PG test.
- o Monitoring gadgets, instruments and equipment required for maintenance (till PG test & Plant Hand over).

- All personnel required during commissioning, trial run and PG Test.
- Trial run for requisite period.
- Performance testing.
- Painting of all equipment within scope of supply and final touch up painting at site.
- Training of plant Owner's personnel, O&M operators' personnel on plant operation and maintenance.
- All other facilities/ services as described in sections/volumes on site services in specification and related to CETP scope of work.
- Any other service required for making the installation complete in all respect within battery limits and for satisfactory erection & commissioning of the system as well as to meet any statutory requirement relevant to the package, unless specifically EXCLUDED from scope of services.
- 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 in Bidder's scope.
- Bidder shall be responsible for the ready and timely availability for all the start-up and commissioning spares as required during various stages of erection, testing, cleaning and commissioning up to handing over of plant.
- One set of all special tools shall be furnished and shipped with each piece of equipment for dismantling, maintenance, adjustment, and calibration of the equipment. The tools shall be shipped in separate heavily constructed wooden boxes provided with hinged covers and padlock hasps.
- The Contractor shall supply under this contract all maintenance tools for each piece of equipment / system and it shall be boxed separately and the boxes shall be appropriately marked for shipment and identification of contents.
- A weather-proof itemised list of the contents shall also be attached to the outside of each container.
- The maintenance tools shall include all special handling rigs, bars, slings, cable and all specialised equipment for control system maintenance such as extender boards, scopes, and all software and hardware. Further, Bidder shall also include a full set of regular maintenance tools and tackles required. Bidder shall also include all

maintenance tools and tackles in their scope. Total price of all the maintenance tools and tackles shall be included in the quoted lump sum price.

ADDITIONAL TECHNICAL REQUIREMENTS

- For selection of pump head during detailed engineering, Bidder will consider 15 m static head + 10% margin in addition to the losses in straight length and bend in pipes and valves etc.

- Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

- In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.

- Bidders shall make Site visit in order to familiarize themselves with existing condition of site before submitting the bid in order to make their offer complete. During detail engineering also, the successful bidder shall be responsible for the correctness of details w.r.t. existing facility at site. Customer approval on any drawing having details of existing facility shall not be cited by the successful bidder a valid reason for any shortcoming in the work by them. TPPA shall also not entertain any cost implication for any lack of input data with regard to site during detail engineering.

- Final Electrical Load list will be submitted by the successful bidder as per agreed drawing/ doc submission schedule. Thereafter any change in the electrical load list shall be entertained only subject to its feasibility.

- The complete system shall be proven and necessary design

documentation in support of proveness shall be submitted by the successful bidder in support of the systems, if asked by the customer without any price and delivery implication to TPPA and customer.

- Vendor to attend regular engineering meeting with TPPA and customer fortnightly in TPPA or customer office as decided during detail engineering. Vendor will depute all his concerned engineering representative along with the project manager for discussion and approval. Meeting can be held at site also.

- The total space available for the complete CETP Area has been indicated in the Key plan attached elsewhere in the Technical specification. Bidder to accommodate all the equipment within the allocated space.

- Bidder to submit MTO during detailed engineering after approval of Basic documents. MTO shall be equal to BOQ for the package and there shall be no price and delivery implication is applicable to TPPA for the same.

- TAG numbering as per TPPA/Customer requirement shall be provided by the Bidder during detailed engineering stage without any commercial/delivery implication to TPPA.

- Any statutory requirement / clearance required for the packages from government / local body shall be in bidder's scope.

- In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.

- Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the works for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The bidder without any extra charge shall provide the same

- All drawings/documents shall be approved by TPPA during detailed engineering stage. Successful vendor shall comply with the comment of the TPPA without price & delivery implication.

- Site facility as available or as extended by Customer shall only be provided.

- Complete CETP shall be designed to run continuously.
- All the equipment of CETP shall be designed for outdoor duty.
- The treated water shall also be used for gardening purpose. Bidder to check all the regulations for the water used for gardening purpose. The system shall be designed in such a way that the water can be used for gardening purpose as per the norms of Central pollution control board, Karnataka pollution control borad, WHO etc. All the arrangements to meet the norms is in bidder's scope though not indicated in the technical specification. Taking the clearance form respective agencies is also in bidder's scope.

EXCLUSIONS

Bidder shall clearly mention in a separate document titled Exclusions of any specific deviations and exclusions that he has considered while preparing the technical bid.

SECTION - 4

DRAWING/DOCUMENTS SUBMISSION SCHEDULE

After award of LOI/LOA, following minimum drawing/documents shall be submitted by the bidder for TPPA Customer approval. However any additional drawing/document if found necessary for completion of the engineering, the same shall be submitted by bidder without any commercial & delivery implication to TPPA.

Bidder has to submit the revised drawing/document along with the compliance sheet indicating enumerate reply to all TPPA and customer comments or observations. Without compliance sheet the submission of the drawings/documents will not be considered and the delay on this account will be solely on bidder's side only.

Every revised submission incorporating comments shall be resubmitted within 7 days. TPPA shall provide observation / approval within 7 days from the date of document submission by bidder. Bidder to note that drawings submitted shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. Engineering meeting shall be held fort nightly, for which the bidder shall depute his concerned engineers along with project manager to TPPA/Consultant office without fail.

Minimum drawing list is provided below; Bidder to confirm the list and provide list of any additional drawings that they deem fit are required for this project.

SI NO	DRAWING/ DOCUMENT TITLE	APPROVAL CATEGORY
1	P&I DIAGRAM FOR CETP	A
2	LAYOUT PLAN FOR CETP INCLUDING UTILITY AREA AND ELECTRICAL INSTALLATION (MASTER PLAN)	A
3	PROCESS & UNIT SIZING & HYDRAULIC CALCULATIONS FOR CETP	A
4	SUB VENDOR LIST FOR CETP	A
5	EQUIPMENT LAYOUT FOR CETP (MAIN PLANT)	
6	CONTROL PHILOSOPHY FOR OPERATING THE CETP	A
7	QUALITY ASSURANCE PLAN FOR CETP EQUIPMENT	A
8	ELECTRICAL LOAD LIST & SINGLE LINE DIAGRAM FOR CETP	A
9	GA DRAWINGS FOR TANKS FOR CETP	A

10	TECHNICAL DATASHEET OF VALVES FOR CETP	A
11	TECHNICAL DATASHEET FOR INSTRUMENTS FOR CETP	A
12	TECHNICAL DATA SHEET OF HORIZONTAL / VERTICAL CENTRIFUGAL/SCREW/METERING PUMPS	A
13	TECHNICAL DATASHEET FOR STRAINERS, AGITATORS, ISOLATION GATES ETC	A
14	MECH. GA OF ALL MECHANICAL EQUIPMENT INCLUDING CLARIFIERS, AERATORS, AGITATORS, EVAPORATORS, DRYERS ETC	A
15	PIPING LAYOUT FOR CETP	A
16	YARD PIPING LAYOUT	A
17	INSTRUMENT SCHEDULE FOR CETP	I
18	CIVIL CONSTRUCTION DRAWINGS (IFC)	I
19	INSTRUMENT INSTALLATION/ HOOK UP DIAGRAMS	A
20	FIELD JB TERMINATIONS /GROUPING DOCUMENT	A
21	LCP PANEL DATASHEET, GA (INTERNAL & EXTERNAL) DRAWING	A
22	QAP FOR LOCAL CONTROL PANEL	A
23	CABLE SCHEDULE (EXCEL FORMAT) & CABLE INTERCONNECTION DETAILS	A
24	CABLE TRAY/TRENCH & CONDUIT ROUTING DIAGRAM AND EARTHING LAYOUT OF CETP	A
25	CABLE INTERCONNECTION DRAWING FOR CETP	A
26	PG TEST PROCEDURE FOR CETP	A
27	O&M MANUAL FOR CETP	A

Notes:

1. A= APPROVAL. I = INFORMATION.

2. Any additional drawings-documents required during detailed engineering stage shall be provided by bidder without any commercial, technical and delivery implication to TPPA

3. Bidder to note that the successful bidder, during detail engineering, will submit the drg/doc through web based Document Management System in addition to hard copies to be submitted for final As-built documentation

SECTION – 5

REFERENCE DRAWINGS

Three documents are provided as reference drawings to this tender

1. Overall layout of the Pharma Park showing the location of all plots and area earmarked for CETP (Exhibit 1)
2. Proposed Process Flow diagram for treatment scheme. (Exhibit 2)
3. Suggested layout for CETP and other infrastructure (Exhibit 3)

SECTION – 6

OPERATION AND MAINTENANCE REQUIREMENTS

1. Scope of Works for O&M

The Bidder shall also quote for Operation and Maintenance of the CETP for a minimum period of **12 months** from the date of commissioning. The general conditions for O&M shall be as follows:

2. General

Major components and works shall include the following but not limited to:

(a) Bidder shall operate and maintain the Common Effluent Treatment Plant, Utilities, Boiler and related accessories, Electrical sub-station and its related infrastructure, system proposed for recycled water and provision for transport of Solid waste generated (salt), complete for 6 years on 24 hours x 7 day basis throughout the year.

(b) Bidder shall operate and maintain all Equipment, Civil works, Mechanical items, Electrical and Control automation equipment's in accordance with the aim and purpose of CETP and recycled water supply. The plant & equipment will be totally attended to, by the Bidder including any Troubleshooting to ensure smooth and trouble-free operation.

(c) Bidder has to incur all the operating cost, pay taxes & duties, costs for transportation, cost of labour, cost of repairing & replacing equipment, making good any part or all part of civil works, equipment, consumables, motors, pumps, gear units, evaporators, Dryers, RO packages, Boiler, Cooling tower, Air compressor, Electrical transformers, DG sets, Panels, Capacitors, HT/LT Switchgear, filter media, valves, chemicals and laboratory testing equipment etc. complete including Electricity Charges.

(d) The Bidder shall be responsible for procuring all spares, all tools & tackles, parts or components, Consumable chemicals (acid, alkali, PAC, Polyelectrolyte etc.) and all consumables including grease, lubricating oil, cleaning agents, equipment, laboratory instruments, glassware and chemicals, laboratory reagents, labour transportation and other charges, etc. Further the Bidder will plan about the requirement well in advance and procure the material from the market.

(e) Bidder shall prepare O&M Manual for the Common Effluent Treatment Plant inclusive of all the related infrastructure. Bidder shall initiate and take

adequate actions to ensure smooth and satisfactory performance/ running of the plants on a 24 hours/ round the clock basis. Operate and maintain all units and equipment of the Effluent Treatment Plant as per the requirement of the process to meet continuously and consistently desired quality of recycled water (Treated Effluent) as per the contract.

(f) The operation and maintenance service provided by the Bidder for the period specified in the Contract shall ensure the continuous operation of the Plant and that the breakdown or deterioration in performance, under normal operating conditions, of any items of Plant and equipment and component parts thereof is kept to a minimum.

(g) The Bidder will determine operating parameters, select Chemical doses etc. and optimize the process, and working of the Effluent Treatment Plant. Excessive chemical dozing i.e. dose more than normal should be avoided.

(h) The Bidder shall prepare and implement an effective plant maintenance program in consultation with the TPPA engineer. It is Bidder‘s responsibility to look after all sorts of maintenance whether preventive, Minor, Major, or break-down. The Bidder will be responsible to carry out day to day as well as periodic maintenance necessary to ensure smooth and efficient performance/running of all equipment. Bidder shall attend all the breakdown of civil, mechanical, electrical, piping, automation and instrumentation works and maintain the plant and equipment throughout the Contract Period.

(i) The Bidder shall keep additional spares, Tools and consumables in any time during O&M period.

(j) No structure of any kind will be allowed to be constructed/ altered within the plant premises, without the approval of TPPA. Nothing is to be paid by TPPA for any addition if allowed. In case of damages to the building/machines and shortcoming to the machines, the same has to be made good as per original shape/good running condition by the Bidder. The decision of TPPA‘s Engineer/ TPPA in this regard shall be final and binding.

(k) In case, the motor or any other equipment is burnt or damage due to negligence of the Bidder or due to faulty operation it shall be sole responsibility of the Bidder to rewind/replace/repair it as per standards of the equipment free of cost. In case of any fault in operation and performance of the plant, Bidder or his staff at duty will immediately report to the TPPA‘s Engineer about it.

(l) The Bidder will be responsible for keeping up-to-date record of documents including History Card for equipment and maintaining every day log book relating to various analysis performed. The Bidder shall maintain and update logbook, in which details of operational parameters are recorded in every shift and at regular interval say hourly or as decided mutually. Bidder shall take the approval of the format of logbooks and records from TPPA.

(m) The Bidder will prepare and submit daily, fortnightly and monthly reports of plant performance and will assist the TPPA in preparing the necessary documents for their purpose and records. Carry out regular and frequent sampling, analysis and result recording of industrial effluent and treated effluent as per the procedures laid out by the T P P A / T N P C B and in conformity with standard methods.

(n) The Bidder shall employ appropriate and skilled manpower. The Bidder shall have to issue identity cards with photographs to all the staff employed for Operation and Maintenance. The list of the same shall be submitted to the TPPA mentioning qualification & experience. A suggested minimum list of manpower is as below :

Site In Charge	:	1 No.
Shift Supervisor	:	1 per shift
ETP Operators	:	2 per shift
Utility operator	:	1 per shift
Boiler Operator	:	1 per shift (C certificate holder)
Mechanical Maintenance	:	2 per shift (Fitter/Helper)
Electrician	:	1 per shift

(o) The scope of works for operation & maintenance includes the calibration of all meters e.g. pressure gauge, temperature gauges, level gauges, flow meters, other field instruments, electrical meters like Ammeter, voltmeter, relay, Energy meters etc. for measurement of accurate readings.

(p) The Bidder shall be responsible for maintaining the lighting and other equipment. The premises of various works shall be provided with LED energy efficient industrial Indoor fixtures and also ceiling fans/exhaust fans inside the various structures. Daily on/off operation and routine cleaning of all type of electric fixtures. Replacement of lamps / Tubes / Fans in case of failure at Bidder‘s cost.

(q) The Bidder shall be responsible for the maintenance of Garden, lawn, green belt etc within the CETP premises. The work shall include the watering, grass cutting, removal of shrubs, weed cutting of branches of tree/ plant,

growth of garden, Plantation etc.

(r) The Bidder shall be responsible for the maintenance of all buildings in the CETP. The Bidder shall be responsible to keep watch on overflowing of sumps/ reservoirs/ wet wells for pumping stations etc. If such overflow takes place the Bidder shall have to bear the damages caused to surrounding properties.

(s) The Bidder shall carryout cement paint/ enamel paint/ white wash for exterior finish of civil units twice during in six year of O & M of the plant and shall also carry out painting on mechanical equipment/ above ground pipe lines/ hand railing twice in six years of O & M of the plant. On the expiry date of his contract operation and maintenance, the Bidder shall hand over the plant back to TPPA in fully working condition satisfying the requirement of treated Effluent. All the electrical, mechanical and instrumentation including standby shall be in perfect working condition. An option to extend the O & M shall be mutually discussed and agreed if required at the end of the six year period.

(t) The Bidder shall be responsible for safety on Site during the O & M of the Works by the Bidder. Health of workers shall be protected against infectious and contagious diseases. Environmental protection shall also be given priority so as to conserve the environment.

(u) The Bidder shall at his own cost provide and maintain at the Site of Works standard first aid boxes as directed and approved by the TPPA for the use of his own as well as the TPPA's staff on Site as stipulated by local regulations. The Bidder shall arrange to train all their staff in first aid treatment within 3 months.

(v) The Bidder shall provide a Notice Boards/Display Boards at appropriate locations detailing precautions to be taken by operation and maintenance personnel in work in conformity with Industries and Labour Regulations and Department of Explosives.

(w) Periodical monitoring & testing of incoming effluent sample, and controlling the parameters of incoming effluent from user units, so that common CETP can be operated on standard operating conditions & rectify the operational / treatment process disorders, if any occurs.

(x) Maintaining flow / effluent discharges of user units & total effluent coming to common CETP on daily basis.

(y) Collections of effluent from inlet pit of CETP received from user unit and/ or other concerned sampling point and test in-house laboratory for analysis, maintain deviation of inlet design criteria parameters of proposed CETP, if any financial impact occurred.

(z) Maintaining quantity & quality of effluent received from user industries on day to day basis. The record keeping / formats / log sheets of CETP operation should be maintained & submitted to ITCOT.

(aa) Maintain record of plant performance data, plant maintenance data,

Inventory and consumables at plant in the prescribed log books at CETP.

(bb) There shall be no discharge of effluent outside industrial area i.e.—Zero Liquid Discharge condition —to be maintained for all the time.

(cc) All Equipment/pumps/Motors/pipe lines/valves/ flow meters/stirrers installed should always be in working condition.

(dd) Daily cleaning of pumps, motors, Weekly oiling greasing, testing of drain valves. Once in six month cleaning and changing of filter material of pressure sand filter unit and Changing filter of Air compressors.

(ee) Attending Mechanical and electrical break downs such as burnt motor winding Replacing damaged bearings , leakage of pipelines, replacement of defective valves, Gland packing change if leakage is there or worn out.

(ff) Dense plantation is to be done along the periphery of the CETP premises. Plantation done by the Bidder during construction period shall also be maintained during operation and maintenece period. Number of plants planted during construction period will be the same as at the end of performance guarantee period with sufficient growth. Water, manure, pesticides, labour, civil work etc. required during plantation work and its maintenance work shall be arranged by the Bidder. During 1st to 5th year maintenance replacement of plant casualties, soil conservation work, weeding of plants, protections of plants safety measures of plants are included in the contract.

(gg) 24 Hrs Security of facility shall be provide by the Bidder. The Bidder shall designate necessary security personnel to ensure safety and security of all fittings and fixtures of all components of various items of executed work as per contract document for entire period, The Bidder shall be liable for losses due to theft and shall be liable to repair/ replace or refit the concerned item.

3. Housekeeping:-

Daily Cleaning of the plant area, control room, lab areas, electrical room etc and open area around, drains removing tree leaves in addition to above the house Keeping of the CETP premises includes cutting and cleaning grass vegetation , landscape etc. on daily basis. The cut grass and vegetation to be disposed safely and directed places.

The Bidder shall provide experienced administrative, managerial, technical personnel, duly approved by the TPPA‘s Engineer/TPPA including supervisory, non- technical personnel and labour necessary to operate and maintain the plant properly, safely and efficiently on a continuous 24 hours basis for the full term of the O & M Contract Period. During O & M period if any expert person, special persons or manpower needed, the Bidder shall arrange at his own cost.

4. Treated effluent Quality for CETP

The Bidder shall operate the Effluent Treatment Plant in such a way that the recycled water (treated effluent) quality attains the parameters as per PCB norms.

If the Bidder fails to achieve the recycled water (treated Effluent) quality, he will be responsible for all modification without extra cost. The proposal submitted by the Bidder should be suitable to work round the year and supported by the documents as satisfactorily tested and tried. Documentary proof in this regard from the TPPA engineer needs to be submitted along with the proposal.

No toxic chemical shall be used by the Bidder at any stage of treatment, he will submit the toxicity test report from any govt. recognized laboratory at his own cost before using such chemical.

The Bidder shall operate the Effluent Treatment Plant such that the sludge produced is of a spade-able consistency and the volume of sludge produced after necessary process, is minimum. The Bidder shall dispose off the sludge cake and SALT from ATFD at his own cost, through proper approved means of transport to the disposal site and necessary clearance, if required for this purpose, from the regulatory authority, is to be obtained by the Bidder. The Bidder has to dispose solid dry sludge/salt/ screened material/ grit from Treatment plants to nearby approved landfill site as directed by the TPPA. The Bidder needs to check the quality of the sludge/salt before disposal and get the approval of TPPA‘s Engineer.

5. Tests to be carried out during O&M Period

The testing of industrial Effluent and treated Effluent at CETP site shall be as per the O&M manual for Effluent Treatment and TNPCB regulations. The frequency of testing of parameter shall be submitted by the Bidder and approved by the TPPA‘s Engineer.

The minimum requirement of sampling and testing to be carried out shall be agreed and approved by TPPA and the schedule shall also be maintained during the O&M period.

All costs associated with the taking and analysis of samples shall be met by the Bidder.

6. Staffing for the operation of Effluent Treatment Plant

Staffing shall be as per Clause (n) mentioned above. The Bidder shall give or provide all necessary superintendence during the O&M period and as long thereafter as the TPPA's Engineer may consider necessary. Such superintendence shall be given by a competent person having adequate knowledge of the operation and maintenance to be carried out (including the methods and techniques required), the hazards likely to be encountered and methods of preventing accident) as may be required for the satisfactory working of the entire plant.

List of staff is to be given by the Bidder to the TPPA's Engineer and advance intimation to be given before deputing/removing any staff from site during the period of contract. Not more than one of the Bidder's key staff shall be absent from the project site at any given time. In case it is necessary for more than one of the key personnel to be absent at a given time, the Bidder shall provide replacement of equivalent or better qualifications. The CVs of such replacements shall be got pre- approved from TPPA/ TPPA's Engineer in advance.

7. Reporting

The Bidder will prepare daily / monthly reports of project performance and submit to the TPPA's Engineer and will assist in preparing the necessary documents for their purpose and record. The reports shall contain, inter-alia, the following:

- Industrial Effluent quality
- Treated Effluent quality
- A description of the maintenance work carried out in the reporting period.
- A report on major failures, if any, their causes and remedial actions taken.
- Sludge cake and Salt quality and quantity (daily basis) in the reporting period.
- Power and chemicals consumed in the reporting period.
- An inventory of the chemicals and spare parts available at the end of the reporting period.
- O&M staff deployed by the Bidder during the reporting period.
- Record of daily readings of flow meter at inlet point and record of total treatment quantity
- Any major repair works, if any.

The Bidder is required to maintain separate register/computerized records at site of following information:

- Pump register
- CETP performance register
- Working hours register
- Power break down register
- Maintenance register
- Staff attendance register
- Equipment breakdown, repair record and extent of repair

8. As Built Drawings" and "Operation and Maintenance Mannual"

On Completion of the Inspection and Tests for the various facilities the Bidder would be required to make the —As Built drawings of the equipment, pipeline, appurtenances and all the components and works involved. The drawings would be on long lasting material along with tracings and blueprints. Soft copies of the same are also to be included.

The Bidder shall submit the O & M Manual for approval of TPPA, which may be modified, if required by TPPA and this manual shall be approved from TPPA prior to commissioning. The Bidder shall be modified the operation and maintenance manual as per the modification in the Effluent Treatment plant if any.

9. Operation and Maintenance Manual

The Bidder shall provide draft O&M Manual to TPPA, at the time of the commissioning of the project and on approval of draft, 4 copies of operation & maintenance manual shall be supplied by the Bidder.

The O&M Manual shall include in elaborate detail, all operating and maintenance procedures and policies which are required, advisable and / or necessary for the Facility to achieve full compliance with the operational guarantees and to achieve maintenance and repair standard for the Facility which will ensure compliance with the maintenance specifications. Without limiting the generality of the foregoing the O&M Manual shall include descriptions, procedures, and shall comply with the requirements, set forth in the provisions of the Bid Documents.

The draft of the O&M Manual shall be subject to the review and approval of TPPA, which shall have the right to make any changes and revisions to the O&M Manual as it may deem appropriate. The Bidder shall revise such draft O&M Manual prior to the commencement of the O&M period.

During the term of this Agreement, the Bidder shall promptly notify TPPA of any revisions, additions or modifications which he, in his professional

opinion, believes should be made to the O&M Manual, whether as a result of additional experience in operating and maintaining the Facility, changes in influent quality or volume, changes or modifications to any equipment, part, component or structure incorporated in the Facility. Such notification shall set forth the reason for the proposed revision. Any proposed revision shall be subject to the approval of the TPPA. In addition, during the term of this Agreement, TPPA shall have the right to require relevant changes, revisions, or additions to the O&M Manual as it, shall deem appropriate to ensure full compliance with the O&M Standards.

SECTION – 7

GENERAL TECHNICAL SPECIFICATION

1. General Technical Specifications of Civil Works, Mechanical Works & Electrical works (Exhibit 4)

SECTION – 8

LIST OF APPROVED MAKES

1. List of Approved makes (Exhibit 5)

ANNEXURE – XI

PART – 2 (PRICE BID)

Price Bid

a) Name of the Work: "Design, Engineering, Construction, Fabrication, Supply, Erection, Testing & Commissioning of 250 KLD capacity Zero Liquid Discharge (ZLD) based Common Effluent Treatment Plant (CETP) on Turn-key basis, including 12 months comprehensive Operation & Maintenance"

Sl No	Description	Total Rate in Rs	Total Rate (In words)
1	Design, Engineering, Construction, Fabrication, Supply, Erection, Testing & Commissioning of 250 KLD capacity Zero Liquid Discharge (ZLD) based Common Effluent Treatment Plant (CETP) including 12 months comprehensive Operation & Maintenance Excluding GST		
	Add: GST @ 18%		
	Total Contract Value including GST		

Total sum of (in Figures as in Rs. ……(Including GST) (in Words) Rupees ……

Note:

- **Incase of any discrepancy between the price quoted in words and figures, lowest of the two shall be considered.**
- **GST should be quoted separately.**
- **In case of any deviation, the NPV estimated by TPPA will be final.**

Dated:

Bidder's Signature

Address……

Witness……..

Seal

Address…….

ANNEXURE – XII

COST BREAK UP OF OPERATION AND MAINTENANCE OF CETP FOR FIVE YEARS

(Amount in ₹)

Sl No	Description	10% (25 KLD)	20% (50 KLD)	30% (70 KLD)	50% (125 KLD)	60% (150 KLD)
A	**Variable Cost**					
i	Power					
ii	Fuel					
iii	Consumables					
iv	Other variable expenses					
	Total Variable cost (A)					
B	**Fixed Cost**					
i	Manpower					
ii	Maintenance					
iii	Profit margin / other fixed cost					
	Total Fixed Cost (B)					
	Total O&M Cost (A+B)					
	GST @ 18%					
	TOTAL O&M COST INCL GST					
	COST PER LITER (CAPACITY / TOTAL O&M COST INCL GST)					

Note: The above request for the operation and maintenance (O&M) costs for different input capacities is solely for the purpose of price discovery and understanding the operational modalities of various bidders. The requested costs will not influence or be included in the evaluation of the price bids.

EXHIBIT

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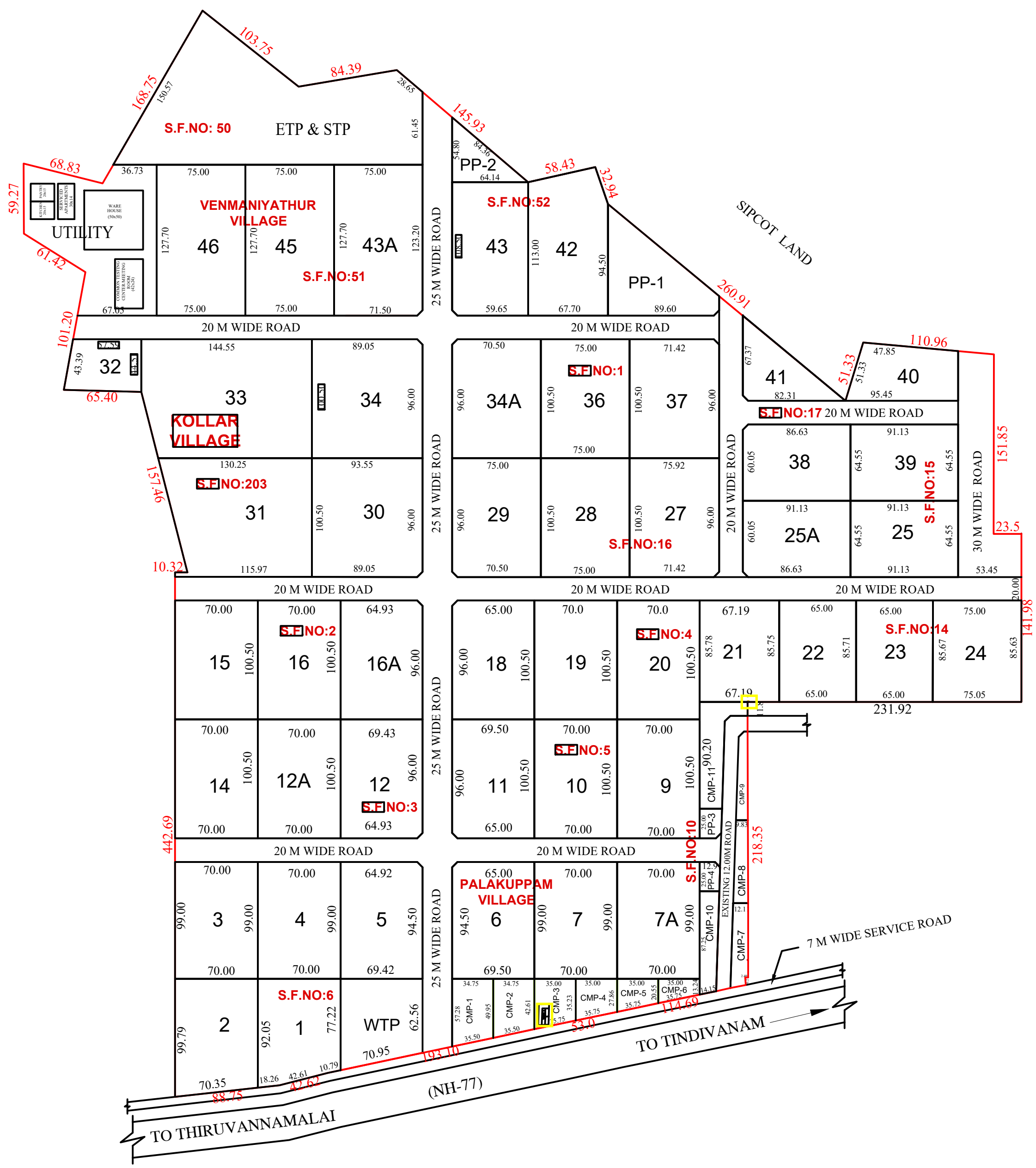
EXHIBIT-1



TOWN AND COUNTRY PLANNING DEPARTMENT
VILLUPURAM DISTRICT

INDUSTRIAL LAYOUT APPROVAL: TANSIDCO Pharma Industrial Park Layout in Plot No.A17 of Approved SIPCOT Industrial Park Layout L.P/A.D.T.C.P(V.D) NO : 20/2022.

VILLUPURAM DISTRICT, TINDIVANAM TALUK, MAILAM PANCHAYAT UNION, PELLAKUPPAM VILLAGE: S.F.NOS: 1/1, 1/2A, 1/2B, 1/2C, 1/2D, 1/3, 1/4, 1/5A, 1/5B, 2, 3/1, 3/2, 4/1A, 4/1B, 4/1C, 4/2, 4/3, 4/4, 4/5, 4/6, 5/1, 5/2, 6/1, 6/2A, 6/2B, 6/3, 10/1A1, 10/1A2, 10/2A1, 10/2A2,14/1A1A, 14/1A2, 14/2A1, 14/2A2, 15/1, 15/4, 15/5, 16, 17/3A, 17/4, 17/5A1, 17/5A2, 17/5B, 17/5C, 17/7, 18/3, 18/4

MAILAM PANCHAYAT UNION, KOLLAR VILLAGE:
S.F.NOS: 202/2A, 202/2B, 202/2C, 202/2D, 202/2E, 202/2F, 202/2G, 202/2H, 202/2I, 202/2J, 203/1A, 203/1B, 207/2

OLAKKUR PANCHAYAT UNION, VENMANIYATHUR VILLAGE:
S.F.NOS: 50/2B, 51/1, 51/2, 51/3B, 51/4, 52/2B, 52/3, 52/5

FILE NO:HIVL68HD/2023/TCP — SCALE 1:1600

GENERAL NOTES

TOTAL EXTENT	:	113.00Acres
ROAD AREA	:	17.48 Acres
EXTENT AFTER DETECTION OF ROAD AREA	:	95.52 Acres
PUBLIC PURPOSE (PP-1,PP-2,PP-3&PP-4)	:	1.93 Acres
COMMERCIAL PURPOSE (CMP)	:	3.26 Acres
ETP & STP PLOTS	:	5.07 Acres
WTP	:	1.20 Acres
UTILITY	:	2.76 Acres
SALEABLE INDUSTRIAL AREA	:	81.30 Acres

NUMBER OF PLOTS

INDUSTRIAL PLOTS	:	46 NOS.
COMMERCIAL PURPOSE PLOTS(SHOP)	:	11 NOS.
PUBLIC PURPOSE PLOTS (PP-1,PP-2,PP-3 & PP-4)	:	4 NOS.
ETP & STP PLOTS	:	1 NO
WTP	:	1 NO
UTILITY	:	1 NO
TOTAL NO OF PLOTS	:	64 NOS.

OPEN SPACE RESERVATION LAND

ALL DIMENSIONS ARE IN 'METER'

PUBLIC PURPOSE LAND

PP No	EXTENT IN ACRES
PP - 1	1.29
PP - 2	0.43
PP - 3	0.11
PP - 4	0.10
TOTAL	1.93

COMMERCIAL PURPOSE LAND

SL.NO	CMP No	EXTENT IN ACRES
1	CMP - 1	0.46
2	CMP - 2	0.40
3	CMP - 3	0.34
4	CMP - 4	0.27
5	CMP - 5	0.21
6	CMP - 6	0.15
7	CMP - 7	0.24
8	CMP - 8	0.20
9	CMP - 9	0.16
10	CMP - 10	0.32
11	CMP - 11	0.51
TOTAL		3.26

INDEX:

- PLOT BOUNDARY LINE
- INNER SUBDIVISION LINE
- VILLAGE BOUNDARY LINE
- EXISTING HIGHWAYS ROAD
- INTERNAL ROADS
- COMMERCIAL PLOTS
- PUBLIC PURPOSE
- ETP & STP
- UTILITY
- WTP

epge; jidfs;

1. The Channel flow through the site should be realigned and the culvert provided in the required place with approval of concerned Department.

2. epy cupik Fwpj;J toq;fg;gl;l rhd;Wfs;(k) guprPyidf;F rkh;g;gpf;fg;gl;l Mtzq;fs; rupahditay;y vd mwpag;gl;lhy; (m) kidg;gpuptpw;F njhopy;El;g xg;Gjy; toq;fpajhy; ghjpg;G Vw;gl;$ba R;o;eply Vw;gbd; kidg;gpuptpw;F toq;fg;gl;l njhopy;El;g xg;Gjy; Kd;dwptpg;Gkpd;wp efh; Cuikg;G ,af;Feu; mth;fshy; uj;J nra;agLk;.
(If the land documents and ownership certificates furnished for scrutiny are found to be incorrect or if the tecnical approval accorded to the layout is found to affect the situation, the approval will be cancelled without prior notice by Director of Town and Country Planning, Chennai.)

3. murhiz vz;:157> tPl;Ltrjp (k) efu;Gw tsu;r;rp Jiw> ehs;: 28.08.2017 —d; gb kidg;gpuptpy; mikAk; rhiy xJf;fPL (k) nghJ cgNahf gFjpfis rpg;fhl; rpl;Nfh guhkupf;fg;gl Ntz;Lk;.

4. ePu; eplyfs; eplyapy; cs;sthW eplyepWj;jg;gl Ntz;Lk;. Mf;fpukpg;G VJk; nra;aj; $lhJ.

5. kidg;gpuptpy; mikAk; kidfspy; Gy tiugl;jpy; cs;sthW fpzW mikAk; gFjpapy; fl;llq;fs; fl;lg;gl $lhJ.

6. epy cupik Fwpj;J ePjpkd;w tof;Ffs; VNjDk; epYitapy; ,Ug;gpd; mt;tof;fpd; jPu;g;gpd; mbg;gilapy; cj;juT khw;wpaikf;fg;gLk;.

k. t /e. C. c. ,. (tp. kh)vz;: 04/2024 (,izajs xg;Gjy;)

mstH cjtp tluthsu;

tluthsu; eply —II

Nkw;ghHitahsH/ tluthsh; eply —II

cjtp ,af;Feu;
khtl;l efu; Cuikg;G mYtyfk;
tpOg;Guk; khtl;lk;

PROPOSED TREATMENT SCHEME

EXHIBIT-2

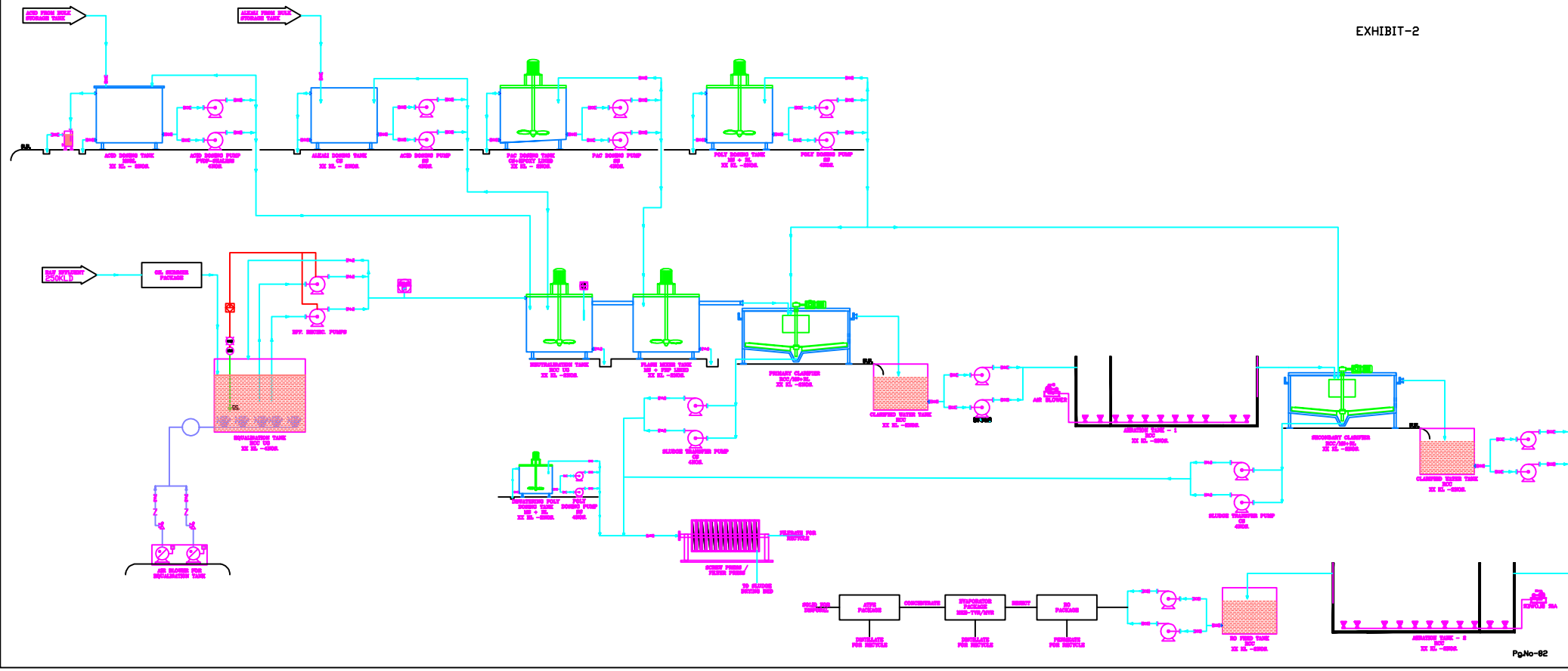


EXHIBIT-3

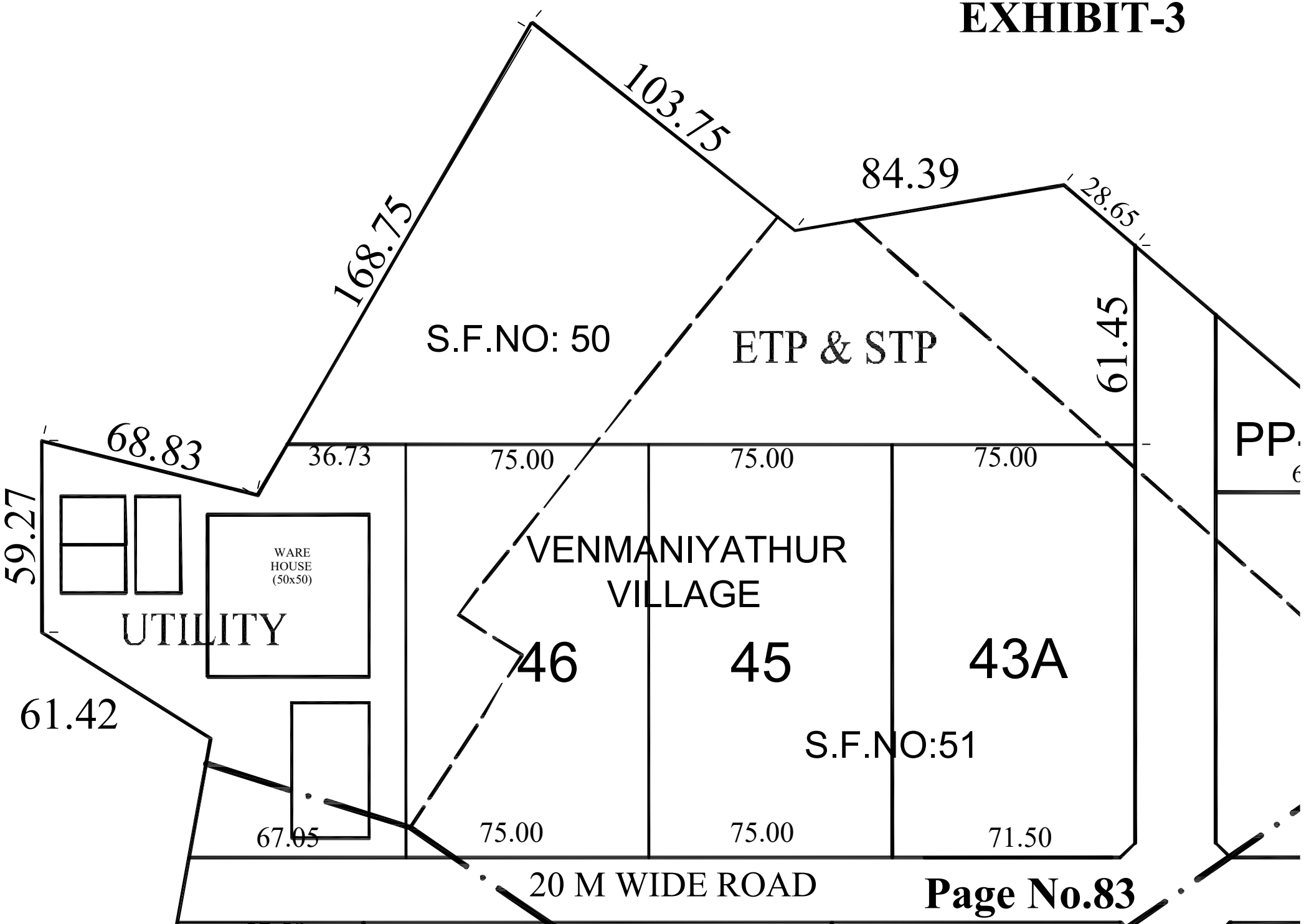

103.75
84.39
28.65
168.75
S.F.NO: 50
ETP & STP
61.45
68.83
36.73
75.00
75.00
75.00
PP
59.27
WARE
HOUSE
(50x50)
VENMANIYATHUR
VILLAGE
UTILITY
46
45
43A
61.42
S.F.NO:51
67.05
75.00
75.00
71.50
20 M WIDE ROAD

EXHIBIT 4

SECTION – 7

GENERAL TECHNICAL SPECIFICATIONS

A. CIVIL WORKS

B. MECHANICAL WORKS

C. ELECTRICAL WORKS

1 Order of Precedence of Specifications

The order of precedence in referring to various specifications are as follows in ascending order

a. Technical specification of the Contract
b. Indian Standard specifications
c. PWD of Tamil Nadu state /TNBP
d. CPWD
e. Manufacturers recommendations

The Contractor shall also not be paid for any extra working space beyond concrete dimensions during excavation of foundations of various proposed structures in the Project. Any damage done to the work due to the contractor's operation beyond the excavation lines shall be repaired at the expense of the contractor. Any and all excess excavation or over breaking performed by the contractor for any purpose or reason except as may be ordered in writing by the TPPA /PMC and whether or not due to the fault of the contractor shall be at the expense of the contractor. Cost of refilling for all such excavation with materials as specified by the TPPA /PMC has to be done by the contractor at his expense.

2 General

The scope of work shall comprise of (but not limited to) supply, construction, installation, testing, commissioning and approvals from TPPA /PMC statutory authorities for all works described in the tender. Complete scope of works should be read in conjunction with all documents and drawings which are the part of tender. The drawings and documents attached in the tender document are for reference only.
All materials shall conform to the latest edition of the Indian Standard Specifications. Standards issued elsewhere may be used only if approved by the TPPA /PMC and for those materials only for which appropriate Indian Standards do not exist.

If specification for any material/work is not available in these Technical Specifications, the material/work shall conform to the latest Specifications, with up to date correction slips, amendments and additions / IS CODES / Manufacturers specifications / as per drawings / as per instructions of TPPA /PMC.

The work shall be carried out according to the design, drawings and specifications issued by TPPA /PMC as "Good for Construction" drawings from time to time during execution stage and approved by TPPA /PMC.

All equipment and components shall be accommodated within the locations, space and dimensions indicated in the Architectural drawings. Any changes required shall be suggested by the Contractor and submitted for approval of TPPA. No changes shall be done without the approval of TPPA /PMC.

All sections of Tender documents and Tender drawings shall complement each other. Any discrepancy between various documents shall be studied and implemented as best for the project and as per decision of TPPA /PMC, without any cost implication.

If there is any variation in Design and Specifications between tender documents/drawings and any of the statutory/standard's requirement, then higher standard of specifications from either of them shall be implemented in approval with TPPA /PMC. Nothing extra shall be payable on any account.

It shall be responsibility of the Contractor to ensure that all works are carried out in full compliance with the TPPA's requirements, System Requirements. This Specification gives the project specific special requirements for the Construction of Commercial Building, Chennai herein after referred to as the Works, except where otherwise modified or amended within the Contract. Reference must be made to the General Specification for general requirements and to the appropriate Technical Specification for the corresponding technical requirements of all work.

The Specifications listed below have been added for guidance of the TPPA /PMC responsible for carrying out the Works who shall however ensure that all aspects of the construction of the Works shall comply with Local Standards, Laws and Regulations and accepted good practice in India.

Contractor's Responsibility

Apart from carrying out necessary surveying and setting out of the buildings and equipment foundations wherever required collecting all materials, equipment, plant, labour, consumables, tools and services necessary for proper execution, fabrication, ensuring quality control by conducting required tests at the appropriate time and intervals during the execution, disposal of excavated material as instructed, carrying out all associated works like removal, disposal of the debris, getting out, remove temporary facilities on completion of the works, clearance from local bodies / authorities for commissioning of all installation / equipment of the project work shall be obtained and furnished before taking over of the completed work, all within the quoted rates only. Machinery operators, drivers should have valid license.

Child labors are strictly prohibited. Top most attention shall be paid to the Health, safety of workers and Environment and the same shall be monitored on daily basis by qualified and experienced personnel in HSE.

A. TECHNICAL SPECIFICATIONS – CIVIL WORKS

1.0 EARTHWORK IN GRADING, EXCAVATION AND BACKFILLING

2.0 DEWATERING

3.0 REINFORCED CONCRETE

4.0 TERMITE PRE CONSTRUCTIONAL CHEMICAL TREATMENT IN BUILDINGS

5.0 WATERPROOFING

6.0 GENERAL BUILDING WORKS

7.0 PAINTINGS

1 EARTHWORK IN GRADING, EXCAVATION AND BACKFILLING SCOPE

This specification covers the general requirements of site grading, excavation in all type of strata (soil and rock) and mass/back filling around foundations & in plinths as per good for construction drawings. Handling surplus materials either by stacking or disposing it, to meet all the operations requirement mention within the intent and purpose of this specification and/or as per the direction of the TPPA/PMC.

1.1 APPLICABLE CODES

The following minimum codes and standards, unless otherwise specified herein, shall be applicable. In all cases, the latest revisions of the codes on the date of signing of contract agreement shall be referred to.

If any BS code mentioned below is replaced by Euro code, the CONTRACTOR shall follow corresponding Euro code with approval of TPPA/PMC. Contractor shall adopt and follow all applicable codes and standards for satisfactory completion of the work with approval of TPPA/PMC.

The codes and standards mentioned in the various specifications and requirements specified in the enquiry document shall be latest as on the day of execution of the works unless otherwise specified. The revisions in the relevant codes and standards after the date of award of contract shall be informed by the Contractor to the TPPA/PMC within 30 days of the issue of such revision of the code/ standard. TPPA/PMC may approve use of the earlier code/ standard if the revisions do not materially affect the statutory requirements of the project or does not impact safety practices. Any cost impact arising out of such revisions shall be mutually agreed.

S. No	Standard	Title
1	ASTM C40	Test Method for Organic Impurities in Fine Aggregates
2	ASTM C136	Test Method for Sieve Analysis for Fine and Coarse Aggregate
3	ASTM D422	Standard Test Method for Particle-Size Analysis of Soils
4	ASTM D698	Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-

S. No	Standard	Title
		lbf/ft3 (600 kN-m/m3)
5	ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
6	ASTM D1557	Standard Test Method for Laboratory Compaction Characteristics of Soil using Modified Effort (56,000 ft-lb/ft3 (2700 kNm/m3))
7	ASTM D2487	Practice for Classification of Soils for PPA/PMCing Purposes (Unified Soil Classification System)
8	ASTM D2488	Practice for Description and Identification of Soils (Visual-Manual Procedure)
9	ASTM D3017	Test Method for Moisture Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
10	ASTM D3080	Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions
11	ASTM D4253	Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
12	ASTM D4254	Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
13	ASTM D4318	Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
14	ASTM D4718	Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles
15	ASTM D4767	Test Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils.
16	ASTM D5030	Test Method for Density of Soil and Rock in Place by the Water Replacement Method in a Test Pit
17	ASTM D6938	Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

S. No	Standard	Title
18	BS EN 1997	Euro code 7 – Geotechnical Design
19	BS 812	Code of Practice for Testing Aggregates
20	BS 1377	Methods of Test for Soils for Civil TPPA/PMCing Purposes
21	BS 1427	Guide to Field and On-Site Test Methods for the Analysis of Waters
22	BS 5930	Code of Practice for Site Investigations
23	BS 6031	Code of Practice for Earthworks
24	EN 933-1	Tests for geometrical properties of aggregates- Part 1: Determination of particle size distribution-Sieving method
25	EN-ISO 17892-1	Geotechnical investigation & testing- Laboratory testing of soil-Part 1: Determination of water content
26	EN-ISO 17892-2	Geotechnical investigation & testing- Laboratory testing of soil-Part 2: Determination of bulk density
27	EN-ISO 17892-3	Geotechnical investigation & testing- Laboratory testing of soil-Part 3: Determination of particle density
28	EN-ISO 17892-4	Geotechnical investigation & testing- Laboratory testing of soil-Part 4: Determination of particle size distribution
29	EN-ISO 17892-5	Geotechnical investigation & testing- Laboratory testing of soil- Part 5: Incremental Loading Oedometer Test

1.2 DRAWINGS

The CONTRACTOR shall furnish good for construction drawings to the TPPA/PMC for review and approval as applicable. Such drawings shall indicate areas to be excavated/ filled, grade levels, areas demarcated for stacking of excavated material etc. The contractor shall follow strictly such drawings and instruction given by the TPPA/PMC.

1.3 GENERAL

- The contractor shall visit site to understand the site condition and make his own assessment about sub-soil strata and water level likely to be encountered during the execution.
- The CONTRACTOR shall obtain written approval from the TPPA/PMC on the execution method statement. Execution method statement prepared by contractor shall indicate the detailed sequential execution plan covering manpower & machinery, safety aspects, time duration etc. based on the project requirement. Contractor's execution methodology will include detailed calculation related to:
    a) Slope stability and or shoring by using parameters related to proposed site, if it is in contractor's scope otherwise the excavation drawing shall be followed.
    b) Dewatering.
- However, the approval of construction methodology shall not in any way relieve the contractor of his responsibility for any consequent loss or damage. In case the project is expected to involve blasting contractor will carry-out conditional survey of nearby properties to record it as a baseline prior to commencement of the excavation activities.
- The contractor in accordance with the specification and project requirements shall mobilize all necessary tools, plants, qualified supervisory personnel, labour, instruments, materials (consumables and non-consumable) required for any temporary/permanent works etc., or any such items not specifically stated herein for completion of the job.
- The CONTRACTOR shall carry out the detailed site survey prior to commencement of the site work and shall mark all footprints within + 10mm tolerance and record existing ground levels with respect to established reference/ grid lines at 10 m intervals or nearer or as determined by the TPPA/PMC based on ground profile. Initially ground levels, finish ground level, depth of excavation etc., at every intermediate and final stages shall be confirmed with TPPA/PMC and thereafter properly recorded.
- The excavation shall be done to correct lines and levels within + 10mm tolerance. This shall also include, where required, proper shoring to maintain excavations.

- Temporary fences, guardrails, barricades, lights, and other protective measures around the excavation area required for the safety of personnel shall be provided and maintained in good condition.
- The price quoted by CONTRACTOR shall also include for dumping of excavated materials in segregated manner within the areas demarcated, in regular heaps, bunds, riprap with regular slopes as directed by the TPPA/PMC and levelling the same so as to provide natural drainage. Rock/ soil excavated shall be stacked properly as directed by the TPPA/PMC. As a rule, all softer material shall be laid along the centre of heaps, the harder and more weather resisting materials forming the casing on the sides and the top. Expansive or organic soil, if encountered shall be stacked separately and shall not be used in any case for site grading activities. The surplus excavated earth shall be disposed by the CONTRACTOR at a designated location by the local authorities or as directed by TPPA/PMC.
- Known contaminated soils and water if any, shall be managed in accordance with approved soil management plan.
- Soil erosion /sediment control shall be implemented in accordance with local authority regulations or approved erosion/sediment control measures.
- Drainage of cuts, excavations, fills, stockpiles, spoil areas, surcharge embankments, and borrow areas shall be maintained at all times to prevent ponding of surface water because of ground water or rainfall by providing temporary ditches, swales, or pumping systems as required in each respective site area. Contractor shall submit management plan for this water along with work method statement.
- Quality control and Quality Assurance
    1. A written Quality Control Program document that provides details of how compliance with the requirements of this specification and contract documents shall be achieved and submitted by contractor to purchaser for approval a minimum of 14 days before start of construction.
    2. Certified laboratory test data for the materials and products to be used in the work shall be submitted to purchaser for approval a minimum of 14 days before shipping of materials and products.
    3. Results of the quality control tests required during the performance of

the work shall be submitted to TPPA/PMC within 2 days of completion.

4. An independent testing/inspection firm (see Section 4.13.1), shall provide the following submittals to purchaser and contractor:

- A statement attesting that contractor's work is in accordance with the requirements of this specification and the contract documents.
- Informal daily "pass" or "fail" reports.
- Formal weekly reports including all test logs and comments. These formal reports shall include density and moisture content test logs, indicating location of tests by coordinates and elevation and all appropriate comments.
- Upon earthwork completion, all density and moisture content test logs and comments compiled and submitted for permanent project records.
- Sources and test results of all borrow materials used for fill.
- Unless otherwise specified in the contract documents, a qualified independent inspection and testing agency will be retained by purchaser to perform field and laboratory testing and/or evaluations in accordance with the criteria of ASTM D3740 to verify compliance of the work with the requirements of this specification and to ensure the achievement of the intents and purposes of the work.
- The performance or lack of performance of the tests and inspections by purchaser's inspector shall not be construed as granting relief from the requirements of this specification or the other contract documents.
- During construction, purchaser shall have access to all contractor's facilities and records for the purpose of conducting performance inspection/audits.
- During an audit by purchaser, all inspection and test reports, and/or TPPA/PMCing analyses and calculations associated with the scope of work shall be provided to purchaser upon request.

1.4 CLASSIFICATION

All materials to be excavated shall be classified by the TPPA/PMC, into one of the following classes. The decision of the TPPA/PMC regarding the classification of the material shall be final and binding on the CONTRACTOR and not be a subject matter of any appeal or arbitration. Earthwork will be classified under any of the following categories: Ordinary and Hard Soils

These shall include all kinds of soils containing sand, silt, shingle, gravel, clay, loam, peat, ash, shale, etc., which can be easily excavated either manually or mechanically and which is not classified under "Soft and Decomposed Rock" and "Hard Rock" defined below. This shall also include embedded rock boulders not longer than 1 metre in any one direction and not more than 200 mm in any one of the other two directions.

(a) **Soft and Decomposed Rock**

This shall include completely to highly weathered/fractured rock, boulders, slag, chalk, slate, hard mica schist, laterite and all other materials, which in the opinion of TPPA/PMC is soft rock, difficult to excavate manually with a pick axe or required very light mechanical excavating machines, but does not need blasting. The mere fact that the CONTRACTOR resorts to blasting without prior approval from local authorities or TPPA/PMC, shall not qualify for classification under 'Hard Rock'.

This shall also include excavation in macadam & tar roads and pavements, rock boulders not longer than 1 metre in any direction and not more than 500 mm in any one of the other two directions.

(b) **Hard Rock**

This shall include all rock occurring in large continuous masses, which can only be excavated by blasting or by Pneumatic hydraulic breakers. Harder varieties of rock with or without veins and secondary minerals, which in the opinion of the TPPA/PMC require blasting, shall be considered as hard rock.

Where hard rock is met with and blasting operations are not permitted, the CONTRACTOR shall use other methods such as use of chemicals or Pneumatic hydraulic breakers or any other method approved by the TPPA/PMC for loosening the rock mass, developing cracks, etc. The loosened material shall be thereafter removed mechanically. Boulders of rock occurring in such sizes and not classified under (a) and (b) above shall also be classified as hard rock. Buried concrete work both reinforced and unreinforced to be dismantled will be measured under this item, unless a separate provision is made in the tender.

1.5 EXCAVATION

- Contractor shall obtain written permission from intra departmental heads prior to commencement of work to ensure that there is no presence of underground utilities in the proposed excavation area.
- All the required work permits shall be obtained by CONRACTOR from the
- TPPA/PMC / LOCAL AUTHORITIES / GOVERNMENT AGENCY, as
- applicable.
- In case of existence of underground utilities, the same shall be diverted away from the excavation area in consultation with the TPPA/PMC. Payment of Diversion of utilities shall made as per the item specified in the tender and if there is no provision in the tender than the same shall be executed based on the mutually agreed terms with the TPPA/PMC.
- Excavation for permanent work shall be carried out as per the approved drawings. In area involving mass excavation, initially area shall be excavated up to a depth 150 mm above the final level. The balance depth shall be excavated with special care just prior (not more than 12 hours before) the laying of P.C.C. Soft pockets, if any, shall be removed even by excavating below the final level and extra excavation shall be filled up using plum concrete or plain cement concrete as directed by the TPPA/PMC.
- All excavation shall be done to the minimum dimensions as required for safety and working facility. The excavation must be carried out in the most expeditious and efficient manner. Where the nature of soil or the depth of the trench and season of the year do not permit vertical sides, the CONTRACTOR shall erect the necessary shoring, strutting and planking or cut slopes with or without steps, to a safer angle or both with due regard to the safety of personnel and works and to the satisfaction of the TPPA/PMC. The scheme proposed by the CONTRACTOR shall take into consideration the presence of existing buildings/ structures/traffic movement in the vicinity, if any. All necessary precautions shall be taken to avoid slipping of loose soil / rock.
- In case of deep excavation in rocky strata the fractured excavated rock sides shall be stabilised by using rock anchors.
- The CONTRACTOR shall make all necessary pumping arrangements for dewatering the low lying area or area where excavation is required to carry out below ground water table. CONTRACTOR shall keep area under execution to be

workable. The low lying areas may receive water from any source such as rains, accumulated rainwater, floods, leakages from sewer and water mains, water ingress from near-by canals / channels, subsoil water table being high or due to any other cause whatsoever.

- In case of deep excavation in the area of high water table special precautions shall be taken to main water table level at least 500 mm below the layer of blinding concrete (Plain Cement Concrete (PCC) level to avoid uplift/damage of building basement raft/foundation due to water pressure. The water table shall not be allowed to rise above base of raft/foundation level until the structure attains adequate height required to counterbalance the uplift pressure.
- The CONTRACTOR shall take all necessary precautions for the safety of traffic during construction and provide, erect and maintain such barricades including signs, markings, flags, lights and flagman, as necessary at either end of the excavation/ embankment and at such intermediate points as directed by the TPPA/PMC for the proper identification of construction area. He shall be responsible for all damages and accidents caused due to negligence on his part.

1.6 STRIPPING IN LOOSE ROCK

- All loose boulders, semi-detached rocks (along with earthy stuff, which might move therewith) which is not directly in the excavation but so close to the area to be excavated, and in the opinion of the TPPA/PMC liable to fall or otherwise endanger the workmen, equipment, or the work, etc., shall be stripped off and removed away from the area of the excavation. The method used shall be such as not to shatter or render unstable or unsafe the portion, which is originally sound and safe.
- Any material not requiring removal as contemplated in the work, but which, in the opinion of the TPPA/PMC, is likely to become loose or unstable later, shall also be promptly and satisfactorily removed as directed by the TPPA/PMC.

1.7 EXCAVATION IN HARD ROCK

- After removal of overburden, if any, excavation is likely to continue in rock to adequate depths and area of excavation footprint shown in the drawings and if the site condition permits to excavate rock by using blasting, then as far as possible, all blasting operations shall be completed prior to commencement of

other construction activities. At all stages of excavations, precaution shall be taken to preserve the rock below and beyond the lines specified for the excavation, in the soundest possible condition by adopting technique like pre-shearing method etc., for creating excavation boundary. The quantity and strength of explosives shall be designed in such a way that it will neither damage nor crack the rock outside the limits of excavation.

- All precautions shall be taken by the contractor during the blasting operations so that no damage is caused to adjoining buildings or structures as a result of blasting operations. In case of any damage to permanent or temporary structures, CONTRACTOR shall repair the same to the satisfaction of TPPA/PMC at his cost. As excavation approaches its final lines and levels, the depth of the charge holes and amount of explosives used shall be progressively and suitably reduced.
- Specific permission of TPPA/PMC shall be taken by CONTRACTOR for blasting rock and he shall also obtain a valid Blasting License from the authorities concerned. If permission for blasting is refused by either by TPPA/PMC or by local authority, the rock shall be removed by wedging, pick, barring, heating and quenching, pneumatic hydraulic breakers etc., or other approved methods including chemicals required if any. All loose or loosened rock in the sides shall be removed by barring, wedging, etc. and if any unstable wedges of rock mass from sides of excavated surface shall be stabilised by providing temporary rock bolts. The price quoted by contractor for excavation in hard rock shall include the cost of all these operations. Safety net shall be used to arrest the movement of fractured rocks as a safety precaution for the workers working inside the pit.
- CONTRACTOR shall obtain necessary license or permit from the authorities dealing with explosives, for storage of explosives, fuses and detonators issued to him from TPPA's stores or from supplier arranged by him. The fees, if any, required for obtaining such license, shall be borne by CONTRACTOR. CONTRACTOR shall have to make necessary storage facilities for the explosives, etc. as per rules of local statutory regulations. Explosives shall be kept dry and shall not be exposed to direct rays of sun or not to be stored in the vicinity of fire, stoves, steam pipes or heated metal, etc. No explosives shall be brought near the work in excess of quantity required for a particular amount of firing

to be done; and surplus left after filling the holes shall be removed to the magazine. TPPA/PMC's prior approval shall be taken for the location proposed for the magazine.

- In no case shall blasting be allowed closer than 30 metres from any structure or at locations where concrete has just been placed. In the latter case, the concrete must be at least 7 days old.

1.8 SPECIFIC REQUIREMENTS FOR BLASTING

- CONTRACTOR shall employ a competent, experienced supervisor and licensed blaster in-charge of each set of operation, who shall be held personally responsible to ensure that all safety regulations are followed during the blasting work.
- Before any blasting is carried out, CONTRACTOR shall intimate TPPA/PMC and obtain his approval in writing along with required permission from regulatory authorities for resorting to such operations. He shall intimate the hours of firing charges, the nature of explosive to be used and the precautions taken for ensuring safety.
- CONTRACTOR shall ensure that all workmen and the personnel at site are vacated from an area, at least 15 minutes before firing time by sounding warning siren or PA system or whistle. The area shall also be given a warning by sounding a distinguishing siren or whistle.
- The blasting of rock near any existing buildings, equipment or any other property shall be done under cover and CONTRACTOR has to make all such necessary muffling arrangements. Covering may preferably be done with small charges only and where directed by TPPA/PMC; a trench shall have to be cut by chiselling prior to the blasting operation, separating the area under blasting from the existing structures. In no case contractor shall be allowed exceed the Peak particle velocity (PPV) near all the structures above 25mm/sec or as specified by the project/local authorities. Contractor shall put the sensor-based equipment in the vicinity of all the adjourning structures to measure PPV.
- The firing shall be supervised by a Supervisor and not more than 6 (six) holes at a time shall be set off successively. If the blasts do not tally with the number fired, the misfired holes shall be carefully located after half an hour and when

located, shall be exploded by drilling a fresh hole along the misfired hole (but not nearer than 600 mm from it) and by exploding a new charge.

- A wooden tamping rod with a flat end shall be used to push cartridges inside the charge hole. A metal rod or hammer shall not be permitted to push the cartridge. The charges shall be placed firmly into place and not rammed or pounded. After a hole is filled to the required depth, the balance of the hole shall be filled with stemming which may consist of sand or stone dust or similar inert material.
- CONTRACTOR shall preferably detonate the explosives electrically.
- The explosives shall be exploded by means of a primer, which shall be fired by detonating a Fuse Instantaneous Detonator (FID) or other approved cables. The detonators with FID shall be connected by special nippers.
- In dry weather and normal dry excavation, ordinary low explosive gunpowder may be used. In damp rock, high explosive like gelatine with detonator or equivalent and fuse wire may be used. Underwater or for excavation in rock with substantial accumulated seepage electric detonation shall be used.
- Holes for charging explosives shall be drilled with pneumatic drills, the drilling pattern being so planned that rock pieces after blasting will be suitable for handling without secondary blasting.
- When excavation has almost reached the desired level, hand trimming shall have to be done for dressing the surface to the desired level. Any rock excavation /overcuts beyond the required level shall be filled up with concrete having cylinder strength not less than 12MPa at 28 days. The cost of filling such excess depth shall be borne by CONTRACTOR and the excavation carried out beyond the limit specified will not be paid for. Stopping in rock excavation shall be done by hand trimming.
- CONTRACTOR shall be responsible for any accident to workmen, public or TPPA's property due to blasting operations. CONTRACTOR shall also be responsible for strict observance of rules, laid by Inspector of explosives, or any other Authority duly constituted under the local government.

FILL MATERIAL FOR BACK FILLING AND SITE GRADING

All fill material will be subject to the TPPA/PMC s approval. If any material is rejected by the TPPA/PMC, the CONTRACTOR shall remove the same forth with

from the site at no extra cost to the TPPA. Surplus fill material shall be deposited/ disposed as directed by the TPPA/PMC after the fill work is completed. No earth fill shall commence until surface water discharges and streams have been properly intercepted or otherwise dealt with as directed by the TPPA/PMC.

EXCAVATED SOIL

To the extent available, selected surplus soils from excavated materials shall be used as backfill subject to the approval based on the below test results. Contractor shall categorise the surplus excavated material and stack separately. Fill material shall be free from clods, salts, sulphates, organic or other foreign material and non-expansive in nature. All clods of earth shall be broken or removed. The CONTACTOR shall arrange to carry out the minimum following tests on selected soil samples from excavated material in an accredited geotechnical laboratory.

a) Grain size analysis

b) Moisture content

c) In-situ density

d) Specific gravity

e) Liquid limit and plastic limit

f) Standard/Modified proctor density (based on project requirement) or relative density (in case of sandy strata)

g) Free swell Index and Swelling pressure.

h) Tri- axial test / direct shear test under undrained and unconsolidated condition.

1.9 BORROWED MATERIAL:

If any selected fill material is required to be borrowed, it shall be CONTRACTOR'S responsibility to locate suitable borrow areas for borrowing fill material, the CONTRACTOR shall make arrangements for bringing such material from outside borrow pits. The material and source shall be subject to prior approval of the TPPA/PMC The approved borrow pit area shall be cleared of all bushes, roots of trees, plants, rubbish, etc. Topsoil containing salts/ sulphates and other foreign material shall be removed. The CONTRACTOR shall arrange to have trial pits of

specified dimensions and numbers dug at locations specified, for the TPPA/PMC to examine the nature and type of material to be obtained from the borrow area. Any material rejected by the TPPA/PMC shall be removed from the site immediately. The CONTRACTOR shall make necessary access road to the borrow areas and maintain the same, if such access road does not exist. CONTRACTOR shall obtain all necessary permits from local authorities. The properties of borrow material shall meet following requirements.

SL.No	Properties	Range of Values
1	**Field Characteristics**	
1.1	Bulk Density (γbulk)	1.8 to 2.1 gm/cc
1.2	Dry density (γdry)	1.3 to 1.6 gm/cc
1.3	Moisture content	34 to 36 %
1.4	Modified Proctor Density	More than 1.8 gm/cc
2	**Physical Properties**	
2.1	Specific gravity	2.65 to 2.85
3	**Index properties**	
3.1	Liquid limit (%)	40 to 65%
3.2	Plastic Limit (%)	20 to 25 %
3.3	Shrinkage limit (%)	15 to 35 %
3.4	Free swelling index	Less than 50%
4	**Mechanical analysis**	
4.1	Gravel (above 2.0 mm)	0 to 10%
4.2	Sand (2.0 to 0.06 mm)	30 to 40%
4.3	Silt (0.06 to 0.002 mm)	0 to 45 %
4.4	Clay (Below 0.002 mm)	15 to 25 %
5	**Chemical properties**	
5.1	Loss on ignition	3.5-4.5
5.2	Chloride (Cl)	Less than 500 mg/litre
5.3	Sulphate (SO3)	Less than 400 mg/litre
6	**TPPA/PMCing properties**	
6.1	C (kg/cm2)	0.2-0.3
6.2	Bulk Density Φ	10 to 25 degree
6.3	Permeability K (cm/sec)	10-4 to 10-5
6.4	CBR (%)	03-Jun

Filling with excavated earth shall be done in regular horizontal layers each not

exceeding 300 mm in depth and compacted. All lumps and clods exceeding 125 mm in any direction shall be broken. The CONTRACTOR shall make good all subsidence and shrinkage in earth fillings, embankments, traverses, etc. during execution and till the completion of work unless otherwise specified.

RECYCLED MATERIALS:

In addition to using selected material from approved borrow areas, fine aggregates from other than natural sources as specified in clause 5 of ASTM C33 for use in concrete may also be used. These include crushed quarry rock, crushed boulders, cobbles or gravel, or manufactured sand (crushed air cooled blast furnace slag and crushed hydraulic cement concrete). CONTRACTOR shall establish the compaction procedure for these types of materials through laboratory testing to achieve the desired degree of compaction indicated in drawing and execute under controlled conditions to achieve the compaction on field.

1.10 METHOD OF BACKFILLING

- **CRUSHED ROCK FILL**

  Where excavated material is mostly rock, the boulders shall be broken into pieces not larger than 250 mm size in any direction, the rock mass shall be broken into angular shapes pieces, flaky pieces of rock mass shall be avoided. Voids between the rock pieces shall be filled with approved finer soil material before compaction. The crushed rock fill shall be spread in uniform horizontal layers and each layer shall be compacted with minimum ten (10) passes of 12 tonne smooth wheeled vibratory roller. In this clause and all subsequent clauses, the number of passes will mean the number of times that each point on the surface of the layer being compacted has been traversed by roller. During rolling, the roller shall uniformly overlap not less than one third of the roller track width made in the proceeding travel.

  Rock Fill shall comprise material consisting predominantly of rock fragments of such a size that it cannot be placed in layers of the thickness allowed without crushing, or further breaking down. Rock Fill may be placed in the layers not exceeding twice the average size of the larger fragments. Rock fill shall be laid in layers alternate to layer of C-Φ soil layer. Voids in the stone layer shall be

filled with properly graded fine material to fill up the voids prior to laying of soil layer.

- **EXCAVATED MATERIAL OR BORROWED MATERIAL (C-ϕ SOIL)**
  - ✓ Approved soil consisting of ordinary soil, soil containing gravel, shingle, etc. shall be deposited in layers. CONTRACTOR should ensure that all clods of earth are broken down to a size not larger than 100 mm.
  - ✓ Each layer of loose soil shall be compacted to minimum of 95% of standard proctor density or modified proctor density as determined by ASTM D 1557.
  - ✓ Where not specified, compaction of each layer shall be carried out by means of 12 tonnes roller smooth wheeled/ sheep-foot or wobbly wheeled rollers.
  - ✓ Field compaction test shall be carried out at different stages of filling and also after the fill to the entire height has been completed. The frequency for carrying out in-situ tests shall be one test for every 600 to 800 sq. m. of backfill area and shall be carried out for every layer of backfill. If the in-situ-tests are not satisfactory, soil shall be compacted and tested again for the conformity to the required compaction level. Till that time no further layer of fill material shall be laid.

- **SAND FILL:**
  - ✓ At places backfilling shall be carried out with local sand if directed by the TPPA/PMC. The sand used shall be clean, medium grained and free from impurities. The filled-in-sand shall be kept flooded with water for 24 hours to ensure maximum consolidation. Any temporary work required to contain sand under flooded condition shall be to the CONTRACTOR's account. The surface of the consolidated sand shall be dressed to required level or slope. Construction of floors or other structures on sand fill shall not be started until the TPPA/PMC has inspected and approved the fill. In this case, CONTRACTOR should ensure that the fill material is not washed away. This work should be carried out as directed by TPPA/PMC. CONTRACTOR shall make arrangement for draining away of water after consolidation of the sand mass.

- ✓ Sandy fill shall be compacted, where so specified, by minimum 12 tonne vibratory rollers. The fill material shall be compacted to the specified relative density or compacted fill shall be compacted to 85% of relative density of sand.

UNDER VARIOUS SITE CONDITIONS:

As per the guidelines discussed above , backfilling under various site conditions shall be carried out as below:

- **FILLING IN PITS AND TRENCHES AROUND FOUNDATIONS OF STRUCTURES, WALLS, ETC:**
  - ✓ As soon as the work in foundations has been accepted (after attaining 28 days strength) and measured, the spaces around the foundations, structures, pits, trenches, etc. shall be cleared of all debris, and filled with earth in layers as specified above., each layer being watered, rammed and properly compacted, before the succeeding one is laid. Each layer shall be compacted to the satisfaction of the TPPA/PMC. The final backfill surface shall be trimmed and levelled to proper profile as directed by the TPPA/PMC or indicated on the drawings.

- **PLINTH FILLING**
  - ✓ Plinth filling shall be carried out with approved material and shall be filled in layers as specified above, watered and compacted with mechanical compaction machines. When filling reaches the finished level, the surface shall be flooded with water, unless otherwise directed, for at least 24 hours, allowed to dry and then the surface again compacted as specified above to avoid settlements at a later stage. The finished level of the filling shall be trimmed to the level/ slope specified.
  - ✓ At some locations/ areas it may not be possible to use rollers because of space restrictions, etc. The CONTRACTOR, if permitted by an TPPA/PMC, shall use pneumatic tampers, rammers, etc. to ensure proper compaction.

- **FILLING IN TRENCHES**

Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipes and drains have been tested and passed. The backfilling material shall be properly compacted by watering and ramming, taking due care that no damage is caused to the pipes.

- ✓ Where the trenches are excavated in soil, the filling from the bottom of the trench to the level of the centre line of the pipe shall be done with selected approved earth in layers; backfilling above the level of the centre line of the pipe shall be done with selected earth in layers with proper compaction of each layer.
- ✓ In case of excavation of trenches in rock, the filling up to a level 300 mm above the top of the pipe shall be done with fine materials. The filling from a level 300mm above the top of the pipe to the top of the trench shall be done using broken rock filling of size not exceeding 150mm mixed with fine material as available to fill up the voids.
- ✓ Filling of the trenches shall be carried simultaneously on both sides of the pipe to avoid unequal pressure on the pipe.
- ✓ Any marking tiles required for identification and safeguard the electrical cables /pipelines, same shall be provided and laid as per the drawings/specification.

1.11 SITE GRADING

- ✓ Site grading shall be carried out as indicated in the drawings and as directed by the TPPA/PMC. Excavation shall be carried out as specified under relevant clauses.
- ✓ To ensure that the fill has been compacted as specified, field and laboratory tests shall be carried out by the CONTRACTOR.
- ✓ Field compaction test shall be carried out (as per relevant ASTM standard) at different stages of filling and also after the fill to the entire height has been completed. This shall hold good for embankments as well.
- ✓ The CONTRACTOR shall protect the earth-fill from being eroded or washed away by rain or damaged in any other way. Should any slip occur, the CONTRACTOR shall remove the affected material and make good the

slip at his cost.

- ✓ The fill shall be carried out to such dimensions and levels as indicated on the drawings after the stipulated compaction. The fill shall be considered as incomplete if the desired compaction has not been achieved.
- ✓ Access roads, whether of temporary or other nature, required to be constructed for access and for movement of men, materials, equipment, transport vehicles, vehicles carrying fill material, etc. to or over borrow areas and/ or to or over areas on which fill has to be deposited shall be constructed by the CONTRACTOR. Such access roads shall be maintained in good condition during all seasons to ensure completion of work according to time schedule.

2 DEWATERING

All excavations shall be kept free of water. Grading and surface water drainage scheme in the vicinity of excavation shall be properly closed to prevent surface water from draining into excavated areas. CONTRACTOR shall remove by pumping or other means approved by TPPA/PMC any water inclusive of rain water and subsoil water accumulated in excavation and keep all excavations dewatered until the foundation work is completed and backfilled. Sumps made for dewatering must be kept clear of the excavation/ trench areas required for further work of foundation construction. Method of pumping shall be approved by TPPA/PMC; but in any case, the pumping arrangement shall be such that there shall be no movement of subsoil or blowing in or excavation wall collapse due to differential head of water during pumping. Pumping arrangements shall be adequate to ensure no delays in construction.

The CONTRACTOR shall take adequate measures for bailing and/ or pumping out water from excavations and construct diversion channels, bunds, sumps, coffer dams, etc. as may be required. Pumping shall be done directly from the foundation trenches or from a sump outside the excavation in such a manner as to preclude the possibility of movement of water through any fresh concrete or masonry and washing away parts of concrete or mortar. During laying of concrete or masonry and for a period of at least 24 hours thereafter, pumping shall be done to ensure that the surface below the concrete remains dry.

Capacity and number of pumps, location at which the pumps are to be installed, pumping hours, etc. shall be reviewed by the CONTRACTOR from time to time. The TPPA/PMC may direct the CONTRACTOR to make changes in his scheme if the adopted scheme fails to achieve the desired results.

Pumping shall be done in such a way as not to cause damage to the work or adjoining property by subsidence, etc. Disposal of water shall not cause inconvenience or nuisance in the area or cause damage to the property and structures nearby or shall not be a cause for environmental pollution of natural water bodies.

When there is a continuous inflow of water and quantum of water to be handled is considered in the opinion of TPPA/PMC as large, well point system - Single stage or

multi stage, shall be adopted. CONTRACTOR shall submit to TPPA/PMC his scheme of well point system including the stages, the spacing, number and diameter of well points, headers, etc. and the numbers, capacity and location of pumps of approvals. Normal dewatering using bailing arrangement, submersible pumps shall be included in the item rate for excavation. Special dewatering system using well point system shall be considered as separate item.

In case well point dewatering is required, the Indian Standard IS 9759: 1981 (Reaffirmed 2016) - Guidelines for De-Watering During Construction shall be used for design of the dewatering system.

3 REINFORCED CONCRETE

- ✓ This Specification covers the general requirements for ready mixed concrete and for concrete using on-site production facilities including requirements with regard to the quality, handling, storage of ingredients, proportioning, batching, mixing, transporting, placing, curing, protecting, repairing, finishing and testing of concrete; formwork; requirements with regard to the quality, storage, bending and fixing of reinforcement; grouting as well as mode of measurement and payment for completed works.
- ✓ It shall be very clearly understood that the specifications given herein are brief and do not cover minute details. However, all works shall have to be carried out in accordance with the relevant standards and codes of practices or in their absence in accordance with the best accepted current TPPA/PMCing practices or as directed by TPPA/PMC from time to time. The decision of TPPA/PMC about the specification to be adopted and their interpretation and the mode of execution of work shall be final and binding on CONTRACTOR and no claim whatsoever will be entertained on this account.

3.1 CODES AND SPECIFICATIONS

- ✓ The pertinent clauses of the following Indian Codes, Standards and Specification shall apply to the material and workmanship covered by this specification. In the event of the conflict of certain requirements between this specification and the codes referred herein, this specification shall govern.
- ✓ The codes and standards mentioned herein shall be latest as on the day of award of contract of the works unless otherwise specified. Contractor shall be responsible to inform to the Consultant/ TPPA in case of any revisions/re-affirm/amendment in the relevant codes and standards after the date of award of contract within 30 days of the issue of such revision/re-affirm/amendment of the code/ standard. PMC/ TPPA may approve use of the earlier code/ standard if the revisions do not materially affect the statutory requirements of the project or does not impact safety practices. Any cost impact arising out of such revisions shall be mutually agreed.
- ✓ It is not the intent to specify herein all the codes and standards required for the satisfactory completion of work. The list of codes and standards indicates certain primary codes and standards and not all the codes required for the work under

the contract. It is understood that all the pertinent codes and standards shall form the part of this specification whether explicitly indicated or not. Indian Standards shall be supplemented by International Standards for clarity and coverage wherever felt so.

3.2 MATERIALS

IS 455	Specification for Portland Slag Cement.
IS 1489: PART 1	Portland pozzolana cement - specification part 1 fly ash based
IS 1489: PART 2	Portland pozzolana cement - specification part 2 calcined clay based (fourth revision)
IS 12330	Specification for Sulphate Resisting Portland Cement
IS 383	Coarse and fine aggregate for concrete - specification (third revision)
IS 432	Specification for Mild Steel and Medium Tensile Steel Bars and Hand Drawn Steel Wire for Concrete Reinforcement – Part 1 and 2
IS 1786	High strength deformed steel bars and wires for concrete reinforcement - specification
IS 1566	Specification for hard-drawn steel wire fabric for concrete reinforcement
IS 9103	Concrete admixtures - specification
IS 2645	Integral waterproofing compounds for cement mortar and concrete - specification
IS 4990	Plywood for concrete shuttering work - specification
IS 4926	Ready-mixed concrete - code of practice
IS 8041	Specification for rapid hardening cement.
IS 12600	-Specification for Low Heat Portland Cement
IS 6909	Specification for super-sulphated cement
IS 12089	Specification for granulated slag for manufacture of portland slag cement

3.3 MATERIAL TESTING

IS 4031 (Part 1 to 15)	Methods of physical tests for hydraulic cement
IS 4032	Method of chemical analysis of hydraulic cement.
IS 650	Specification for standard sand for testing of cement.
IS 2430	Methods for sampling of aggregates for concrete.
DIN EN 12620	Aggregates for concrete (Refer Note).
IS 2386	Methods of test for aggregates for concrete (Parts 1 to 8)
IS 3025 (Part 1 to 51)	Methods of sampling and test (physical and chemical) for water and wastewater
Is 6925	METHODS OF TEST FOR DETERMINATION OF WATER- SOLUBLE CHLORIDES IN CONCRETE ADMIXTURES

MATERIAL STORAGE

IS 4082	Recommendations on stacking and storage of construction materials and components at site.

CONCRETE MIX DESIGN

IS 10262	Concrete mix proportioning-guidelines

CONCRETE TESTING

IS 1199	Method of sampling and analysis of concrete.
IS 516	Method of test for strength of concrete.
IS 9013	Method of making, curing and determining compressive strength of accelerated cured concrete test specimens.
IS 8142	Method of test for determining setting time of concrete by penetration resistance.
IS 9284	Method of test for abrasion resistance of concrete.
IS 2770 (Part 1)	Methods of testing bond in reinforced concrete: Part 1 Pull-out test

EQUIPMENT

IS 4925	Specification for concrete batching and mixing plant.
IS 7251	Specification for concrete finishers.
IS 2750	Specifications for steel scaffoldings.

CODES OF PRACTICE

IS: 456	Plain and reinforced concrete - code of practice.
IS: 457	Code of practice for general construction of plain and reinforced concrete for dams and other massive structures.
IS 3370 (Part 1)	Concrete structures for storage of liquids - code of practice - part 1 : general requirements
IS 3370 (Part 2)	Concrete structures for storage of liquids - code of practice - part 2 : reinforced concrete structures
IS 3370 (Part 3)	Code of practice for concrete structures for the storage of liquids: part 3 prestressed concrete structures
IS 3370 (Part 4)	Code of practice for concrete structures for the storage of liquids: part 4 design tables
IS 3935	Code of practice for composite construction.
IS 2204	Code of practice for construction of reinforced concrete shell roof.
IS 2210	Criteria for the design of reinforced concrete shell structures and folded plates.
IS 2502	Code of practice for bending and fixing of bars for concrete reinforcement.
IS 5525	Recommendation for detailing of reinforcement in reinforced concrete works.
IS 2751	Code of practice for welding of mild steel plain and deformed bars used for reinforced concrete construction.
IS 9417	Welding of high strength steel bars for reinforced concrete construction-recommendations
IS 3558	Code of practice for use of immersion vibrators for consolidating

	concrete.
IS 3414	Code of practice for design and installation of joints in buildings.
IS 4326	Earthquake resistant design and construction of buildings - code of practice
IS 4014 (Part 1)	Code of practice for steel tubular scaffolding Part 1 Definitions and materials
IS 4014 (Part 2)	Code of practice for steel tubular scaffolding: Part 2 Safety regulations for scaffolding (first revision)
IS 2571	Code of practice for laying in situ cement concrete flooring
IS 7861 (Part 1)	Code of practice for extreme weather concreting: Part 1Recommended practice for hot weather concreting
IS 7861 (Part 2)	Code of practice for extreme weather concreting: Part 2Recommended practice for cold weather concreting
IS 3812 (Part 1)	Pulverized fuel ash – Part 1 – For use as pozzolana in cement, cement mortar and concrete
IS 15388: 2003	Specification for Silica Fume

CONSTRUCTION SAFETY

IS 3696 (Part 1)	Safety code of scaffolds and ladders: Part 1 Scaffolds (first revision)
IS 3696 (Part 2)	Safety code of scaffolds and ladders: Part 2 Ladders (first revision)
IS 7969	Safety code for handling and storage of building materials.
IS 8989	Safety code for erection of concrete framed structures.

MEASUREMENT

IS 1200 (Part 2)	Method of measurement of building and TPPA/PMCing works (Part 2 and 5) Methods of measurement of building and civil TPPA/PMCing works: Part 2 Concrete works (third revision)
IS 1200 (Part 5)	Methods of measurement of building and civil TPPA/PMCing works: part 5 Form work (fourth revision)

3.4 GENERAL

- TPPA/PMC shall always have the right to inspect all operations including the sources of materials, procurement, layout and storage of materials, the concrete batching and mixing equipment, and the quality control system. Such an inspection shall be arranged, and TPPA/PMC's approval obtained, prior to starting of concrete work. This shall, however, not relieve CONTRACTOR of any of his responsibilities. All materials, which do not conform to this specification, shall be rejected.
- Materials should be selected so that they can satisfy the design requirements of strength, serviceability, safety, durability and finish with due regards to the functional requirements and the environmental conditions to which the structure will be subjected. Materials complying with codes/ standards shall only be used. Other materials may be used after approval of the TPPA/PMC and after establishing their performance suitability based on previous data, experience or tests.

3.5 MATERIALS

CEMENT

- Unless otherwise specified or called for by TPPA/PMC, cement shall be Ordinary Portland Cement conforming to IS: 269.
- The Portland Pozzolana Cement shall conform to IS: 1489 & Portland Slag Cement conforming to IS: 455 shall be used as directed by TPPA/PMC.
- Sulphate Resisting Portland Cement conforming to IS: 12330 may be used for mass concrete construction and generally complying with IS: 12330, but with Tricalcium Aluminate (C3A) content not more than 5% by mass (as manufactured by an approved manufacturer) may be used for reinforced concrete construction.
- Only one type of cement shall be used in any one mix unless specifically approved by TPPA/PMC. The source of supply, type or brand of cement within the same structure or portion thereof shall not be changed without prior approval from TPPA/PMC.
- Cement, which is not used within 90 days from its date of manufacture, shall be tested at a laboratory approved by TPPA/PMC and until the results of such

tests are found satisfactory, it shall not be used in any work.

- Fly Ash Blended Cements conforming to IS: 1489 (Part I) may be used in RCC structures as per the guidelines given below:
  - ✓ IS: 456 - Code of Practice for Plain and Reinforced Concrete shall be followed about Concrete Mix Proportion and its production as under: The concrete mix design shall be done as "Design Mix Concrete" as prescribed in clause 9 of IS: 456. Concrete shall be manufactured in accordance with clause 10 of IS 456 covering Quality Assurance measures.
  - ✓ Minimum M25 grade of concrete shall be used in all structural elements made with RCC both in load bearing and framed structure.

Use of Fly Ash Admixed Cement Concrete (FACC) in RCC Structures

There shall be no bar on use of FACC in RCC structures subject to following additional conditions.

- Fly ash shall have its chemical characteristics and physical requirements, etc. conforming to IS: 3812 (Parts I) and shall be duly certified.
- To ensure uniform blending of fly ash with cement in conformity with IS: 456, a specific facility needs to be created at site with complete computerised automated process control to achieve design quality or with similar facility from Ready Mix Concrete (RMC) plants.
- As per IS: 1489 (Part-I) maximum 35% of mass of total cementitious material is permitted to be substituted with fly ash conforming to IS: 3812 (Part-I).
- Separate storage for dry fly ash shall be provided. Storage bins or silos shall be weather proof and permit a free flow and efficient discharge of fly ash. The filter or dust control system provided in the bins or silos shall be of sufficient size to allow delivery of fly ash maintained at specified pressure to prevent undue emission of fly ash dust, which may interfere with weighing accuracy.
- Use of Silica Fume Admixed Cement Concrete in RCC Structures
- Silica fume conforming to IS 15388 may be used to the extent of 5 – 10% of the cement content as stipulated in IS 456 as a part replacement of cement.
- Use of Fly Ash Blended Cements in Cement Concrete (PPCC) in RCC Structures
- Subject to General Guidelines detailed out as above, PPC manufactured

conforming to IS: 1489 (Part-I) shall be treated at par with OPC for manufacture of Design Mix concrete for structural use in RCC.

- Till the time, Bureau of Indian Standards (BIS) makes it mandatory to print the percentage of fly ash on each bag of cement, the certificate from the PPC manufacture indicating the same shall be insisted upon before allowing use of such cements in works.
- While using PPC for structural concrete work, no further admixing of fly ash shall be permitted.

AGGREGATES

- Aggregates shall consist of naturally occurring stones and gravel (crushed or uncrushed) and sand. They shall be chemically inert, strong, hard, clean, durable against weathering, of limited porosity, free from dust/ silt/ organic impurities/ deleterious materials and conform to IS: 383. Aggregates such as slag, crushed over burnt bricks, bloated clay ash, sintered fly ash and tiles shall not be used.
- Aggregates shall be washed and screened before use where necessary or if directed by the TPPA/PMC.
- Aggregates containing reactive materials shall be used only after tests conclusively prove that there will be no adverse effect on strength, durability and finish, including long term effects, on the concrete.
- The fineness modulus of sand shall neither be less than 2.2 nor more than 3.2. If use of sand having fineness modulus more than 3.2 is unavoidable then it shall be suitable blended with crusher stone dust.
- The maximum size of coarse aggregate shall be as stated on the drawings, but in no case greater than 1/4 of the minimum thickness of the member, provided that the concrete can be placed without difficulty to surround all reinforcement thoroughly and fill the corners of the form.
- For concrete elements less than 100 mm thick, consideration should be given to the use of 10 mm nominal maximum size aggregates. Where 10 mm maximum size aggregate is required, 10 mm single-size grading shall be used.
- Plums 160 mm and above of a reasonable size may be used where directed.

Plums shall not constitute more than 20% by volume of concrete unless specified by TPPA/PMC.

WATER

- Water used for both mixing and curing shall conform to IS: 456. Potable water is generally satisfactory. Water containing any excess of acid, alkali, sugar or salt shall not be used.
- The pH value of water shall not be less than 6.
- Seawater shall not be used for concrete mixing and curing.

REINFORCEMENT

- Reinforcement bars shall conform to IS: 432 and/ or IS: 1786 and welded wire fabric to IS: 1566 as shown on the drawing.
- All reinforcement shall be clean, free from pitting, oil, grease, paint, loose mill scales, rust, dirt, dust or any other substance that will destroy or reduce bond.
- Special precaution like coating of reinforcement may be provided with the prior approval of TPPA/PMC.
- Reinforcement bars produced by rerolling may be used subject to the approval of the TPPA/PMC. CONTRACTOR shall furnish the manufacturer's certificate stating the process of manufacture to the satisfaction of the TPPA/PMC and the test sheet signed by the manufacturer giving the result of each mechanical test applicable for each lot of the material supplied including result of chemical composition. At-least one Sample from each lot received at site shall be tested in the laboratory approved by the TPPA/PMC and the cost of testing shall be borne by the CONTRACTOR. It shall be ensured that all the test results conform to IS: 432 or IS: 1786 as applicable.

ADMIXTURES AND ADDITIVES

- Approval of Admixtures - Admixture from approved manufacturer shall be used in concrete mix along with aggregates, cement and water without the written instruction or approval of the TPPA/PMC in each case. If more than one admixture is proposed for use in the same concrete mix, their interaction shall be checked by trial mixes to ensure their compatibility.
- The CONTRACTOR shall note that the description of any proposed admixture

by trade or brand name will not be sufficient for the approval of the TPPA/PMC.

- The CONTRACTOR shall submit manufacturer's test certificates and technical literature of the admixture proposed to be used. If directed by the TPPA/PMC, the admixture shall be got tested at an approved laboratory at no extra cost.
- The TPPA/PMC will, wherever appropriate, call for trial batches of concrete to be prepared to demonstrate the effect of the proposed admixtures both on the fresh concrete and on the hardened concrete before giving his approval. He may also lay down additional requirements for the control of the use of such admixtures.
- Notwithstanding any previously given approval, the TPPA/PMC may withdraw such approval at any time with respect to any mix containing admixtures if, in his opinion, the performance of the admixture under actual Site conditions is not completely satisfactory.
- Supply and Storage of Admixtures - Accelerating, retarding, water-reducing, super plasticizing and air entraining admixtures shall conform to IS: 9103, integral cement water proofing admixture to IS: 2645, any other admixture to BS: 5075, if it is applicable, unless otherwise specified or agreed. Admixtures shall be stored strictly in accordance with manufacturers' recommendations and precautions shall be taken during delivery and storage to prevent damage to or adulteration of admixtures.
- Use of Admixtures - Any admixture used in any concrete mix shall only be used at the rate of dosage or in the proportions previously approved by the TPPA/PMC, method of mixing, etc. all in accordance with the manufacturer's instructions and within the manufacturer's recommended ambient temperature range.

SAMPLES AND TESTS

- All materials used for the works shall be tested before use. The frequency of such confirmatory tests shall be decided by TPPA/PMC.
- Manufacturer's test certificate shall be furnished for each batch of cement/ reinforcing steel and when directed by TPPA/PMC samples shall also be got tested by the CONTRACTOR in a laboratory approved by TPPA/PMC at no extra cost to TPPA. However, where material is supplied by TPPA, all testing charges shall be borne by TPPA, but transportation and preparation of material samples for the laboratory shall be done by CONTRACTOR at no extra cost.

- Sampling and testing of aggregates shall be as per IS: 2386 under the supervision of TPPA/PMC. The cost of all tests, sampling, etc. shall be borne by CONTRACTOR.
- Water to be used shall be tested to comply with clause 5.4 of IS: 456.
- CONTRACTOR shall furnish manufacturer's test certificates and technical literature for the admixture proposed to be used. If directed, the admixture shall be got tested at an approved laboratory at no extra cost.

STORING OF MATERIALS

- All material shall be stored in a manner to prevent its deterioration and contamination, which would preclude its use in the works. Requirements of IS: 4082 shall be complied with.
- CONTRACTOR shall make his own arrangements for the storage of adequate quantity of cement even if cement is supplied by TPPA. If such cement is not stored properly and has deteriorated, the material shall be rejected. Cost of such rejected cement, where cement is supplied by TPPA, shall be recovered at issue rate or open market rate whichever is higher. Cement bags shall be stored in dry weatherproof shed with a raised floor, well away from the outer walls and insulated from the floor to avoid moisture from ground. Not more than 15 bags shall be stacked in any tier. Storage arrangement shall be approved by TPPA/PMC. Storage under tarpaulins shall not be permitted. Each consignment of cement shall be stored separately and consumed in its order of receipt. CONTRACTOR shall maintain record of receipt and consumption of cement.
- Each size of coarse and fine aggregates shall be stacked separately and shall be protected from dropping leaves and contamination with foreign material. The stacks shall be on hard, clean, free draining bases, draining away from the concrete mixing area.
- CONTRACTOR shall make his own arrangements for storing water at site in tanks of approved capacity. The tanks shall be cleaned at least once a week to prevent contamination.
- The reinforcement shall be stacked on top of timber sleepers to avoid contact with ground/ water. Each type and size shall be stacked separately.

CONCRETE

Concrete grade shall be as designated on drawings. Concrete in the works shall be "DESIGN MIX CONCRETE" or "NOMINAL MIX CONCRETE". All concrete works of up to grade M15 shall be NOMINAL MIX CONCRETE whereas all other grades, M20 and above, shall be DESIGN MIX CONCRETE.

DESIGN MIX CONCRETE

For this specification, Design Mix Concrete is classified as "Normal Concrete". It shall be identified by a prefix and two numbers. Prefix "M" would denote Normal Concrete. The two numbers e.g. 25 - 40 would denote the crushing strength of cube at 28 days in N/mm^2 and maximum size of the coarse aggregates in millimeters respectively. Normal concrete shall have a net dry unit weight of not less than 25 kN/m^3, for the finished structure after curing.

MIX DESIGN AND TESTING

- For Design Mix Concrete, the mix shall be designed as per IS 10262 to provide the grade of concrete having the required workability and characteristic strength not less than appropriate values given in IS: 456. The design mix shall in addition be such that it is cohesive and does not segregate during placement and should result in a dense and durable concrete capable of giving the specified finish. For liquid retaining structures, the mix shall also result in watertight concrete. The CONTRACTOR shall exercise great care while designing the concrete mix and executing the works to achieve the desired result.
- The minimum grade of concrete shall be as per Table 5 of IS: 456 for various exposure conditions of concrete. For various environmental conditions, refer to Table 3 of IS: 456.
- The minimum cement content for Design Mix Concrete shall be as mentioned in the Schedule of Quantities.
- The quantity of maximum mixing water per unit volume of concrete may be determined from Table 2 of IS 10262.The water content in Table 2 is for angular coarse aggregate and for 25 to 50 mm slump range. The water estimate in Table 2 can be reduced by approximately 10 kg for sub- angular aggregates,20 kg for gravel with some crushed particles and 25 kg for rounded gravel to

produce same workability. For the desired workability (other than 25 to 50 mm slump range),the required water content may be established by trial or an increase by about 3 percent for every additional 25 mm slump or alternatively by use of chemical admixtures conforming to IS 9103.Water reducing admixtures or super plasticizing admixtures usually decrease water content by 5 to 10 percent and 20 percent and above respectively at appropriate dosages.

- It shall be CONTRACTOR's sole responsibility to carry out the mix designs at his own cost. He shall furnish to TPPA/PMC for approval at least 30 days before concreting operations, a statement of proportions proposed to be used for the various concrete mixes and the strength results obtained. The strength requirements of the concrete mixes ascertained on 150 mm cubes as per IS: 516 shall comply with the requirements of Table – 2 of IS: 456.
- A random sampling procedure shall be adopted to ensure that each concrete batch shall have a reasonable chance of being tested i.e., the sampling should be spread over the entire period of concreting and cover all mixing units. The minimum frequency of sampling of concrete of each grade shall be in accordance with the cl. 15.2 of IS 456.:
- 3 test specimens (cubes) shall be made for each sample for testing at 28 days. The test results of the sample shall be the average of the strength of 3 specimens.
- In the 'very low' category of workability where strict control is necessary, for example pavement quality concrete, measurement of workability by determination of compacting factor will be more appropriate than slump (refer to IS: 1199) and a value of compacting factor of 0.75 to 0.80 is suggested.
- In the 'very high' category of workability, measurement of workability by determination of flow will be appropriate (refer to IS: 9103).
- Where single size graded coarse aggregate are not available, aggregates of different sizes shall be properly combined. The CONTRACTOR's mix design shall show that combined grading of coarse aggregate meets the requirements of Table 2 of IS: 383 for graded aggregates.

BATCHING AND MIXING OF CONCRETE

- Proportions of aggregates and cement, as per approved concrete mix design, shall be by weight. These proportions shall be maintained during subsequent concrete batching by means of weigh batchers capable of controlling the

weights within ±2% for cement and ±3% for aggregate. The batching equipment shall be calibrated at the frequency decided by TPPA/PMC.

- Amount of water added shall be such as to produce dense concrete of required consistency, specified strength and satisfactory workability and shall be so adjusted to account for moisture content in the aggregates. Water- cement ratio specified for use by TPPA/PMC shall be maintained. Each time the work stops, the mixer shall be cleaned out, and while recommencing, the first batch shall have 10% additional sand and cement to allow for sticking in the drum.
- Arrangement should be made by CONTRACTOR to have the cubes tested at his own expense in an approved laboratory or in field with prior consent of TPPA/PMC. Sampling and testing of strength and workability of concrete shall be as per IS: 1199, IS: 516 and IS: 456. It is preferable to cast additional cubes (minimum 3 specimens) for testing at 7 days and 14 days.

NOMINAL MIX CONCRETE

- MIX DESIGN AND TESTING - Mix Design and preliminary tests are not necessary for Nominal Mix Concrete. However, works tests shall be carried out as per IS: 456. Proportions for Nominal Mix Concrete and water- cement ratio may be adopted as per Table 9 of IS: 456. However, it will be CONTRACTOR's sole responsibility to adopt appropriate nominal mix proportions to achieve the specified characteristic strength, if required or directed by the TPPA/PMC..
- BATCHING AND MIXING OF CONCRETE - Based on the adopted nominal mixes, aggregates shall be measured by volume. However, cement shall be by weight only. Appropriate correction shall be made for bulking of sand after testing.
- READY MIXED CONCRETE - All specification as per IS: 4926 – "Specification for Ready Mixed Concrete" shall be applicable. The design mix prepared by the RMC supplier shall be the responsibility of the CONTRACTOR. The testing of concrete as per Codal provisions and the specifications shall be done by the CONTRACTOR same as the normal concreting works.

FORMWORK

- The formwork shall be either steel or lined with steel, waterproof/ laminated board or such other material as directed and approved by the TPPA/PMC. Forms shall be strongly constructed, closely jointed and smooth and shall be such as to ensure true sharp arises and a perfect surface. Forms shall be so designed

that they can be taken apart and reassembled readily.

- Surface Finish of precast units shall comply with requirements of this specification. The class of Finish shall generally be of F2 type unless detailed differently on the drawings or as directed by the TPPA/PMC. No construction joints will be permitted within any precast work.

CASTING TOLERANCE

- The casting tolerance, unless otherwise ordered or directed, shall be within +3 mm of true dimensions.

CURING

- The top and sides of all precast units shall be kept covered constantly and in a damp condition with clean, potable fresh water for at least seven days after casting or for such further period as the TPPA/PMC may direct. It is preferable to have a curing pond for this purpose.

REINFORCEMENT FABRICATION AND PLACEMENT

- Reinforcing bars shall be bent and fixed in accordance with the procedure specified in IS 2502.
- All bars shall be bent by Bar bending machines.
- Re-bending or straightening incorrectly bent bars shall not be done without approval of TPPA/PMC.
- Reinforcement shall be accurately fixed and maintained firmly in the correct position using blocks, spacers, chairs, binding wire, etc. to prevent displacement during placing and compaction of concrete in accordance with clause 12.3 to 12.6 of IS 456. The tied in-place reinforcement shall be approved by TPPA/PMC prior to concrete placement. PVC or concrete spacers of appropriate size shall be used with the approval of TPPA/PMC.
- Binding wire shall be 18-gauge soft annealed wire. Ends of the binding wire shall be bent away from the concrete surface and in no case encroach into the concrete cover.
- Substitution of reinforcement, laps/ splices not shown on drawing shall be proposed by CONTRACTOR and approved by TPPA/PMC.
- If permitted by TPPA/PMC, welding of reinforcement shall be done in

accordance with IS: 2751, IS: 9417 and SP: 34 as applicable.

- Tolerance on placement of reinforcement shall be as per Cl. 12.3 of IS: 456.

TOLERANCES

- Tolerance for formed and concrete dimensions shall be as per IS: 456 unless specified otherwise.
- Tolerance is a specified permissible variation from lines, grade or dimensions given in drawings. No tolerance specified for horizontal or vertical building lines or footings shall be construed to permit encroachment beyond the legal boundaries. Unless otherwise specified, the following tolerances will be permitted.

TOLERANCES FOR RC BUILDINGS

(a) Variation from the Plumb

i.	In the lines and surfaces of columns, piers, walls and in arises 5 mm per 2.5 m or 25 mm, whichever is less.		
ii.	For exposed corner columns and other conspicuous lines.		
	In any bay or 5 m maximum	-	5 mm
	In 10 m or more	-	10 mm

(b) Variation from the level or from the grades indicated on the drawings

i.	In slab soffits, ceilings, beam soffits and in arises		
	In 2.5 m	-	5 mm
	In any bay or 5 m maximum	-	10 mm
	In 10 m or more	-	15 mm
ii.	For exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines		
	In any bay or 5 m maximum	-	5 mm
	In 10 m or more	-	15 mm

(c) Variation of the linear building lines from established position in plan and related position of columns, wall and partitions

In any bay or 5 m maximum	-	10 mm
In 10 m or more	-	20 mm

(d) Variation in the sizes and locations of sleeves, openings in walls and floors - 5 mm except in the case of and for anchor bolts.

(e) Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls

Minus	-	5 mm
Plus	-	10 mm

(f) Footings

i.	Variation in dimension in plan		
	Minus	-	5 mm
	Plus	-	50 mm
ii.	Misplacement or eccentricity		
	2% of footing width in the direction of misplacement but not more than 50 mm		
iii.	Reduction in thickness		
	Minus	-	5% of specified thickness subject to a maximum of 50 mm

(g) Variation in steps

i.	In a flight of stairs		
	Rise	-	3 mm
	Tread	-	5 mm
ii.	In consecutive steps		
	Rise	-	1.5 mm
	Tread	-	3 mm

TOLERANCES IN OTHER STRUCTURES

(h) **All structures**

i.	Variation of the construction linear outline from established position in plan.		
	In 5 m	-	10 mm
	In 10 m or more	-	15 mm
ii.	Variation of dimensions to individual structure features from established positions.		
	In 20 m or more	-	25 mm
	In buried construction	-	50 mm
iii.	Variations from plumb, from specified batter or from curved surfaces of all structures.		
	In 2.5 m	-	10 mm
	In 5 m	-	15 mm
	In 10 m or more	-	25 mm
	In buried construction	-	Twice the above values
iv.	Variations from level or grade indicated on drawings in slabs, beams, soffits, horizontal grooves and visible arises.		
	In 2.5 m	-	5 mm
	In 7.5 m or more	-	10 mm
	In buried construction	-	Twice the above values
v.	Variation in cross-sectional dimensions of columns, beams, buttresses, piers and similar members.		
	Minus	-	5 mm
	Plus	-	10 mm
vi.	Variation in the thickness of slabs, walls, arch sections and similar members.		
	Minus	-	5 mm

	Plus	-	50 mm

FOOTING FOR COLUMNS, PIERS, WALLS, BUTTRESSES AND SIMILAR MEMBERS

i.	Variation of dimension in Plan		
	Minus	-	10 mm
	Plus	-	50 mm
ii.	Misplacement or eccentricity		
	2% footing width in the direction of misplacement but not more than 50 mm		
iii.	Reduction in thickness		
	5% of specified thickness subject to a maximum of 50 mm		

TOLERANCE IN FIXING ANCHOR BOLTS SHALL BE AS FOLLOWS:

i.	Anchor bolts without sleeves	1.5 mm in plan
ii.	Anchor bolts with sleeves	5.0 mm in elevation
	- for bolts up to and including 28 mm dia.	5 mm in all directions
	- for bolts up to 32 mm dia.	3 mm in all directions
iii.	Embedded parts	5 mm in all directions

TOLERANCES IN FORMWORK

The formwork shall be designed and constructed to the shapes, lines and dimensions shown on the drawings within the tolerances given below:

1.	Deviation from specified dimensions of cross section of columns and beams	-6 mm
2.	Deviations from dimensions of footings (tolerances apply to concrete dimensions only, not to positioning of vertical reinforcing steel or dowels)	+12 mm
(a)	Dimension in Plan	-12 mm +50 mm
(b)	Eccentricity	0.02 times the width of the footing in the direction of deviation, but not more than 50 mm
(c)	Thickness	± 0.05 times the specified thickness

- Tolerance for top of concrete of equipment and structural steel foundations shall be as under unless more stringent requirements are specified by equipment manufacturer:
    (a) Where grout thickness is less than or equal to 25 mm: ±5 mm.
    (b) Where grout thickness is more than 25 mm: ±5 mm.

EXECUTION AND REMOVAL OF FORMS

- Before placing concrete, the surface of all forms shall be coated with suitable non- staining form releasing agents such as raw linseed oil to prevent adhesion of concrete and to facilitate removal of forms.
- The form releasing agent shall cover the forms fully and evenly without excess over drip. Care shall be taken to prevent form releasing agents from getting on the surface of the construction joints and on reinforcement bars. Special care shall be taken to thoroughly cover form strips for narrow grooves, to prevent swelling of the forms and the consequent damage to concrete prior to or during removal of forms.
- Immediately before concrete is placed care shall be taken to see that all forms are in proper alignment and the supports and fixtures are properly secured and

tightened.

- Where forms for continuous surfaces are placed in successive units, the forms shall lap and fit tightly over the completed surface to prevent leakage of cement slurry from the fresh concrete and to maintain accurate alignment of the surface.
- Forms shall be left in place until their removal is authorised and shall then be removed with care to avoid injury to concrete.
- Removal of forms shall be started when the concrete has achieved strength of at least twice the stress to which the concrete may be subjected at the time of removal of formwork.
- In normal circumstances and where ordinary Portland cement is used forms can be allowed to be struck asper the guideline given in clause 11.3 of IS 456.

SETTLEMENT OF FORMWORK AND CAMBER

- Due to various reasons such as closure of form joints, shrinkage of timber, dead load deflections, elastic shortening of form members or formwork, deflections, settlement may occur. The CONTRACTOR shall take precautions, including using adequately rigid formwork, to prevent excessive settlement/ deflection; the usual acceptable limit being 1/500 of the spans of the formwork.
- In the absence of any specified camber on the drawings, soffit of all beams more than 5 m in span and other than pre-stressed concrete beams shall be laid to a camber, the amount of which at mid span shall not be less than 1/500 of the span of the structure. The profile of soffit shall be parabolic.

PREPARATION PRIOR TO CONCRETE PLACEMENT

- The faces of formwork coming in contact with concrete shall be cleaned and two coats of approved mould oil applied before fixing reinforcement. All rubbish, particularly chippings, shavings, sawdust, wire pieces, dust, etc. shall be removed from the interior of the forms before the concrete is placed. Where directed, cleaning of forms shall be done by blasting with a jet of compressed air at no extra cost.
- All arrangements - formwork, equipment and proposed procedure, shall be approved by TPPA/PMC. CONTRACTOR shall maintain separate Pour Card for each pour as per the format enclosed.

TRANSPORTING, PLACING AND COMPACTING CONCRETE

- Concrete shall be transported from the mixing plant to the formwork with minimum time lapse by methods that shall maintain the required workability and will prevent segregation, loss of any ingredients or ingress of foreign matter or water.
- In all cases concrete shall be deposited as nearly as practicable directly in its final position. For locations where, direct placement is not possible and in narrow forms, CONTRACTOR shall provide suitable drops and "Elephant Trunks". Concrete shall not be dropped from a height of more than 1.5 m.
- Concrete shall not be placed in flowing water. Under water concrete shall be placed in position by tremie or by pipeline from the mixer and shall never be allowed to fall freely through the water.
- While placing concrete the CONTRACTOR shall proceed as specified below and ensure the following:

    (a) Continuously between construction joints and predetermined abutments.

    (b) Without disturbance to forms or reinforcement.

    (c) Without disturbance to embedment.

    (d) Without dropping in a manner that could cause segregation or shock.

    (e) In deep pours only when the concrete and formwork is designed for this purpose and by using suitable chutes or pipes.

    (f) Do not place if the workability is such that full compaction cannot be achieved.

    (g) Without disturbing the unsupported sides of excavations; prevent contamination of concrete with earth. Provide sheeting, if necessary. In supported excavations, withdraw the linings progressively as concrete is placed.

    (h) If placed directly onto hardcore or any other porous material, dampen the surface to reduce loss of water from the concrete.

    (i) Ensure that there is no damage or displacement to sheet membranes.

    (j) Record the time and location of placing structural concrete.

    (k) When concrete is brought from batching plant to site in millers, the

time of mixing and the time of pour shall be checked to ensure that setting has not started.

- Concrete shall normally be poured & compacted in its final position within initial setting time. Concrete shall be compacted during placing with approved vibrating equipment without causing segregation until it forms a solid mass free from voids, thoroughly worked around reinforcement and embedded fixtures and into all corners of the formwork. When placing concrete in layers advancing horizontally, care shall be taken to ensure adequate vibration, blending and melding of the concrete between successive layers. Vibrators shall not be allowed to come in contact with reinforcement, formwork and finished surfaces after start of initial set. Over-vibration leads to segregation and shall be avoided.
- Concrete may be conveyed and placed by mechanically operated equipment after getting the complete procedure approved by TPPA/PMC. The slump shall be held to the minimum necessary for conveying concrete by this method. When concrete is to be pumped, the concrete mix shall be specially designed to suit pumping. Care shall be taken to avoid stoppages in work once pumping has started.
- CONTRACTOR shall submit a method statement to TPPA/PMC for approval, furnishing details of pour sequence, thickness of each layer, mixing and conveying equipment proposed, etc. preferably with a sketch.
- Except when placing with slip forms, each placement of concrete in multiple lift work, shall be allowed to set for at least 24 hours after the final set of concrete before the start of subsequent placement. Placing shall stop when concrete reaches the top of the opening in walls or bottom surface of slab, in slab and beam construction, and it shall be resumed before concrete takes initial set but not until it has had time to settle as determined by TPPA/PMC. Concrete shall be protected against damage until final acceptance.

PLACING OF CONCRETE BY PUMPING METHODS

- Placing of concrete by pumping will be as specified or authorised by TPPA/PMC to achieve the required speediness of construction and maintain targeted schedules.
- Pumping of concrete shall be done only after conducting pumpability trials to ascertain the performance of fresh concrete on pumping in presence of the

TPPA/PMC as per approved procedure. During pumping, concrete shall be conveyed either through rigid pipe or through flexible hose and discharged directly into the desired area. A steady supply of pumpable concrete is necessary for satisfactory pumping. Pumpable concrete requires properly graded aggregates, material uniformity, consistent batching and thorough mixing. They shall be used for concreting densely reinforced structures, internal structural elements of buildings and for large pours of concrete. Concrete pumps used shall be able to deliver concrete over a horizontal and vertical distance as per the directives of the TPPA/PMC.

- Placement of normal concrete by pumping will be permitted as specified or authorised by the TPPA/PMC. The decision, whether to pump any mix shall rest entirely with the TPPA/PMC and no extra claims for payment on this account will be entertained. The pumping equipment, pipe lines and accessories as well as proportioning of pumpable concrete shall generally conform to the recommendations of ACI-304.2R (latest revision) – Placing of concrete by pumping method - Proportioning of pumpable mixes gives certain guide lines on concrete mix. However, final selection of mix shall be as instructed by the TPPA/PMC.

PUMPING EQUIPMENT

- Requisite number of modern dependable concrete pumps capable of pumping concrete of specified quality at a rate required to meet the construction schedules, together with a balanced complement of pipelines, accessories, spare parts, power-controlled placing booms, and experienced pump operators and maintenance staff shall be provided at locations and in a manner approved by the TPPA/PMC.
- The pumping plant shall be completely installed on each occasion, with preliminary mock operation for a sufficient length of time prior to scheduled placement of a concrete pour, to enable the TPPA/PMC to conduct pumpability tests and necessary adjustments for the concrete mix, prior to use of the pumping for placement of concrete.

PROPORTIONING PUMPABLE CONCRETE

- Although the ingredients of concrete to be placed both by pumping and by

other means are the same, more emphasis shall be laid on the quality control and proportioning of a dependable pumpable mix. Dependability is ensured by the equipment and the operator, with the control of all the ingredients in the mixture, the batching and mixing operations, and the knowledge and experience of all the personnel from beginning to end.

- Concrete mixes for pumping shall be "plastic" at all times. Stiff mixes shall not be used for pumping as they do not pump well. Attention shall be given to the mortar (cement, sand and water) and the amounts and sizes of coarse aggregates.

3.6 NORMAL WEIGHT AGGREGATES

3.6.1 Coarse Normal Weight Aggregates

The maximum size of angular coarse aggregate shall be limited to one-third of the smallest inside diameter of the hose or pipe based on simple geometry of cubical shape aggregates. For well-rounded aggregates, the maximum size shall be limited to 40% of the pipe or hose diameter. Adequate provisions shall be made to eliminate over size particles in the concrete by screening or by careful selection of aggregate. Gradation of sizes of coarse aggregates shall correspond to Grades A and B of Table-1 and shall meet IS: 2386 requirements. If required, certain fractional sizes shall be combined and blended to produce the required gradation. Greater emphasis shall be laid on uniformity of gradation throughout the entire job.

The maximum size of the coarse aggregate has a significant effect on the volume or amount of coarse aggregate that may be effectively used in a mix. As will be seen from Table-2 the quantity of coarse aggregate must be substantially reduced as the maximum size becomes smaller. Mixes consisting of too large a portion of coarse aggregate with less cement shall be avoided.

Grading Requirement of Coarse Aggregates for Pumped Concrete

Grade – A (Maximum Size 40 mm)		Grade – B (Maximum Size 20 mm)	
Sieve Size	Percent Passing by Weight	Sieve Size	Percent Passing by Weight
50 mm	100	25 mm	100
40 mm	95 to 100	20 mm	90 to 100

20 mm	35 to 70	12.50 mm	20 to 55
10 mm	10 to 30	10 mm	0 to 15
4.75 mm	0 to 5	4.75 mm	0 to 5

Volume of Coarse Aggregate per unit of Volume of Concrete

Grade – A (Maximum Size 40 mm) & Grade – B (Maximum Size 20 mm)				
Maximum Size	Volume of Dry-rodded Coarse Aggregate per Unit Volume of Aggregates of Concrete for different Fineness Moduli of sand			
	FMS = 2.40	FMS = 2.60	FMS = 2.80	FMS = 3.00
10	0.50	0.48	0.46	0.44
12.50	0.59	0.57	0.55	0.53
20	0.66	0.64	0.62	0.60
25	0.71	0.69	0.67	0.65
40	0.76	0.74	0.72	0.70
50	0.78	0.76	0.74	0.72

Fine Normal Weight Aggregate

Fine aggregate shall consist of natural sand, manufactured sand or a combination thereof and shall be graded within the following limits.

Sieve Size	Percent passing by Weight
9.50 mm	100
4.75 mm	95 to 100
2.36 mm	80 to 100
1.18 mm	50 to 85
600 microns	25 to 60
300 microns	10 to 30
150 microns	2 to 10

3.7 WATER AND SLUMP

- Water requirements and slump control for pumpable normal weight concrete are interrelated and extremely important considerations. The mixing water

requirements for a mix shall be determined by the TPPA/PMC and modified to suit the fineness of sands, quality of admixtures, additives, cement replacements or other special materials being used in the concrete.

- The CONTRACTOR shall establish the optimum slump jointly with the TPPA/PMC for a pumpable mix at the discharge hose end and shall maintain control of that slump throughout the course of a job. Excess water shall not be added in the receiving hopper to make the concrete mix pumpable, instead attempt shall be made to obtain 'truly plastic mix' by proper proportioning.
- Slump of concrete may undergo change between initial mixing and final placement. If the slump at the discharge hose end are to be maintained within specified limits, it will be necessary for the concrete to enter the pump at a higher slump to give the required mobility during transport. Slump adjustments by re-proportioning of the constituents as may be required shall be carried out by the CONTRACTOR jointly in consultation with the TPPA/PMC for every type of mix and for every new placement and set up of pump and pipelines.

3.8 CEMENT CONTENT

- The determination of the cement content for a normal weight pump mix shall follow the same basic principles used for conventionally placed concrete. The water cement ratio shall be established by the TPPA/PMC based on exposure conditions, strength requirements or minimum cement consumption, whichever governs. However, because of slightly higher ranges of slump and ratios of fine to coarse aggregates, the pump mix may require an increase in the amount of cement above those pumpable concrete mass. The total quantity of fines passing through the 300-micron sieve including cement, fine sand, stone dust, etc. shall be in the range of 380 to 450 kg/cum of concrete.
- Cement content in case of M50 shall be maximum of 425 kg/cum, and shall be a mix with high range of workability i.e. 175 mm +/- 25 mm. All the contents shall be mixed based on the mix design and trial studies.
- While establishing the cement content for normal weight trial mixes, it will be necessary to consider the capabilities of the pump and its operator for over strength proportioning in the laboratory to provide for field variations.
- In case of pumping difficulties, it is desirable and economical to correct any

deficiencies in the aggregates, especially in the sand instead of using extra quantities of sand. With well graded coarse and fine aggregates properly combined, the cement requirement for pumpable mixes shall closely resemble to those used in conventionally placed concrete.

3.9 ADMIXTURES

- The use of poor aggregate grading or aggregate with continuous change in overall grading of the 'combinations' during concreting operation will make special admixtures quite useful in overcoming the main difficulty like blockage in pumping. These admixtures shall be incorporated in pumpable concrete to achieve the following.

  (a) Increase in the range of mix designs, which may be successfully pumped using water reducing admixtures/ super plasticisers with the approval of the TPPA/PMC.

  (b) Reducing the risk of pipeline blockages by preventing segregation of concrete mix.

  (c) To have satisfactory/ specified performance both in fresh and hardened state.

- Any admixture that increases workability in normal weight concrete may usually improve pumpability. The choice of type of admixture and the advantage gained from its use in concrete to be pumped will depend on the characteristics of the pump mix and will be finally decided by the TPPA/PMC in consultation with the admixture manufacturer.

- For improvement of pumpability the following admixtures are generally recommended. Such admixtures used shall conform to ASTM C-494/ IS: 9103:

(a) **Water Reducing Admixtures/ Super Plasticisers**

These cause reduction in water requirements at constant slump or an increase in slump at constant water-cement ratio. They can be designed to have no apparent effect on setting time, or alternately to achieve varying degrees of acceleration or retardation in rate of hardening of the mixture. Most water reducing admixtures increase the palpability of the concrete mix through plasticising action.

(b) **Air Entraining Admixtures**

Air entrained concrete is considerably plastic and more workable than non-air entrained concrete. It can be pumped with less coarse aggregate segregation and has less tendency for concrete to bleed. Start-up after shutting down is also generally easier due to reduced bleeding. For pumped concrete these limits shall be obtained at the point of placement in the structure. To compensate for air content loss in the air entrained concrete higher entrainment of air may be required at the batching plant. The required adjustment of admixture dose shall be carried out by the TPPA/PMC after carrying out necessary air loss tests. An air content in the range of 3 to 5% shall be preferred as higher ranges reduces the delivery capacity of pump systems due to increased compressibility of the concrete and reduces strength of concrete.

If air-entraining plasticiser is used, typically 13% minimum water reduction is possible. Therefore, strength loss due to air entrainment will be compensated by using such air- entraining plasticiser.

Finely Divided Mineral Admixtures

- CONTRACTOR, if specifically approved by the TPPA/PMC, can use mineral admixture. In concrete mixtures, deficient in fines, the addition of a finely divided inert mineral admixture generally improves workability, pumpability, reduces the amount of bleeding and increases the strength.
- The effect on strength depends on the type of mineral admixture used, conditions under which the concrete is cured, and the amount of admixture used. Water soluble polymers obtained from cellulose derivations may also be used as an admixture with a small dose of 60 to 150 gms/cum to increase viscosity of the mixing water and reduce the frictional resistance to flow and bleeding in the pipe system.

TRIAL MIXES

- The trial mixes for pumping shall be prepared and tested in the Site laboratory by CONTRACTOR in accordance with clause 14.9 of this specification. The ingredients, particularly the coarse and fine aggregates

shall also be checked for the conformance to the desired properties described, by the CONTRACTOR. Table-2 may be used to select the volume of coarse aggregate per cum of concrete.

- In using this Table, it is recommended that the highest probable fineness modulus of sand be used rather than the average fineness modulus to ensure consistent performance during pumping. For additional plasticity, 10% reduction in coarse aggregate quantities shall be considered. Experience with the use of local aggregate and their uniformity shall also be considered in the proportioning concepts.

MIX DESIGN FOR PUMPABLE CONCRETE

- Taking the above factors into account, the concrete shall first be designed for normal placement conditions and then modified as necessary to suit pumping. The following procedure shall be adopted:

(a) Design the mix for specified characteristic strength and workability.

(b) Check and ensure combined grading of aggregates i.e. as uniform grading as possible. This requirement is vital as gaps or partial gaps are the basic reasons for poor water retention property and segregation under pressure.

(c) Determine the optimum sand content for the required workability and increase sand content by reducing volume of coarse aggregate per unit volume of concrete by about 10% as a degree of protection against under sanding due to batch variations.

(d) Recheck the minimum cement content for durability.

(e) Examine the total fines content i.e. cement and fine aggregates passing through 300- micron sieve and readjust the mix, if necessary. A very rich mix with fine sand will be as problematic as a coarse sand with lean mix. Re-appraise the grading if the particle shape of any fraction is such as may cause excessive voids. Re-adjust as required, if necessary, examining the void ratio of various combinations, using void meter to achieve minimum voids at the expense of 'sufficient fines' content.

(f) If dissatisfied with (a) to (f) as above, consider what remedial action may be taken to overcome the troublesome factor. For example, the following

two situations may occur:

If the sand has coarser fraction it is worth considering the addition of a proportion of finer sand, or alternately if the sand has finer fraction, the addition of coarse fraction may be considered. Addition or reduction of cement may help, but the correct solution is to overcome the gap in overall grading as stated above.

(g) In a 20 mm aggregate maximum size, if there is an excess of 10 to 4.75 mm fraction, and this fraction is flaky with unduly large surface area, either increase the sand content to reduce the possibility of segregation and to reduce the inter-practical stresses, or (better) re-grade using single sized aggregates.

(h) At the trial mix stage small variations can be made preferably in the light of the pressures registered and observed performances through the pump. In certain cases, admixtures may be economically and beneficially used to improve or eliminate circumstances that cannot readily be overcome by other means.

TESTING FOR PUMPABILITY

No mix shall be accepted for use on a pumping job until an actual test under field condition has been completed. Testing a mix for pumpability involves duplication of the anticipated job condition from beginning to end. The batching and conveying by truck mixers shall be the same as will be used, the same pump and operator shall be present. The pipe and hose layouts shall simulate the actual condition as far as practicable. Prior use of a mix on another job may furnish evidence of pumpability, but only if conditions are duplicated. Before commencing a new concreting job, the CONTRACTOR shall carry out pumpability tests in consultation with the TPPA/PMC. Concrete used in such tests shall not be used in the actual construction, unless specifically permitted by the TPPA/PMC. Following parameters shall be established by pumpability trials:

(a) In-situ compressive and split tensile strength of concrete.

(b) Curing the sample at Site by sprinkling water.

(c) Curing the sample at Laboratory in curing tanks.

(d) Wet sieve analysis of concrete to ensure that proportions of ingredients

before and after pumping are same.

CURING

Curing and protection shall start immediately after the compaction of the concrete to protect it from:

(a) Premature drying out, particularly by solar radiation and wind;

(b) Leaching out by rain and flowing water;

(c) Rapid cooling during the first few days after placing;

(d) High internal thermal gradients;

(e) Low temperature or frost;

(f) Vibration and impact, which may disrupt the concrete and interfere with its bond to the reinforcement.

4 TERMITE PRE CONSTRUCTIONAL CHEMICAL TREATMENT IN STRUCTURES

This specification covers the general requirements for Anti-termite Constructional Measures, chemical treatment of soils for the protection of buildings from attack by subterranean termites, chemicals to be used with their minimum rates of application and procedure to be followed while the building is under construction.

4.1 APPLICABLE CODES AND SPECIFICATIONS

The following codes, standards and specifications are made a part of this specification. In case of discrepancy between this specification and those referred to herein, this specification shall govern.

The codes and standards mentioned below shall be latest as on the day of award of contract of the works unless otherwise specified. Contractor shall be responsible to inform to the TPPA/PMC in case of any revisions/re-affirm/amendment in the relevant codes and standards after the date of award of contract within 30 days of the issue of such revision/re- affirm/amendment of the code/ standard. TPPA/PMC may approve use of the earlier code/ standard if the revisions do not materially affect the statutory requirements of the project or does not impact safety practices. Any cost impact arising out of such revisions shall be mutually agreed.

IS 6313 Part 1: 1981 (R2015)	Code of practice for anti-termite measures in buildings: Part 1 Constructional measures
IS 6313 Part 2: 2013 (R2018)	Code of Practice for Anti-Termite Measures in Buildings - Part 2: Pre-Constructional Chemical Treatment Measures
IS 6313 Part 3: 2013 (R2018)	Code of Practice for Anti-termite Measures in Buildings - Part 3: Treatment for Existing Buildings
IS:8944-2005	Specification for Chloropyrifos Emusifiable Concentrates
IS:16131-2015	Specification for inidacloprid suspension concentrate
IS:4015-1998	Guide for Handling cases of Pesticide Poisoning

TERMS

- ✓ Contractor shall furnish all tools, plants, instruments, qualified supervisory personnel, labour, materials, any temporary works, consumables, any and everything necessary whether such items are specifically stated herein for completion of the job in accordance with specification requirements or not.
- ✓ All work shall be done in the order of progress required by TPPA's construction programme. Contractor shall take all necessary precautions to prevent any accident in connection with the performance of the work.
- ✓ On completion of all work, Contractor shall leave the entire premises within the site of his operation clean and free from all rubbish resulting from his operation.
- ✓ TPPA reserves the right to inspect, check and direct any or all operations at any stage of the work and to require unsatisfactory work to be remedied at Contractor's expense.
- ✓ No work shall be carried out under unsuitable weather conditions viz. when raining or when the soil is wet due to rain or sub-soil water.
- ✓ Chemicals shall be brought to site of work in sealed original containers. The materials shall be brought in, at a time, in adequate quantity to suffice for the work. The material shall be kept in cool and locked stores. The empties shall not be removed from the work site till the relevant item of work has been completed and permission granted by TPPA/ TPPA/PMC.
- ✓ Chemicals available in concentrated forms with concentration indicated on the sealed containers only shall be used. Chemicals shall be diluted with water in required quantity before use, using graduated containers to achieve the desired percentage of concentration.

4.2 PRE-CONSTRUCTIONAL CHEMICAL TREATMENT

- ✓ Hand operated pressure pump with graduated containers shall be used to ensure uniform spraying of the chemical. Continuous check shall be kept ensuring that the specified quantity of chemical is used for the required area during the operation. On large projects, a power sprayer may be used to save time and labour.
- ✓ The treated soil barrier shall be complete and continuous under the whole of the structure to be protected. All foundations shall be fully surrounded by and in close contact with the barrier of treated soil. Each part of the area treated shall receive the specified dosage of chemical.

- ✓ Soil treatment shall start when the foundation trenches and pits are ready to receive mass concrete in foundations. Laying of mass concrete shall start when the chemical emulsion has been absorbed by the soil and the surface is quite dry. Treatment shall not be carried out when it is raining, or soil is wet with rain or sub-soil water. The foregoing also applies in the case of treatment to the filled earth surface within the plinth before laying the subgrade for the floor.
- ✓ The treated soil barriers shall not be disturbed after they are formed. If by chance, treated soil barriers are disturbed, immediate steps shall be taken to restore the continuity and completeness of the barrier system.

4.3 Soil Treatment

- ✓ Any one of the following chemicals (conforming to Indian Standards) in water emulsion shall be applied uniformly over the area to be treated. The treated area shall be immediately covered by polythene sheet. It can be uncovered 2 hours before concrete casting.

4.4 Treatment of Column-pits, Wall-trenches and Basement excavations

- ✓ The bottom surface and the sides (up to a height of about 300 mm) of the excavations made for column pits, wall trenches and basements shall be treated with the chemical at the rate of 5 litres per sqm of the surface area.
- ✓ After the column foundations and the retaining walls of the basement come up, the backfill in immediate contact with the foundation structure shall be treated at the rate of 7.5 litres per sqm of the vertical surface of the sub-structure for each side. If water is used for ramming the earth- fill, the chemical treatment shall be carried out after the ramming operation is done by rodding the earth at 150 mm centres close to the wall surface and spraying the chemical with the above dose. The earth shall be returned in layers and the treatment shall be carried out in similar stages. The chemical emulsion shall be directed towards the concrete or masonry surfaces of the columns and walls so that the earth in contact with these surfaces is well treated with the chemical.
- ✓ In the case of R.C.C. framed structures with columns and plinth beams and R.C.C. basements, with concrete mix 1:2:4 or richer, the treatment shall start at the depth of 500 mm below ground level for columns and plinth beams. From this depth the back-fill around the columns, beams and R.C.C basement walls shall be treated at the rate of 7.5 litres/sq.m of vertical surface. The other details of treatment

shall be as laid down in clause

Treatment of Top Surface of Plinth Filling

The top surface of the filled earth within plinth beams/walls shall be treated with chemical emulsion at the rate of 5 litres per sq.m of the surface before the sand bed/subgrade is laid. Holes up to 50 to 70 mm deep at 150 mm centres both ways shall be made with 12 mm dia. crow-bar on the surface to facilitate saturation of the soil with chemical emulsion.

Treatment of Junction of Wall and Floor

To achieve continuity of vertical chemical barrier to inner wall surfaces from the ground level, small channel 30 x 30 mm shall be made at all the junctions of wall and columns with the floor (before laying the subgrade) and rod holes made in the channel up to ground level 150 mm apart and the chemical emulsion poured along the channel at the rate of 7.5 litres/ sqm of the vertical wall or column surface so as to soak the soil right to the bottom. The soil shall be tamped back into place after this operation.

Treatment of Soil Under Apron Along External Perimeter of Building

The top surface of the consolidated earth over which the apron is to be laid shall be treated with chemical emulsion at the rate of 5 litres/ sqm of the surface before the apron is laid. If consolidated earth does not allow emulsion to seep through, holes up to 50 to 75mm deep at 150 mm centres both ways may be made with12 mm diameter mild steel rod on the surface to facilitate saturation of the soil with the chemical emulsion.

Treatment of Soil Along External Perimeter of Building

After the building is complete, holes shall be made in the soil with iron rods along the external perimeter of the building at interval of about 150 mm and depth 300 mm and these holes filled with chemical emulsion at the rate of 7.5 litres/metre of perimeter of the external wall. If the earth outside the building is graded on completion of building, this treatment shall be carried out on completion of such grading. If the filling is more than 300 mm the external perimeter treatment shall extend to the full depth of filling up to the original ground level so as to ensure

continuity of chemical barrier.

Treatment for Expansion Joints

Anti-termite treatment shall be supplemented by treating through the expansion joint after the sub-grade has been laid at the rate of 2 litres per linear meter of expansion joint.

Treatment of Soil Surrounding Pipes and Conduits

When pipes and conduits enter the soil inside the area of the foundations, the soil surrounding the points of entry shall be loosened around each such pipe or conduit for a distance of 150 mm and to a depth of 75 mm before treatment is commenced. When they enter the soil external to the foundations, they shall be similarly treated for a distance of over 300 mm unless they stand clear of the walls of the building by about 75 mm.

5 WATERPROOFING WORKS

5.1 Terrace Waterproofing

- ✓ The specified waterproofing system is meant for the water tightness and protection of roof/podium slab from water penetration. Waterproofing shall be seamless waterproofing membrane. The waterproofing membrane has high elasticity having elongation > 500%, excellent, tensile strength of >4 MPa, Shore A hardness of 60-65 (±5).
- ✓ The cleaning and preparation of the substrate on which the waterproofing coating is applied as follow.
- ✓ Cleaning the surface, removing laitance ensuring substrate shall be free from dust by mechanical
- ✓ Grinding of the substrate, ensuring substrate shall be free from any coating, oil or other contaminants that interferes to the bond or membrane with concrete.
- ✓ Treatment of Honey combing/ loose concrete, cracks, termination points in wall to slab joints using geotextile fabric.
- ✓ Providing and applying 100 x 100mm thick fillet using cement concrete M15 grade mixed with polymer @ 10kgs per 50 kg bag of cement.
- ✓ Directly above prepared mother concrete, parapet walls, upstands pedestals etc. apply moisture insensitive epoxy primer followed by sand broadcasting. Consumption of primer shall be between 0.2-0.25kgs per sqm
- ✓ Apply PU membrane in two coats. Check the application shall reach to every corner, covering pipe penetrations, up stands, pedestals seamlessly.
- ✓ Waterproofing is to be terminated at parapet walls by taking waterproofing vertically upto 300mm above finished floor level. Vertical to horizontal joints shall be treated using geotextile mat to be sandwiched using PU waterproofing.
- ✓ 48 Hours water ponding to check leakage (if any).
- ✓ All areas where waterproofing is exposed to sun such as parapet walls, upstands, terminations etc. shall be protected using UV top coat.

6 GENERAL BUILDING WORKS

7.1 BLOCK WORKS

Light Weight Block Masonry (AAC Block)

The lightweight block shall be of approved manufacturer. The blocks shall have thickness of 200 mm, 150 mm, 100 mm for walls, partitions, and cladding work, etc. The blocks shall have a maximum density of 640 kg / cum or less.

Structural Strength requirement:

a) Compressive Strength: The lightweight concrete block shall have a minimum compressive strength of 35 kg / sq.cm.

b) Bending Compression: 15 kg / sq.cm.

The mortar used for light weight concrete block shall be as specified in the Schedule of Items; Cement and water used in mortar shall conform to the quality as described in 'Concrete', whereas sand used for mortar shall be fine screened only. The lightweight concrete block masonry should not be used below ground or in plinth. The block masonry work shall be built in stretcher course only.

The lightweight concrete block (Siporex or equivalent) wall or required thickness as described in Schedule of Items, shall be constructed with R.C.C. vertical and horizontal stiffeners, of required size at suitable intervals, as directed by the TPPA/PMC, or as per drawing. R.C.C. and steel reinforcement shall be included in the rate and will not be paid separately. The masonry work shall be raised truly in plumb. All courses shall be laid truly horizontal, and all vertical joints shall be truly vertical. The vertical joints should be not more than 12mm thick and shall be fully filled from the top with cement mortar without any void in masonry.

All face joints shall be raked out to a minimum depth of 15 mm. by raking tool, during the progress of the work, when the mortar is still green, so as to provide proper key for the plaster or pointing. All fixtures, pipes, outlets of water, holdfasts, of doors, windows, which are required to be built into the block masonry, shall be embedded in mortar or cement concrete, as specified, in correct position, as the work proceeds and as directed by the TPPA/PMC. After masonry work is over, the masonry shall be marked with date of

construction, visible for inspection and curing.

6.2 Curing:

All joints of block masonry shall be kept constantly moist by sprinkling water on all joints for a minimum period of seven days.

6.3 Scaffolding:

Scaffolding shall be double and shall be erected with steel sections or pipes of adequate strength so as to be safe for construction operations. The contractor shall take all measures to ensure the safety of the work and working people. Any instructions of the TPPA/PMC in this respect shall also be complied with. The contractor shall be entirely responsible for any damage to properly or injury to persons resulting from ill erected scaffolding, defective ladders and materials or otherwise arising out of his default in this respect. Proper scaffolding shall be provided to allow easy approach to every part of the work. Overhead work shall not be allowed. Block work shall be carried out with double scaffolding only. Making holes of any kind for the purpose of supporting the scaffolding shall not be permitted.

6.4 STEEL AND ALUMINUM WORKS

- Fire rated door shall be as per item description and shall be of approved make and shade as per drawing.
- Hollow metal 2 hr fire rated doors as per IS 3614 part-1 & part-2 for stability and integrity. Pressed Galvanized steel shall confirm to IS 277.
- Sample shall be approved by TPPA/PMC before installation. Door shutter - Door leaf shall be 46mm thick fully flush double skin door with or without vision lite. Door leaf shall be manufactured from 1.2mm (minimum) thick galvanised steel sheet. The internal construction of the door shall be rigid reinforcement pads for receiving appropriate hardware. The infill material shall be resin bonded rockwool slab. All doors shall be factory prepped for receiving appropriate hardware and provided with necessary reinforcement for hinges, locks, and door closers. The edges shall be interlocked with a bending radius of 1.4mm. For pair of doors astragals has to be provided on the meeting stile for both active and inactive leaf.
- Door shutter shall be fixed with SS 304 grade fire rated hinges (min 4 no of hinge per shutter) of approved make.

- EPDM open cell sponge seal of size 7x9 mm of approved make shall be provided around the door for single or double shutter for fire and smoke protection, self-adhesive type etc complete

- Door frame - Door frame shall be double rebate profile of size 143 x 57 mm made from 1.60mm (16gauge) minimum thick galvanized steel sheet. The edges shall be interlocked with a bending radius of 1.4mm. Frames shall be mitred and field assembled with self-tabs. All provision shall be mortised, drilled and tapped for receiving appropriate hardware. Rubber door silencers shall be provided on the striking jamb. Frames shall be provided with back plate bracket and anchor fasteners for installation on a finished plastered masonry wall opening. Once frame installed shall be grouted with cement & sand slurry necessary for fire doors on the clear masonry opening.

Vision Panel:

Vision lite wherever applicable shall be provided as per manufacturer's recommendation with fire rated ceramic gasket of approved make as beading and screws from inside. The glass shall be 6mm clear borosilicate fire rated glass of relevant rating of the door.

Finish:

All the doors and Frames shall be finished with approved shade powder coated paints with an average DFT of 70 microns and tested for salt spray test of 500hrs.

Test:

Recommended fire door shall have doors tested at CBRI or ARAI for maximum rating of 2hrs with vision panel. Test certificates shall be available for vision lites /panels as part of the fire door assembly. Independent glass test certificates shall not be accepted. Manufacturer test certificate shall cover doors both single and double leaf and all doors supplied shall be within the tested specimen, deviation in specification and sheet thickness other than what is mentioned in the test certificates are not allowed. Proper label confirming the type of door and the hourly rating is mandatory.

Door frame:

The rate shall be for unit of one meter and paid in relevant item. Rates shall be inclusive of frame, back plate, rubber silencer, smoke seal, anchor fastener, installation of frame

with grout filling, testing etc.

Door shutter:

The rate shall be for unit of one Sqm and paid in relevant item. Rate shall be inclusive of shutter with infill material, SS 304 fire rate butt hinges, smoke seal (in case of double shutter fire door, between the two shutter), finishing and installation but excluding the cost of Vision panel and fire rated hardware other than hinge.

Vision Panel:

The rate shall be for unit of one Sqm and paid in relevant item. Rate shall be inclusive of a fire rated glass with G.I. beading of finish same as shutter & special ceramic tape/ gasket. Fire rated hardware other than hinge and smoke seal shall be paid separately i.e. Door closer,panic device, lock, trim.

7.2 MS Railing

Mild steel tubular sections should be used for hand railing; design should be as per drawing.

Mock-up

Contractor shall install a full-scale mock up for a length of 7.5m of typical detailing treatment at locations to be confirmed by the Architect. The visual mock-up for the assembly will be required to be accepted and endorsed by the Architect with respect to appearance of colour.

6.2.1 Aluminum fixed louver/ Fins

Providing, fixing, aluminium fixed louver/Fins made of approved type of louver/profile section of approved make having polyester powder coating of minimum 60 micron on all the surfaces of approved shade and make as per manufacturer's specifications. Aluminium frame work shall be paid separately under relevant AS PER DESIGN item. Contractor shall submit the shop drawing for louver based on concept design/ intent drawing and as per elevation. Aluminium louver section shall be fixed on aluminium framing with required SS screws, fasteners, Heavy duty angle cleat, hardware as per approved shop drawing etc complete for all floor, all height including scaffolding as directed by TPPA/PMC.

Delivery, Storage and Handling

Delivery - At the time of delivery all materials shall be visually inspected for damage. Any damaged boxes, crates, louver sections, etc. shall be noted on the receiving ticket and immediately reported to the shipping company and the material manufacturer.

Storage - Material may be stored flat, on end or on its side. Material may be stored either indoors or outdoors. If stored outdoors the material must be raised sufficiently off the ground to prevent it being flooded. If stored outdoors the material must be covered with a weather-proof flame-resistant sheeting or tarpaulin.

Handling - Material shall be handled in accordance with sound material handling practices and in such a way as to minimize racking. Louver sections may be hoisted by attaching straps to the jambs and lifting the section while it is in a vertical position. Louver sections should only be lifted and carried by the jambs. Heads, sills, and blades are not to be used for lifting or hoisting louver sections.

Fabrication - Provide louver models, blank-off panels, structural supports, and accessories as specified and/or shown on the drawings. Materials, sizes, depths, arrangements, and material thickness to be as indicated or as required for optimal performance with respect to strength; durability; and uniform appearance. Louvers to be mechanically assembled using stainless steel or aluminium fasteners. Include supports, anchorage, and accessories required for complete assembly.

Louvers/Fins - Material: Heads, sills, jambs and mullions to be one-piece structural aluminium members with integral caulking slot and retaining beads. Mullions shall be sliding interlock. Blades to be one-piece aluminium extrusions with reinforcing bosses.

7.3 MS Ladder

It is the overall length of up-rights of the ladder measured from end to end. All ladders shall be constructed to carry their intended loads safely. Side rails of metal ladders shall be of sufficient cross-section to prevent excessive deflection in use. Ladders which are to remain as a part of the permanent structure after completion of building operations, shall conform to any local, state or municipal byelaws which may be applicable.

Safety shoes, lashing or other effective means shall be used to avoid danger of slipping. All surfaces of the ladder shall be planed, free of splinters and edge of handrails used shall be bevelled. Rung spacing shall be uniform and not over 300 mm on centres. Rungs shall be recessed at least 12 mm into rails. Top and bottom of each built-up ladder shall be securely fastened.

Inspection and Testing - Metal ladders shall be inspected at least once in three months and all parts checked for wear, corrosion, and structural failure. All ladders shall be carefully inspected, if incidentally dropped or otherwise damaged in use.

Storage and Maintenance - Metal rungs shall be cleaned to prevent accumulation of materials which may destroy non-slipping properties. All fittings shall be carefully checked.

7.4 Doors, Windows, And Ventilators

This specification covers the general requirements for doors, windows and ventilators and other related works forming a part of this job, which may be required to be carried out though not specifically mentioned above. The work under this specification shall consist of furnishing of all tools and tackles, plants, labour, materials, and everything necessary for carrying out the work.

Woodwork in doors, windows, & ventilators

Timber to be used shall be first class Teak wood as per IS: 4021. Timber shall be of the best quality and well-seasoned by a suitable process before being planned to the required sizes. The maximum permissible moisture content shall be from 10 to 16 percent for timber 50mm and above in thickness and 9 to 14 percent of timber less than 50mm in thickness for different regions of the country as stipulated in IS: 287. Timber shall be close grained, of uniform colour and free from decay, fungal growth, boxed heart, pitch pockets or streaks on the exposed edges, borer holes, splits, and cracks.

Flush door shutters of the solid core type with plywood face panels shall conform to IS: 2202 (Part 1) and with particle board/hard board face panels shall conform to IS: 2202 (Part 2). Transparent sheet glass shall conform to the requirements of IS: 2835. Wired and figured glass shall be as per IS: 5437. Builder's hardware of fittings and fixtures shall

be of the best quality from approved manufacturers.

6.5 Kota stone / granite slab work

The slabs shall be of approved selected quality, hard, sound, dense and homogenous in texture, free from cracks, decay, weathering, and flaws. The percentage of water absorption shall not exceed 5 percent as per test conducted in accordance with IS:1124. The slabs shall be hand or machine cut to the required thickness. Tolerance in thickness for dimensions of tile more than 100 mm shall be ±5mm. This shall be + 2mm on dimensions less than 100mm.

Slabs shall be supplied to the specified size with machine cut edges or fine chisel dressed to the full depth. All angles and edges of the slabs shall be true and square, free from any chipping giving a plane surface. Slabs shall have the top surface machine polished (first grinding) before being brought to site. The slabs shall be washed clean before laying.

6.6 Vitrified tiles / Ceramic tiles / Glazed tile finish

Tiles shall be of the best quality from an approved manufacturer. The tiles shall be flat, true to shape and free from flaws such as crazing, blisters, pinholes, specks or welts. Edges and underside of the tiles shall be free from glaze and shall have ribs or indentations for a better anchorage with the bedding mortar. Dimensional tolerances shall be as specified in IS: 13756.

6.7 Acid resistant tiles

The ceramic unglazed vitreous acid resisting tiles shall conform to the requirements of IS: 4457. The finished tile when fractured shall appear fine grained in texture, dense and homogeneous. Tile shall be sound, true to shape, flat, free from flaws and any manufacturing defects affecting their utility. Tolerance in the dimensions shall be within the limits specified in the respective IS code.

The tiles shall be bedded and jointed using chemical resistant mortar prepared from resin type conforming to IS: 4832 (Part II) filter, accelerator and catalyst mixed in proportion as recommended by manufacturers. Method of usage shall generally be as per the requirements of IS: 4443.

Anti-skid groove

Making 3 nos. of anti-skid grooves 3mm x 3mm deep on top of staircase tread at front as shown in the drawing in Granite stone/ kota stone or any type of stone etc complete. (Measurement shall be done in Rmt for a set of 3 no grooves together)

6.8 PLASTERING FOR WALL & CEILINGS

This specification covers the general requirements for finishing the plastered brick / concrete surfaces with Plaster of Paris and other related works forming a part of this job, which may be required to be carried out though not specifically mentioned above. The work under this specification shall consist of furnishing of all tools, plants, labour, materials and everything necessary for carrying out the work.

Putty works

Water resistant white cement-based putty ideal for use on concrete / mortar walls (internal and external) and ceiling.

Storage, handling & delivery

Material received at site shall be with original packing and labels. It shall be intact till issued for use of site. Material shall be stored at properly covered dry location and shall be safe from damage. Storage life should not exceed 6 months.

6.9 CEMENT PLASTERING WORK

The proportions of the cement mortar for plastering shall be 1:4 (one part of cement to four parts of sand) unless otherwise specified under the respective item of work. Cement and sand shall be mixed thoroughly in dry condition and then water added to obtain a workable consistency. The quality of water and cement shall be as per relevant IS. The quality and grading of sand for plastering shall conform to IS:1542. The mixing shall be done thoroughly in a mechanical mixer unless hand mixing is specifically permitted by the TPPA/PMC. If so desired by the TPPA/PMC sand shall be screened and washed to meet the specification requirements. The mortar thus mixed shall be used as soon as possible preferably within 30 minutes from the time water is added to cement. In case the mortar has stiffened due to evaporation of water this may be re-tempered by adding water as required to restore consistency, but this will be permitted only up to 30 minutes from the

time of initial mixing of water to cement. Any mortar which is partially set shall be rejected and removed forthwith from the site. Droppings of plaster shall not be re-used under any circumstances.

6.10 GLASS & GLAZING

This part of the specification covers the requirement of providing fitting and fixing in position of glazing of different thickness comprising of clear float glass, wired glass, tinted glass, including curtain glass and hermetically sealed composite double glazing complete with all clips, putty, mastic, etc.

All glass and glazing shall have uniform reflective index and free form flaws, specs and bubbles.

The glass shall be brought to site in the original packing from the manufacturer and cut to size at site. The cut edges shall be straight and free from hips, spells or any other damages. Clear glass shall be float glass and shall be of thickness as specified in the schedule of items. Properties of float glass shall generally meet the requirements of IS: 14900.

Wired glass shall be thick rolled glass with centrally embedded wire mesh of Georgian type conforming to IS: 5437 Composite double glazing shall be made of two 6mm thick clear float glass on either sides and separated by 12mm air gap. The trapped air shall be kept dry by means of suitable desiccant. The glass shall be hermetically sealed. The composite double glazing shall be procured as finished product.

The curtain glazing shall consist of minimum 8mm thick heat strengthened glass fixed with framework made of aluminum sections designed as per structural requirements. The silicone sealant shall be of best quality and shall be brought to site in manufacturer's original packing.

MOCK-UP

The contractor shall prepare and install mock-up samples as per approved shop drawings. Mock-up samples shall be of full size and shall be true representation of actual works to be carried out at site. Mock-ups may be part of completed work if undisturbed.

STORAGE, HANDLING & DELIVERY

- Material received at site shall be with original packing and labels. It shall be intact till issued for use of site.
- Material shall be stored at properly covered dry location and shall be safe from damage. All items shall be protected from dampness both during and after delivery to site.
- Partition shall not be installed in any room or space where concrete, masonry, or plaster work is not completed and dry.
- Care must be taken to ensure that the frames and panels of partition works are not damaged while transporting/erection.

6.11 FALSE CEILING WORKS

This specification covers the general requirements for fabrication and erection of aluminium / gypsum board false ceilings and other related works forming a part of this job, which may be required to be carried out though not specifically mentioned above. The work under this specification shall consist of furnishing of all tools, labour, materials and everything necessary for carrying out the work.The hard fiber board to be used in false ceiling shall be of an approved manufacture as per IS: 1658 or as approved by the TPPA.

- The fiber boards shall be made from substances compound of vegetable fibers such as wood pulp, wood chips or shavings bonded by a synthetic resin. Veneered particle boards shall have a core of particle board sandwiched or glued in between two or more veneers on outer surfaces.
- The fiber boards shall be fire resistant, termite and insect resistant, weather resistant, acoustically satisfactory, dimensionally stable, warp-free, easily workable, treated with anti-fungus chemicals, heat insulated and of adequate structural strength and should have good surface finish as approved by the TPPA.
- The size of fiber board ceiling tile shall generally be 600 x 600 x 12 mm thick. All types of boards and ceiling tiles shall be stored flat under cover at a clean dry place on firm ground. The Contractor should ensure that boards are not stacked on termite infected, wet or loose ground. The boards should be always carried on edges.
- The metal framework shall be interlocking type and made of sections of light

metal, such as extruded anodized aluminium. The shape and cross section shall be such as to facilitate proper suspension and proper fixing of the ceiling boards covering them and shall be structurally sound and rigid.

7 PAINTING SPECIFICATIONS

This section covers the painting requirements for the Ozone generation plant as applicable.

CODES AND STANDARDS

Painting of equipment shall be carried out as per the specifications indicated below and shall conform to the relevant IS specification for the material and workmanship. The following Indian Standards may be referred to for carrying out the painting job:

IS:5	:	Colours for ready mixed paints and enamels
IS:1303	:	Glossary of terms relating to paints
IS:2379	:	Colour code for identification of piplines
IS:1477	:	Code of practice for painting of ferrous metals in buildings (Parts I & II)
IS:2524	:	Code of practice for painting of non-ferrous metals in buildings (Parts I & II)
IS:2395	:	Code of practice for painting of concrete, masonry and plaster surfaces (Parts I & II)
IS:2338	:	Code of practice for finishing of wood and wood based materials (Parts I & II)
IS:6278	:	Code of practice for white washing and colour Washing
IS:3140	:	Code of practice for painting asbestos cement Building products
IS:158	:	Ready mixed paint, brushing, bituminous, black, lead-free, acid, alkali, water and heat resisting
IS:2074	:	Ready mixed paint, air drying, red Oxide Zinc Chrome, priming
IS:104	:	Ready mixed paint, brushing, Zinc Chrome, priming
IS: 2932	:	Enamel , synthetic, exterior (a) undercoating (b) finishing

7.1 PREPARTION OF SURFACES

All surfaces to be painted shall be thoroughly cleaned of all grease, oil, loose mill scale , dust , rust and any other foreign matter. 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 sand 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 TPPA. The sheet steel of electrical and instrumentation panels shall be pre-treated through chemical cleaning (7 tank) process of rinsing, degreasing, rinsing, derusting, rinsing, phosphating and rinsing. However, in case mechanical cleaning is also required Bidder shall carry out the same to get a smooth finish.

PRIMER PAINT

After the surface is prepared one coat of Zinc Phosphate primer conforming to IS 2074 shall be applied. After this first coat is dried up completely, second coat of primer shall be applied. Primer shall be applied by brushing, spray, roller as per manufacture recommendation to ensure a continuous film. The dry film thickness of each coat shall be as indicated in Annexure-A enclosed. Insulated surfaces will have only primer coating and no finish painting.

FINISH PAINT

Synthetic enamel paint conforming to IS 2932 shall be used for finish coats. The colour /shade shall be as approved by TPPA/Customer. After cleaning the dust on the dried up primer, first coat of synthetic enamel 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 allowing the water to get evaporated completely, the second finish coat of synthetic enamel paint shall be applied.

PAINTING AND CORROSION PROTECTION FOR PIPES & FITTINGS

- All uninsulated piping systems, hangers and supports shall have two coats of Zinc

Phosphate Primer (conforming to IS 2074) and finish paint using synthetic enamel paint to give a finish coat. Shades shall be as per IS 5 or as indicated by TPPA/Customer. Service of the pipeline designations shall be painted on all pipes at visible locations.

- Before application of paint, Contractor shall clean the pipes of all mill scale, dirt dust, soot grease, rust etc.
- All pipe lines, piping components shall be adequately protected against corrosion during manufacture, fabrication, shipment and storage by appropriate protective paint.
- Shop fabricated equipment/items shall be dispatched with final paint. Necessary touch up shall be done at site. Site fabricated equipment/items shall be dispatched with primer painting only and final painting shall be applied at site.

PAINTING AND CORROSION PROTECTION FOR VALVES & SPECIALTIES

Two coats of primer of thickness as indicated in Annexure-A shall be applied to all steel and cast iron exposed surfaces as required to prevent corrosion before dispatch. The use of grease or oil, other than light grade mineral oil, for corrosion protection is prohibited. Bores of all vales shall be covered immediately after testing, draining and drying with suitable plastic end covers to avoid ingress of foreign materials.

Suggested Colour Codes for Painting

Suggested colour codes has been enclosed for adherence. Colour codes for piping shall be as per IS 2379 with necessary modifications. Where band colour is specified for piping, same shall be provided at 30 metre intervals on long uninterrupted lines and also adjacent to valves and junctions.

SUGGESTED COLOUR CODES FOR PAINTING

SL. NO.	ITEM/SERVICE	COLOUR	IS-5 Grade	COLOUR (BAND)	IS-5
1.0	Structures, platforms, galleries, ladders and handrails	Dark Admirality Grey	632	-	-

SL. NO.	ITEM/SERVICE	COLOUR	IS-5 Grade	COLOUR (BAND)	IS-5
2.0	Crane				
2.1	Crane structure	Golden Yellow	356	-	-
2.2	Trolley and hook	Crimson	540	-	-
3.0	Fans, pumps, motors, compressors	Light Grey	631	-	-
4.0	Tanks (without insulation and cladding)				
4.1	Outdoor	Aluminium	-	-	-
4.2	Indoor	Light grey	631	-	-
5.0	Vessels & all other proprietary equipment (without insulation & cladding)	Light grey	631	-	-
6.0	Control & relay panels	Light grey	631/7078 of IS 1650	-	-
7.0	Transformers	Aluminium	-	-	-
8.0	Machinery guards	Signal red	537	-	-
9.0	Piping				
9.1	Potable, Service water , Effluent piping	Sea green	217	French blue	166
9.2	Compressed air	Sky blue	101	White	-
9.3	Vacuum pipes	Sky blue	101	Black	-
9.4	Drainage	Black	-	-	-

B. TECHNICAL SPECIFICATIONS - MECHANICAL WORKS

1 Material

All materials incorporated in the works shall be the most suitable for the duty concerned and shall be new & from reputed/approved make or approved quality and of first class commercial quality, free from imperfection and selected for long life and minimum maintenance. Destructive/Non-destructive tests, if called for, shall be carried out. All the moving parts of the plant, or shaft and spindles or faces etc in contact with wastewater shall be of corrosion resistance materials. All parts directly in contacts with various chemicals, shall be completely resistant to corrosion, or abrasion by these chemicals, and shall maintain their properties without aging due to the passages of time, exposure to light or any other causes. All material shall confirm to the material as per BIS or any equivalent standard. All stainless steel materials used shall be of SS 316 unless otherwise specified.

Workmanship

Workmanship and general finish shall be of first class quality and in accordance with best workshop practice. All welds shall be as per BIS or any equivalent standards. All tolerances and clearance shall be as per good and sound TPPA/PMCing practice. Should the owner's representative not consider any material acceptable, it shall be replaced.

1.1 Design Features

As far as practicable, all proposed designs shall be as per latest proven concepts and practices. The equipment shall be new, of robust design for long reliable operating life. These shall be capable of 24 hours operation in a day for 365 days in a year for continues operation for prolong period in the climatic and working conditions prevailing at the site and with a minimum of maintenance. Particular attentions shall be given to extra temperature and the rating of electrical and mechanical equipment, cooling systems and choice of the lubricating system.

The equipment shall be designed to provide easy access to and replacement of the component/parts which are subjected to wear without the need to replace whole units. All parts in contact with water/sewage/chemicals shall have a life from new to replacement for 15 year minimum and new to repair of not less than five years. Design features shall include the protection of equipment against damages caused by vermin, dirt, dust and dampness and to reduce the risk of fire.

Equipment shall operate without undue vibration.

The noise level produced by any equipment like pump sets, compressor sets, blowers etc.., shall not exceed 85 dB(A) measured at a distance of 1.86 m from outer surface of source. At the time of operation, the mechanical vibration shall not exceed the limit given in the Table 2-1, at recommended points of the measurement as per ISO 10816:1995.

During the commissioning of the plant/equipment if noise level/vibrations found beyond the permissible limit, contractor to rectify/replace the particular equipment at no extra cost with in mutually agreed time limit. During the O&M period (O&M is done by contractor) if noise/vibration of equipment found beyond the permissible limit, rectification / replacement of the particular equipment shall be responsibility of contractor.

Table : Permissible Equipment Velocity of vibration (in mm/sec)

Sr. No.	**Equipment**	**Permissible Velocity of Vibration (in mm/sec)**
1	All rotating equipment without reciprocating parts of motor rating ≤ 15 kW	1.12
2	All rotating equipment without reciprocating parts of motor rating > 15 kW & ≤ 75 kW	1.8
3	All rotating equipment without reciprocating parts of motor rating >75 kW	2.8

Parts shall be designed to withstand the maximum stresses under the most sever conditions of normal service. All rotating elements shall be dynamically and statically balanced.

Lubrications

The equipment shall be lubricated by long life lubricants such that working life is not less than 3000 operation hours or as per recommendation of the equipment manufacturer.

A complete schedule of recommended oils and other lubricants shall be furnished by the bidder. The number of different types of lubricants should be kept to minimum. The schedule and the name of the supplier of the lubricant shall be submitted to the owner's representative for approval.

Lubricants shall be oil and grease. The contractor shall indicate indigenously available equivalent lubricants with complete specifications.

Where the lubricant is grease, preference shall be given to a pressure system which does not require frequent adjustment or recharging. Preferably, life lubricated grease packed bearings shall be used. Grease gun for each type of grease used shall be supplied.

Name Plates

Each equipment of the plant shall have permanently attached to it a nameplate and rating plate in a conspicuous position, upon these shall be engraved or stamped, the manufacturer's name, type and serial number of the equipment, details of the loading and duty at which the equipment has been designed to operate, and such diagrams as may be required by the owner's representative. All indicating and operating devices shall securely attached to them or marked upon them designations as to their function and proper manner of use.

Painting

The contractor shall be responsible for the cleaning, preparation for painting and priming or otherwise protecting, as specified, all parts of the plant/equipment at the place of manufacture prior to packing.

Parts may be cleaned but surface defects should not be filled in before testing at manufacture's work. Parts subjected to hydraulic test shall be tested before any surface treatment. After testing, all surfaces shall be thoroughly cleaned and dried out, if necessary by washing with as approved dewatering fluid prior

to surface treatment. Except where the specification provides to the contrary, all painting materials shall be applied in strict accordance with the paint manufacturer's instructions.

Steel and cast iron parts shall be sand blasted to near white cleaning before painting. Edges, sharp corners etc. shall be grounded to a curve before sand blasting. A primer coat of a zinc rich epoxy resin based coating with at least 75 microns dry film thickness is to be provided. In addition, the parts for wet duty are to be provided with an adequate number of coats of coal tar epoxy polyamine coating to a dry film thickness of 175 microns excluding primer coating.

Galvanizing

Wherever galvanizing has been specified the hot dip process shall be used and electro galvanized parts, equipment shall not be permitted. The galvanized coating shall be of uniform thickness. Weight of zinc coatings for various applications shall not be less than those indicated below:

a) Fabricated Steel : 460 gm/m^2

b) Fasteners : 300 gm/m^2

Galvanizing shall be carried out, after all drilling, punching, cutting, bending and welding operations have been carried out. Burrs shall be removed before galvanizing. Any site modification of galvanized parts should be covered well by zinc rich primer and aluminium paint.

All exposed metal parts of the equipment including piping, structures, etc. wherever applicable, after installation unless otherwise surface protected shall be first painted with at least one coat of suitable Zinc rich epoxy primer which matches the shop primer paint used, after thoroughly cleaning all such parts of all dirt, rust, scales, greases, oils and other foreign materials by wire brushing, scraping or sand blasting and the same being inspected and approved by the TPPA/PMC for painting. After wards, the above parts shall be finished with two coats of epoxy / coal tar epoxy coating / paint. The quality of the finish paint shall be as per the standards of ISI or equivalent and to be of the colour as approved by the TPPA/PMC. The paint shall be suitable for use in industrial

corrosive works atmosphere.

Castings

All castings shall have a homogenous structure and be free from blow holes, flaws and cracks. Any casting having a thickness in parts in excess of 3 mm to that which it is purported to be shall be rejected. No repairs or patchwork to castings shall be allowed other than that approved by the TPPA/PMC.

Castings subjected to hydraulic pressure shall be tested to 1.5 times the maximum working pressure. Certified copies of Test Reports shall be forwarded to the TPPA/PMC as soon as the test is completed.

Steel Castings

Where not otherwise specified, steel castings shall be selected from the appropriate grade of BS. 3100.

Grey Iron Castings

All grey iron castings supplied shall be to the appropriate grade of IS:210. The Contractor shall replace any casting which the TPPA/PMC considers is not of first class appearance or is not in any way the best which can be produced, although such a casting may have passed the necessary hydraulic or other tests. No plugging, filling, welding or “burning on” will be acceptable.

Spheroidal Graphite Iron Castings

All spheroidal graphite or nodular graphite iron castings shall be to the appropriate grade of IS:1865 - 1991.

Bronze

Where not otherwise specified, the bronze used shall be made of a strong and durable zinc free mixture to IS : 318.

Aluminium and Aluminium Alloys

Bars and extruded sections shall be to designated to BS 1474-1987. Aluminium and aluminium alloys shall not be utilized unless no other alternative material is considered suitable. The use of aluminium requires the approval of the TPPA/PMC

in all cases.

Aluminium and Aluminium alloy Castings

Castings shall be manufactured to IS:617-1994 and subjected to a chill cast to increase tensile strength. Aluminium and aluminium alloys shall not be utilized unless no other materials is considered suitable. Immersed structures or structures that are periodically immersed shall not be constructed from aluminium or aluminium alloys.

Painting and Metal Protection

All bright metal parts shall be covered before shipment and transportation with approved protective compound and protected adequately during shipment and transportation to the site. After erection, these parts are to be cleaned.

All pipe services wherever applicable are to be painted in accordance with the standard colour code scheme by the Contractor as approved by TPPA/PMC.

MS/GI Hand Rails shall be painted with synthetic enamel paint of shade approved by TPPA/PMC.

Chromium Plating

All chromium plating shall comply with IS:1986-1981.

Fasteners

Bolts, nuts and studs and fasteners with nominal diameters up to and including 39 mm required to be made in carbon steel shall conform to BS 6104 and threaded in accordance with IS: 1363 to 1367. Bright steel washers 3.0 mm in thickness shall conform to BS 4320 and shall be provided beneath bolt head and nut.

These items together with holding – down bolts and anchor plates required to be supplied in high tensile steel shall conform to BS – 970.

Drilled anchor fixings fasteners for use on concrete structures shall be of an approved type by the TPPA/PMC. The Positions of all drilled anchors shall be approved by the TPPA/PMC and a Contractor proposing to use such fixings shall

be deemed to have undertaken to supply, mark off, drill and fit. All exposed bolt heads and nuts shall be hexagonal and the length of all bolts shall be such, that when fitted and tightened down with a nut and washer, the threaded Portion shall fill the nut and not protrude from the face thereof by more than a half diameter of the bolt. Rivets shall conform to BS : 641 and tested in accordance with BS : 1109.

Forgings

Carbon steel forgings shall be manufactured heat treated forgings and tested in accordance with IS:2004-1991.

Foundation and Settings of Machinery

The Contractor shall arrange for the provision of all foundation and plinths required for the plant and shall be responsible and setting for ensuring that all foundations and plinths are constructed and boxed out for Machinery holding down bolts in accordance with the approved drawings.

The Contractor shall provide all necessary templates for suspension of the holding – down bolts during grouting of same.

The Contractor shall visit the site during the course of construction and check the Civil Works to ensure that the foundation and / or plinths are at correct required location and height, for the acceptance of the machinery. When the foundations and/or plinths have been complete and are in a satisfactory condition, the machinery shall be installed as directed by the TPPA/PMC.

The machinery shall be mounted on flat steel packing of a thickness selected to take up variations in the level of the correct foundations. The packing shall be bedded by chipping or grinding of the concrete surface.

Only one packing of selected thickness shall be used at each location, which shall be adjacent to each holding down bolt. The number of shims shall not exceed two at each location and the thickness of each shim shall not exceed 3 mm.

The machinery shall be alighted, levelled and pulled down by the nuts of the holding down bolts with a spanner of normal length, and no grout shall be applied

until the machinery has been run and approved by the TPPA/PMC for stability and vibration. The Civil Contractor shall then carry out the grouting and building in of the machinery. However, the Contractor shall take responsibility for the satisfactory nature of this work, and shall have a representative present.

Built In Items

The Contractor shall include in the relevant Schedule of the Specification, details of all the items of equipment to be "Built in" by the Civil Contractor, together items with details of the period in which these items could be delivered to site.

The Contractor shall provide to the Civil Contractor full details of the box outs and plant fixing and foundation requirements for incorporating in the Civil Work. The Contractor shall liaise closely with the Civil Work and shall obtain from him a program of the Civil works, clearly showing the dates when box-out and plant foundation details will be required. The Contractor will be responsible for co-coordinating and program his work schedule with the Civil Work so as to ensure an optimum arrangement with the minimum of disturbance to the progress of the Works as a whole. The Contractor shall deliver all items of equipment that are required to be built in the civil works, as required by the construction program and shall arrange for a representative from the equipment supplier to be in attendance during the progress of such works. The Civil Contractor shall grout up and make good when instructed by the TPPA/PMC.

Location and Alignment

Where individual items of equipment are mechanically located and coupled, such as alignment motors, gearboxes and similar items depended upon correct alignment for satisfactory operation, each shall be mounted on a common bed plate and when alighted shall be located by means of dowels to ensure that correct re-alignment can be easily achieved when re-assembling the items after removal for overhauls.

Coupling

Flexible couplings shall be Couplings rated at not less than the stalling torque

load of the motor. Couplings liable to impregnation by oil shall be of the all metal flexible type.

General Service coupling shall be of the flexible multi-pin and resilient bush type, having not less than six bushes and each bush shall have an inner sleeve to allow rotation on the pin (bushes shall not be in direct contact with the pin). All pins shall have shoulders to allow positive location and securing to the half coupling face.

Flexible couplings shall be supplied in matching balanced sets machined, balanced and marked before leaving manufacturer's works. The couplings shall be a tight fit on the shafts and secured with hand fitted keys and fully checked for alignment, shall be a tight fit on the shafts and secured the hand fitted keys and fully checked for alignment. All necessary equipment for checking alignment shall be supplied by the Contractor.

Where flexible coupling are used, the Contractor shall fully describe the arrangements proposed for ensuring that the desired freedom of relative movement between the shafts is obtained when transmitting a torques corresponding to the continuous maximum rating of the motor.

Solidly bolted couplings shall be subject to accurate alignment and the Contractor's proposed alignment procedure shall be subject to the approval of the TPPA/PMC. In particular, the alignment procedures which involve rotating one half coupling only will not be accepted.

Overload release couplings shall not rely on shear pins. Release torque shall be adjustable over a wide range and preferably without the need to change components. The coupling shall be capable of angular alignment of 1 deg. Maximum and 1 mm displacement of shafts.

Hydraulic couplings shall be oil filled with thermal overload protection device. The coupling shall be fully rated to transmit the motor full load power without exceeding normal working temperature and due regard shall be taken to ambient temperatures. An enclosure around the coupling shall be provided to prevent oil spray in the event of operation of the thermal overload device.

Final alignment of all types of coupling shall be checked by the Contractor in the presence of the TPPA/PMC.

Bearings and Lubricators

The size of bearing shall be not less than that calculated for bearings and a minimum L10 basic rating life in accordance with BS:5512 Lubricators Part 1., taking into account all considerations of reliability materials of manufacture and operating conditions. All bearings shall be rated and sized to ensure satisfactory running without vibration under all conditions of operation for a minimum life of 50,000 hours running.

They shall be efficiently lubricated and adequately protected from ingress of moisture, dust and sand and the particular climatic condition prevalent at the site. All bearings shall be to ISO standard SI unit dimensions where practicable.

All ball or roller bearings, except those supplied and "sealed for life" shall be arranged for grease gun lubrication and a suitable high pressure grease gun shall be supplied.

Adequate "Stauffer" screw top pressure grease lubricator with 'tell tale' stems or 'Tat" grease nipples shall be provided for all moving parts. The position of all greasing and oiling points shall be arranged so as to be readily accessible for routine servicing. Wherever necessary, suitable access platform shall be provided.

The type of lubricant and intervals of lubrication, which shall be kept to a minimum (not less than nine days), for each individual item of plant shall be entered on a working schedule, which shall form part of the Operation and Maintenance instructions.

A list of recommended Lubricants and their equivalents Bearings shall be entered in the Operation and Maintenance instructions.

Gearboxes

The Gearboxes shall be totally enclosed dust, water and hose proof. Suitable lifting lugs shall be provided. They shall be robustly constructed and arduous duty.

The gear case shall be manufactured from grey cast iron to IS: 210 and of a grade to ensure high strength and wear resistance. Inspection covers shall be provided together with protected oil level indication, breather, with oil mist prevented, and drain plugs.

The gearboxes shall be designed for operation at the ambient temperatures specified without the assistance of a cooling fan.

The mechanical service factor shall be not less than 1.5 when applied to the rated motor power or higher as recommended by equipment manufacturer.

The gears shall be manufactured from steel to BS: 970 of grade selected by the Contractor and entered in the Schedule of Particulars. The teeth shall be profile ground and lapped to a high standard of accuracy and finish.

Rolling bearings shall be adequately rated to ensure a running life of not less than 50,000 hrs.

The input and output shafts shall have oil seals fitted to prevent the ingress of lubricant when the gearbox is mounted in the required orientation. For example, inclined when applied to screw pump installations.

The seals shall also prevent the ingress of dust, sand and moisture. Lubrication of the gears shall be by a splash or forced system. An anti-run back device shall be supplied and fitted to all gearboxes involved in screw pump installation.

Each gear unit shall be subjected to a full load test at the inclinations specified for duration of 3.00 hrs during which time temperature, vibration and noise levels together with oil tightness shall be recorded in the presence of the TPPA/PMCs Representative.

After satisfactory completion of the tests, each unit shall be drained of lubricant. All internal surfaces shall then be coated with suitable preservative.

A metal label shall be securely wired to the gear case to clearly state that the gear case requires to be coated with a suitable preservative.

A metal label shall be securely wired to the gear case to clearly state that the

gear case requires to be filled with lubricant, the type and grade of which shall be clearly identifiable.

Steelwork General

The Contractor shall provide and fix all the steel work, including stairways, ladders, hand railing, chequered plate and open mesh flooring frames and curbing as shown on the as directed by TPPA/PMC.

All steel work shall be constructed in mild steel and shall be galvanized after manufacture or shall be provided with finish as specified in the specifications of specific equipment / work.

For all pre-fabricated metal work, including multiple duct covers, external ladders, open mesh flooring, chequered plating, hand railing, staircase, structural steel work and the like, the Contractor shall submit fabrication drawings for the approval of the TPPA/PMC prior to the manufacture of any of these items.

Hand railing

Hand railing shall be of MS; ERW Medium Class mild steel of circular hollow section and shall comply with the relevant requirements of BS : 1387, BS : 6323 Part I or BS : 4360. Mild Steel toe boards shall be provided, 100 mm high by 3 mm thick positioned above the platform level and fixed securely. All items shall be painted with epoxy primer & epoxy paint.

Vertical rails shall not be less than 38 mm external diameter and rails shall not be less than 32 mm external diameter.

Horizontal handrails shall be 1000 mm high with an intermediate rail at mid height. Handrail height shall be measured vertically from finished floor level to the hand rail centerline.

Handrailing and fixings shall be designed to withstand a horizontal force of 740 N/m run without permanent distortion or failure of components. When a horizontal force of 360 N/m is applied at handrail level the deflection at any point on the handrail shall not exceed 1/125 of the distance between the center

lines of adjacent standards or 10 mm. whichever is the least.

Fittings shall be screwed or secured with grub screws. The standards shall be set at not more than 1.5 m. centers. When provided in sections, hand railing shall be joined together with purpose made fittings secured by screws or grub screws.

All ladder, stairway or other openings shall be guarded on three sides by hand railing conforming to the requirements stated above.

The Contractor shall ensure that unless specified hereinafter to the contrary, all hand railing shall be of uniform appearance and manufacture.

Safety Chain

Mild Steel Safety Chain shall be 8 mm nominal size grade (M 4) non calibrated Chain Type 1, complying with BS: 4942, Part 2. After manufacture, mild steel safety chains shall be hot dipped galvanized in accordance with BS: 729.

Stainless Steel safety chains shall be manufactured from grade 316 S31 steel. Chain links shall be welded and have an internal length not exceeding 45 mm and an internal width of between 12 mm and 18 mm. The fins caused by welding shall be removed and the weld shall be smoothly finished all round. When tested in accordance with Clause 7.3 of BS: 4942 Part 2, each chain shall with stand a breaking force of 30 kN and a proof force of 15 kN.

Open Mesh and Chequer Plate Flooring

Open mesh flooring and gratings shall generally comply with BS: 4592 except where otherwise specified hereinafter. Such flooring and gratings shall be of rectangular mesh and non–slip and shall be mild steel galvanized.

Flooring shall be provided to span between the supporting members, where necessary intermediate support members shall be provided and fixed.

Galvanized mild steel toe plates 100 mm high and not less than 3 mm thick shall be provided and fixed at all cut-outs wherever required.

Both the load bearing and transverse bars in rectangular flooring panels shall be

obtained systemically around the centre lines of the panels in both directions, so that when the panels are fixed in extensive areas or in long runs, the bars of all panels are in line.

Chequer plate flooring shall be galvanized and of the non-slip type, not less than 10 mm thick measured excluding the raised pattern. The flooring shall be secured to its frame by stainless steel countersunk set screws.

All flooring shall be designed to carry a loading of 750 Kg. per Sq. meter and the deflection shall not exceed 1/200 of the span or 10 mm whichever is the least.

All flooring shall be removable and set flush in mild steel galvanized frames. All frames shall be provided with lugs for building in.

Flooring shall be provided in sizes suitable for lifting and removal by one man and with the appropriate cutouts to permits its removal without disturbing or dismantling spindles, supporting brackets, cables or pipe work. Flooring spanning wide openings shall be supported on removable bearers and fixings to provide the required rigidity and these shall be supplied and fitted by the Contractor. These members shall be removable to afford clear access to the openings which includes ducts.

Lifting keys shall be supplied for each location and the type of key shall be such that inadvertent release is avoided.

Stairways

Stairways shall be detailed, fabricated and erected in accordance with BS : 449 Part 2 to carry a load of 750 Kg. Per sq. meter. Treads shall be rectangular open mesh fixed to the stringers, not directly to concrete. Sloping hand railing shall be as specified for horizontal hand railing but with the top rail 850 mm vertically above the line of pitch and standards vertical and spaced at not more than 1500 mm., measured parallel to the line of pitch.

Ladders shall conform to BS: 4211 except where the specified here after. They

shall be in mild steel galvanized. The stringers shall be flat section not less than 65 mm x 10 mm spaced 380 mm apart and shall be flanged and drilled for wall fixing at both ends. The stringers shall be radiuses over the top where they shall be not less than 600 mm apart. Ladders over 3.0 m long shall have additional intermediate stays at not more than 2.5 m centers.

Rungs shall be 20 mm diameter round bar at 250 mm c-c distance shouldered at each end and securely riveted into countersunk holes. Rungs shall be not less than 225 mm from the wall.

All ladders shall have safety cages which shall be constructed of three flat vertical strips supported by flat hoops, with a diameter of 750 mm. The hoops shall be at approximately 70 mm centers and the first hoop shall be 2400 mm. above ground or lower platform level Where the rise exceeds 6000 mm, an intermediate landing shall be provided.

1.2 Mechanical equipment

Manual Trash Screen

Screen shall have opening not more than 50 mm, to prevent coarse debris from entering the inlets and protect the plant against mechanical damage. They shall be inclined at an angle of not less than 60 degrees from vertical to facilitate raking.

The design shall avoid the formation of areas of stagnation in the flow. Sealing shall be provided between the frame and the inlet channel walls.

Screens shall be designed to withstand the maximum possible pressure differential across the screen when fully blinded, without incurring any damage or overload. The working head loss across the screen at maximum flow shall not exceed 50 mm following screen cleaning. Unless otherwise specified the velocity of the flow through the screen shall not exceed 1.2 m/s. The equipment shall be capable of operation under all duty flow variations and debris loadings, and shall be capable of withstanding the impact of large floating material and heavy objects in the flow without damage to the screen.

Screen bars shall pickeld and passivated to remove any residues that may be present on the material as a result of forming, manufacture, or handling. Screen bars shall be washed with a high-pressure wash of cold water to remove any remaining surface debris and promote the formation of an oxidized passive layer which is critical to the long life of the stainless steel.

Screen bars shall be accurately set and secured to give the designed clearance between the bars. The bars shall extend from the sole plate, to which they shall be individually welded, to a point above maximum possible top water level, at which point they shall be individually welded to the screen top plate. Intermediate stiffening supports shall be welded to the screen bars as necessary for screens to accommodate hydraulic pressure due to depth and high flow rates through the inlet channels. The screen bars shall be individually welded to each stiffening support. Stiffening supports shall be fitted so they cannot impede raking. Sole plate shall be profiled to induce screenings and debris to be directed onto the screen bars and not to accumulate at the foot of the screen. The leading edge of the sole plate shall be level with the inlet channel invert.

The top edge of the screen shall be profiled to enable easy raking-off of screenings material.

When specified, for applications where large or heavy oversize debris may accumulate against the screen, hoisting equipment shall be provided. The screen shall then be fitted with hoist-guide pulleys, and operator access shall be provided to enable manual removal of oversize objects from the flow. Screens shall be constructed from SS 316.

Raking shall be manual and screenings shall be transferred manually to a wheel barrow. The scope of supply shall include manual rakes and wheel barrow, with all accessories needed to remove the collected debris.

Rake tines shall be designed to fit the screen apertures, and tines shall be of material which cannot damage the screens. Wheel barrow shall be sized so that, when fully loaded with the typical tropical organic material expected, the gross weight shall not exceed 50kg. They shall be fitted with handles to facilitate

manual or mechanical handling.

1.3 Pumps

Submersible Pumps

Submersible pumps shall be of the single entry design supplied complete with boltless self-aligning duck-foot assemblies giving automatic connection to the discharge pipe work.

The total head capacity curve shall be continuously rising towards the shutoff with the highest at shutoff.

Pumps shall be suitable for single as well as parallel efficient operation at any point in between the maximum and minimum system resistances.

The pumps shall be designed to handle solid sizes for raw sewage of up to 100 mm and normal sewage shall be 80mm (As per design requirements). Pumps shall run smooth without undue noise and vibration. The pump set shall be suitable for starting with discharge valve open and/or closed. The pump set shall be capable of withstanding the accidental rotation in reverse direction.

Construction Features

- Pump shall be centrifugal, vertical spindle, non-clog, wear resisting, single stage type.
- Pump casing shall be of robust construction. Liquid passages shall be finished smooth and designed as to allow free passage of solids. The volute tongue shall be filed to a smooth rounded edge.
- Double mechanical seal shall be provided to protect the motor from ingress of liquid along the shaft. The preliminary and secondary seals shall be oil-lubricated with tungsten carbide or silicon carbide faces and they shall be equipped with an electrical monitoring system for seal failure detection. Sensors are to be provided to detect if leakage of liquid into oil housing is above 30% concentration.
- Impeller shall be non-clog open/semi open type for storm water application with smooth blunt edges and large water ways so as to allow free passage of the large size solids. It shall be free from sharp corners and projections likely

to catch and hold rags and stringy materials. The number of impeller vanes for pumps up to 1000 m3/hr shall be limited to two and shall be limited to three for the pumps higher than 1000 m3/hr.

- The critical speed of the rotor shall be at least 30% above the operating speed.
- Pump sets shall have double bearings. the bearing life shall be minimum 40,000 hrs of operation.
- Each pump shall be complete with a CI delivery connection arrangement for fixing to the concrete floor of the suction well. All necessary SS fixtures required for guiding the pumps during lifting/lowering shall be provided. The installation shall facilitate automatic installation and removal of pump without a person entering the wet well. Each pump shall be provided with a SS-316 lifting chain with suitable provision for engaging the hook of the crane at 1 m interval.
- Each pump shall be provided with an automatic coupling device for attaching the crane hook to the pump at low level, even whilst the pump is submerged, without the need for personnel to enter the wet well. This automatic coupling devise shall easily and automatically couple and uncouple the hoist hook and be complete with necessary accessories. All links and cables shall be multi-stranded SS.
- The submersible pumps shall be suitable for operation with or without submergence.
- The pump shall start and stop automatically based on the level in the wet well.
- The synchronous speed shall not exceed 1500 rpm at 50 Hz supply.
- The material of construction for submersible pumps shall be as follows:

Component	**Material**
Impeller	SS : ASTM A 743 CF8M
Casing	CI, IS: 210 Gr FG 260 with 1.5 to 2 % Nickel
Shaft	SS 410
Bush	Bronze IS 318 Gr LT B2

Guide Rail Pipe	SS : BS 970 AISI Gr 316
Fasteners and Foundation Bolts	SS : BS:970 AISI Gr 316

Material test certificates shall be furnished by the Operator and shall have the approval of TPPA/PMC.

The submerged cable shall be a multi-core flexible cord, Vulcanized rubber insulated with tough rubber sheath and outer PCP sheath to BS 6500.

Where both thermal protection and moisture-sensitive devices are incorporated within the pump, both devices shall be brought out via separate conductor within the motor cable,although one such conductor may be common.

Centrifugal Pumps

- ✓ Centrifugal pumps shall have head/quantity characteristics which fall continuously from the maximum pressure at closed valve conditions and which are steep in order that variation in head shall have a minimal effect on the quantity discharged.
- ✓ The design speed of any pump with a duty flow greater than 20 l/s shall not exceed 1500 rpm. Pump motor rating shall exceed the maximum pump power consumption over the operational range of the pump by at least 10%.
- ✓ Waterway through the pump shall be smooth in finish and free from recesses and obstructions. Impeller passageways shall be as large as possible. The leading edges of the impeller vanes shall be rounded and smooth.
- ✓ Water velocities in the pump suction side shall not exceed 1.5 m/s and on delivery branches of a pump the velocity shall not exceed 2.0 m/s when the pump is operating within its specified duty range and within this working range there shall be no discernible noise due to hydraulic turbulence or cavitations within either the pump or its associated pipe work and valves.
- ✓ The NPSH requirements of the pumps, based on the 3% output drop

criterion shall be at least 2 m less than the NPSH available at every working condition.

- ✓ The velocity of vibration shall be within 4.5 mm/sec. Combined noise level of pump motor system shall be limited to 85 dB(A) at a distance of 1.85 m from the equipment, at manufacturer's works / free field condition at site after erection.
- ✓ The pump shaft shall be of SS BS:970 Gr 410S21 compatible with the impeller which shall be of bronze or stainless steel ASTM A743 CF8M and the impellers and shaft sleeves shall be secured to the shaft by means of a key/s. The impeller retaining nut shall be fitted with a locking device. The pump casing shall be of cast iron to IS 210 Gr. FG 260, wearing rings shall be of bronze to IS: 318 Gr. LT B2 and shaft sleeve shall be of SS ASTM A 743 CA 15.
- ✓ All parts exposed to wear shall be adequately protected by means of renewable sleeves, bushes, wear rings etc. which shall be arranged for easy inspection, adjustment, or replacement without removal of the pump casings, pipe work etc, or the need to disturb the drive shaft alignment.
- ✓ The pump thrust shall be taken by a combined thrust and radial type bearing assembly capable of taking the weight of the moving parts and the hydraulic load under all conditions of the operation with minimum life of 100 000 hours.
- ✓ Bearing cooling arrangement if used shall be designed on the closed-circuit principle; open discharge of cooling water into the pumping station drainage system is not permissible.
- ✓ The pump casing and other parts of the pump subjected to pressure shall be hydraulically tested by the manufacturer to at least one and half times the maximum working pressure.
- ✓ Integral inlet & discharge flanges shall be provided and integral lifting lugs shall be incorporated.
- ✓ Facilities shall be provided for the removal of air during priming and for draining.
- ✓ Glands may be fitted with mechanical seals or conventional soft packing.

The gland arrangement shall be designed for easy adjustment and removal of the seal.

- ✓ When soft packed gland are used suitable means shall be provided for collecting and preventing splashing of the gland leakage water.
- ✓ Drainage and gland leakage water shall be piped into the building drainage system.
- ✓ The shaft of the pumps fitted with conventional packed glands shall be fitted with removable gland sleeves.
- ✓ The rotating element of the pump and the motor shall be readily removable from the pump casing without the need to disconnect the adjoining pipe work.
- ✓ Rotating assemblies of the pumps of 100 mm dia. inlet and over shall be statically and dynamically balanced and shall be designed so that the first critical speed is at least 50% greater than the maximum operating speed.
- ✓ Lubrication arrangements shall be so designed that there is no contamination of the pumped fluid.
- ✓ On pumps of 75 mm inlet and over, tapping shall be provided at both the suction and discharge flanges of suitable size for pressure gauges.

Horizontal split case pumps

Design requirements

- ✓ Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. Components of identical pumps shall be inter-changeable.
- ✓ Pumps shall be single stage designed for continuous operation and shall have a continuously rising head characteristics without any zone of instability.
- ✓ Flow rate versus (Vs.) head curve shall have a stable and continuously rising characteristics towards the shut-off head. In case of unstable (drooping) characteristics the duty point shall be well away from the unstable region. Besides the actual flow rate versus head curve, curves for minimum and maximum impeller diameters shall also be shown.

- ✓ The pumps shall be capable of delivering not less than 150% of rated capacity at a head of not less than 65% of the rated head. The shut off head of pump shall not exceed 120% of the rated head. The drive motor shall be continuous rising type and its rating shall be at least equivalent to the horse power required to drive the pump at 150% of its rated discharge.
- ✓ The required NPSH at duty point shall be at least one (1) metre less than the available NPSH.
- ✓ The rating of the pump driver shall be the larger of the following
- ✓ The maximum power required by the pump from zero discharge to runout discharge at site climatic conditions.
- ✓ 110% of the power required at the duty point at site climatic conditions.
- ✓ The corrosion allowance for pressure parts shall be 3 mm.
- ✓ Pumps shall run smooth without undue noise and vibration. Noise level produced individually or collectively shall not exceed 75 dB(A) measured at a distance of 1.0 metres from the source in any direction. The overall vibration level shall be as per zones A and B of ISO 10816-1.
- ✓ Motor shall be energy efficient, totally enclosed, fan-cooled, class-F insulation.
- ✓ Motor shall be specially designed for quiet operation. The motor rating be such as to ensure that there is no overloading of the motor throughout its capacity range.
- ✓ Motor shall be suitable for 415±10% volts, 3 phase, 50 cycles AC, power supply.

Construction features

- ✓ Pump casing shall be cast steel of heavy section, horizontally axially split volute type. Suction passages shall be volute in form, promoting smooth entry to impeller and increased efficiency.
- ✓ The casing shall be split on the horizontal center line with the suction and discharge nozzles and casing feet cast integral with the lower casing half. The interior of the pump shall be easily inspected by removing the upper half of the casing. This shall be done without disturbing the pipe

connections or pump alignment. The upper and lower halves of the casing shall be accurately located by the use of straight dowel pins to eliminate mismatch between the upper and lower halves which would impair both hydraulic and mechanical performance. Flanges shall be drilled as per BS EN 1092-2.

- ✓ Impeller shall be cast one piece Stainless steel, double suction, enclosed type, accurately machined, hydraulically balanced to minimize thrust and passages smooth-finished for minimum friction and maximum efficiency. The impeller shall be firmly secured to the shaft by a key positioned by shaft sleeves and both locked in place by shaft sleeve locknuts.
- ✓ In addition to static balancing, impeller shall be balanced dynamically at or near the operating speed.
- ✓ Shaft shall be of stainless steel, protected by sleeves extending through stuffing boxes. Stuffing boxes shall be extra deep, water sealed with renewable bushes.
- ✓ Shaft shall be supported with ball /journal bearings, grease lubricated, contained in easily removable housing. Pumps shall be fitted with mechanical seals, an air valve, two grease lubricators, drain plug and water seal drain connections.
- ✓ Base shall be of a size suitable for the pump, motor and shaft and shall be constructed of carbon steel.
- ✓ The pumps shall be installed on a concrete foundation with vibration isolators.
- ✓ Pump shall be provided with renewable type casing ring and shall be accurately machined and securely mounted in the pump casing. Renewable impelle wearing rings shall be of stainless steel and mounted on the impeller at the suction inlets.
- ✓ Pump casing shall be provided with drain and vent connection with plugged or valve connection.
- ✓ Bearing shall be oil-lubricated or grease-lubricated and shall have a life of 40,000 hours of working. In case of oil-lubricated bearing, constant oil leveller with magnetic drain plug shall be provided.

- ✓ Replaceable shaft sleeves shall be provided to protect the shaft where it passes through stuffing box.
- ✓ Stuffing box shall be of such design that it can be repacked without removing any part other than the gland and lantern ring.
- ✓ Mechanical seals shall be provided. If required, a flushing line shall be furnished, complete with strainer and orifice, from the pump discharge to the sealing face. When pumping liquid is not suitable for this purpose, a flushing connection shall be provided so that it can be connected to an external source.
- ✓ Pumps shall be provided with flexible coupling. Flexible coupling shall be protected by a guard mounted on the common inertia base. Coupling guard made of expanded metal and shall be bolted to the base plate.
- ✓ In addition to accessories listed in data sheet, any other accessories required for safe and efficient operation of pump shall be provided.
- ✓ All incidental piping and valves required for sealing, lubrication and cooling for stuffing box packing and/or bearing of pump, casing drains with piping shall be furnished by the vendor.
- ✓ Leakage from the pump shall be led to the nearest surface drain. Pump vendor shall provide necessary arrangement like drip tray, base plate drain connection etc.

Tests and inspection

The Contractor shall carry out the following specific tests and inspections to ensure that the equipment furnished lies in strict conformance with the specification and also in accordance with applicable codes/standards and good TPPA/PMCing practice.

Identification and Testing

- ✓ All materials used for pump construction shall be of tested quality. Material shall be tested as per the relevant standards and test certificates shall be made available to the TPPA.
- ✓ Tests for each pump included under this section shall include but not be limited to the following:

- ✓ The entire surface of the impeller castings shall be subjected to Dye Penetration Test as per ASTM Specification no.: E165-65.
- ✓ Shaft shall be subjected to Dye Penetration and Ultrasonic Tests.
- ✓ Wearing rings shall be subjected to Dye Penetration Test.
- ✓ Verification of material, witnessing of pouring, casting and inspection of finalized fabricated/cast castings.
- ✓ Inspection of finished castings for impeller and verification of materials.
- ✓ Inspection of pump shaft and verification of material.
- ✓ Witnessing of NDT/review of NDT reports.
- ✓ Static balancing test for impeller and dynamic balancing of complete rotating parts as per ISO- 1940.
- ✓ Complete Inspection of assembled pump.

Hydrostatic testing

The pumps shall be tested in accordance with HIS, ISO 9906.Hydro-test pressure on casing shall be 1.5 times maximum discharge head or twice differential head whichever is higher. Maximum discharge head is defined as the sum of the shut-off head and maximum suction head. Hydrostatic tests on the casing shall be conducted for a minimum duration of 30 minutes.

Performance test at shop

- ✓ Each pump shall have to be tested to determine the performance curves of the pumps. These tests are to be conducted in presence of TPPA's representative as per the requirements of the Standards of Hydraulic Institute or any other equivalent standard but the tolerances on head, discharge and power shall be as specified in HIS.
- ✓ The pumps shall be tested in accordance with HIS at rated speed at manufacturer's works to measure capacity, total head, efficiency and power. These tests shall form the basis for acceptance of pumps except for vibration and noise. The pumps shall be tested over the range covering from shut-off head to the maximum flow. The duration of the test shall be minimum one (1) hour. Minimum five (5) readings approximately equidistant shall be taken for plotting the performance

curves.

- ✓ Mechanical run test shall be carried out on all pumps to determine the vibration levels, noise levels etc. This test shall be conducted at site also. However, test value at site shall be used for the acceptance of the equipment.
- ✓ After installation, the pumps shall be subjected to testing at site also. If the site performance is found not meeting the requirements regarding vibration and noise as specified, the equipment shall be rectified or replaced by the vendor, at no extra cost to the purchaser.

End Suction Pumps

- ✓ End suction pumps shall be horizontally mounted complete with drive motor on a common base plate. The pump/Drive coupling shall be of the spacer type to facilitate removal of the pump rotating element and bearing housing without dismantling the pump casing, adjoining pipe work or drive motor. These types of pumps shall be used for filter backwash, Chlorination motive water and service water pumping applications etc.
- ✓ The dimensions of the pump shall be metric confirming to BS 5257 or its equivalent standard.
- ✓ Flanges shall conform to BS EN 1092-2/BS 4504/ IS 1538.
- ✓ The bedplate shall be of substantial fabricated steel construction with floor fixing bolt holes ready drilled. All holding down bolts etc. shall be supplied with the units.
- ✓ The velocity at the entrance to the pump impeller shall not exceed 3.5 m/s.
- ✓ Impellers shall be provided with means to prevent abrasive matter reaching the glands and with fully shrouded impellers, to prevent the trapping of matter between the impeller vanes and the casing.
- ✓ The speed of any pump shall not exceed 1500 rpm.
- ✓ Glands may be fitted with suitable mechanical seals or conventional soft packing. The gland arrangement shall be designed for easy of adjustment or removal of the seal or packing material. Shafts shall be sleeved around

the area of the gland when soft pack gland are used.

- ✓ Flushing facilities shall be provided for mechanical seals or packed glands where pump fluid may be contaminated with abrasive material. Where soft packed glands are used, means shall be provided for collection of the gland leakage water, which shall be piped into the drainage system through adequately sized ports.
- ✓ Lubrication arrangements shall be so designed that there is no contamination of the pumped fluid.
- ✓ The pumps and associated pipe work shall be wherever possible, arranged so that air can be completely expelled during priming. Where this is not possible, facilities shall be provided for the removal of the trapped air. Adequate facilities shall be provided for drainage of the pumps for inspection purposes.
- ✓ Tapping shall be provided at both the suction and discharge flanges for pressure gauge equipment.

Pump performance Guarantees

- ✓ The pump performance guarantee shall relate to the flow rate, the total head and the efficiency of the pump when tested at the manufacturer's work and shall obtain approval of TPPA/PMC.
- ✓ The pump shall operate at its design point within acceptance tolerances for flow rate and total head laid down in BS EN ISO 9906:2000.
- ✓ Each pump shall be tested at the manufacturer's work in accordance with BS EN ISO 9906:2000 or other relevant standards in conjunction with one of the contract motors.
- ✓ This test shall be carried out on at least one pump set using the flexible coupling and contract drive shaft arrangement to establish that the drive arrangement with supports and couplings operates satisfactorily under all operating conditions.

Component	Material
Pump casing	CI FG 260 IS: 210
Shaft	SS 410
Impeller	SS CF-8M / Bronze LTB II
Wearing rings	Bronze LTB II IS:318
Shaft sleeve	Bronze LTB II IS:318
Mechanical seal	Tunsten carbide / SiC
Base frame	Fabricated CS / MS
Bearings	Heavy duty Ball / roller bearings

- ✓ Where similar drive shaft arrangement have been installed by the operator and have been proven satisfactory in service this requirement may be withdrawn subject to the approval of the TPPA/PMC.
- ✓ A test shall be carried out of the performance from closed valve to the maximum quantity that can be delivered under abnormally low discharge heads.
- ✓ Sufficient reading shall be taken at each test to produce accurate curves of the heads, flow, pump speed and power required at pump coupling throughout the operating range of the pump.
- ✓ Vibration and noise dB(A) levels shall be measured and shown to be acceptable and shall have TPPA/PMC's approval. The operator shall have TPPA/PMC approval and provide acceptable test certificates, showing the NPSH requirement for the pump is at least 2m less than the NPSH available under all working conditions.
- ✓ In the absence of the approved test certificates the supplier shall carry out a test on one pump of each type to verify the NPSH requirement based upon the 3% output drop criterion and shall taken approval of TPPA/PMC.
- ✓ The certificates shall be submitted to the TPPA/PMC immediately following each of the test mentioned above. Performance curves shall

also be incorporated in the operation and maintenance manual.

Material of construction for pumps

Constructional Features

Motors weighing more than 25 kg shall be provided with eyebolts, lugs or other means to facilitate safe lifting. The motor construction shall be suitable for easy disassembly and re-assembly. The enclosure shall be sturdy and shall permit easy removal of any part of the motor for inspection and repair.

The rotor bars shall not be insulated in the slot portion between the inner core laminations for squirrel cage motors. All bearings shall be fitted with oil or grease lubricators. Motor bearings shall not be subjected to any external thrust load. Unless otherwise specified, motor bearings shall have an estimated life of at least 40,000 hrs. It shall be possible to lubricate the bearings without dismantling any part of the motor. All terminals shall be of the stud type of adequate size for the particular duty, marked in accordance with an approved standard and enclosed in a weatherproof box.

The equipment shall be thoroughly degreased, all rust, sharp edges and scale removed and treated with one coat of primer and finished with two coats of grey enamel paint.

Terminal Box

Terminal boxes shall be of weatherproof construction designed for outdoor service. To eliminate entry to dust and water, gaskets of neoprene or approved equivalent shall be provided at cover joints and between box and motor frame. It shall be suitable for bottom entry of cables. It shall be capable of being turned through 360 degree in steps of 90 degree.

The terminals shall be of the stud type with necessary plain washers, spring washers and check-nuts. They shall be designed for the current carrying capacity and shall ensure ample phase to phase and phase to ground clearances. Suitable cable glands and cable lugs shall be supplied. Separate terminal boxes shall be

provided for each of the following:

- Stator Leads
- Space Heaters

HORIZONTAL MONOBLOCK SUMP PUMPS

This specification covers the general design, materials, manufacture, shop inspection and testing at manufacturer's works, delivery at site, handling at site, installation, testing, commissioning and carrying out performance test of submersible pumps for water with their accessories.

Standards & Codes

The design, materials, manufacture, inspection, testing and performance of the submersible pumps shall comply with all currently applicable statutes, regulations and safety codes in the locality where equipment is to be installed. The equipment shall also conform to the latest editions of the relevant codes and standards existing as on the date 180 days prior to the deadline for submission of bids, unless otherwise specified. Nothing in this specification shall be construed to relieve the vendor of this responsibility.

Design Requirements:

Pump shall be submersible monobloc type.The pump shall be capable of delivering the required flow rate for both continuous and intermittent operations, at the specified operating conditions. The pump shall be designed to have minimum maintenance and easy accessibility to all components.

Flow rate versus head curve shall have stable and continuously rising characteristics towards the shut-off with the highest at shut off. In case of unstable (dropping) characteristics the duty point shall be well away from the unstable region. Besides the actual flow rate versus head curve, curves for minimum and maximum impeller diameters shall also be shown.

Pumps of a particular category shall be identical and shall be suitable for single as well as parallel operation with equal load division at any point in between the

maximum and minimum system resistance. Components of identical pumps shall be inter-changeable.

Pumps shall run smooth without undue noise and vibration. Noise level produced individually or collectively shall not exceed 85 dB (A) measured at a distance of 1.0 metres from the source in any direction. The overall vibration level shall be as per zones A and B of ISO 10816-1.

The power rating of the pump driver shall be the larger of the following considering the frequency variation:

- The maximum power required from zero discharge to run-out discharge at site climatic condition.
- 110% of the power required at any operating point in between the maximum and minimum system resistance curves for any combinations of pumping.
- 115% of the power required at the design point.

The critical speed of the pump shall be not less than 130% of the normal operating speed of the pump. The pump set shall be capable of withstanding the accidental rotation in reverse direction. The direction of rotation shall be clockwise viewed from the drive end.

Construction Features

Pump casing shall be of robust construction. The pump suction casing shall be guarded by a perforated strainer to prevent the entry of any suspended materials in the water. Closed Impeller shall be equipped with seal rings on their hubs.

The impeller shall be statically and dynamically balanced. Pump bearings shall be water - lubricated and protected against ingress of sand and other suspended particles. In case of open impeller, the pump shall be designed to take care of the additional thrust produced.

Double Mechanical seals shall be provided to protect the motor from ingress of

water along the shaft. The preliminary and secondary seals shall be oil-lubricated with tungsten carbide or silicon-carbide faces and they should be equipped with an electrical monitoring system for seal failure detection.

Motor shall be directly coupled to the pump shaft and shall be a hollow shaft motor with thrust bearings capable of taking thrust load developed by the pump and the dead weight of the shaft and impeller.

In addition to accessories which will listed by vendor in data sheet, any other accessories required for safe and efficient operation of pump shall be provided.

Induction Motor for Submersible Pumps

The submersible motor shall confirm to IS: 9283:2013.

Performance and Characteristics

Motors shall be capable of giving rated output without reduction in the expected life span when operated continuously under varying voltage and frequency supply conditions. Motor shall be of oil-filled or oil-lubricated or water-filled type. Pressure equalising diaphragm and sand guards with seals shall be provided to prevent the outside water and sand entering the motor. The starting current of motor shall not exceed 200% of rated full load current for star/delta starting and 600% of rated full load current for DOL starting, under any circumstances.

Motors shall be suitable for full voltage direct-on-line starting or star-delta starting.

Motors shall be capable of starting and accelerating the load with the applicable method of starting, without exceeding acceptable winding temperatures, when the supply voltage is in the range 85% of the rated motor voltage to maximum permissible voltage.

The locked rotor current of the motor shall not exceed 600% of full load current (subject to tolerance as per the applicable standard).

Motors shall be designed to withstand 120% of rated speed for two minutes without any mechanical damage, in either direction of rotation. The motor vibrations shall be within the limits specified in applicable standard unless otherwise specified for the driven equipment. Except as mentioned herein, the guaranteed performances of the motor shall be met with tolerances specified in applicable standard (IS: 9283:2013).

The stator winding shall be made from high conductivity annealed copper conductor; PVC insulated winding wires conforming to IS 8783 for wet type motors. The stator winding shall be of high conductivity annealed copper enamelled insulated wires confirming to IS 4800 for dry type motors.

Submersible Cable

The cable shall be PVC insulated and PVC sheathed, flexible, 3 core flat type. The size of the conductor shall be adequate for continuous use under water service. The submersible cable shall conform to IS 9283. The cable gland shall be properly sealed to prevent entry of pumped liquid into the motor. Suitable cable guards and supporting clamps for cable shall be provided.

The cable shall be terminated above ground level in a local terminal box with facility for terminating cable. The local terminal box with outlets for incoming and outgoing cables shall be in pump vendor's scope.

The size of the conductor and length of cable should be suitably selected so that the voltage drop at motor terminals does not exceed 3 percent of the rated voltage.

Earthing

Earthing of the motor shall be done in accordance with the relevant provisions of IS: 3043:1987. For fixed installation, earthing connection may be made to discharge pipe clamp.

Insulation

Any joints in the motor insulation such as at coil connections or between slot and end winding sections shall have strength equivalent to that of the slot sections of the coil.

The insulation shall be given tropical and fungicidal treatment for successful operation of the motor in hot, humid and tropical climate. The tropical sing treatment shall be as per the applicable standard.

Temperature Rise

The temperature-rise test of the motor shall be taken with the motor coupled to the suitable pump to give the full load output of the motor. When the various temperatures are stabilized, the set is stopped and the temperature-rise of the stator winding by the resistance method shall not exceed 35°C at rated voltage and 45°C at 85% of the rated voltage. During the test, the temperature of the cooling water may not exceed 45°C. As the cable resistance will also be substantial, it is necessary that while calculating the temperature rise by resistance method, due care is taken to account for the correct hot and cold resistance of windings.

1.4 Pipe work

The term “pipe work” means pipe of any description and includes associated flanges, adopters, couplings, jointing materials, fittings, supports, valves, traps and the like which are necessary to complete plant pipework systems of the pump house.

The Contractor shall design, manufacture, supply, fabricate, and install the pipe work in accordance with the Specification and to satisfy pipework function of the pump house.

All pipes, fittings, bolts, nuts, jointing materials, pipe supports, thrust blocks and appurtenances for piping to be required for execution of the works shall be manufactured and erected in accordance with the erection plans, specifications to be provided by the Contractor and approved by the TPPA. All piping inside the

plant shall be MS. The pipe work installation shall be so arranged to offer ease of dismantling and removal of pumps or major items or equipment. MS piping shall be flange jointed and adequately provided with structural / masonry supports.

All pipe work shall be adequately supported with purpose-made fittings. When passing through walls, pipe work shall incorporate a puddle flange or other suitable sealing device. Flange adapters / dismantling joints shall be fitted in pipe work runs, where necessary, to permit the simple disconnection of flanges, valves and equipment.

The operator shall be responsible for ensuring that the internal surfaces of all pipe work are thoroughly cleaned before and during erection and commissioning. Cleaning shall include removal of dirt, rust, scale and welding slag due to site welding. Before dispatch from manufacturer's works, the ends of the pipe, branch pipes etc., shall be suitable removed until immediately prior to connections adjacent pipes, valves or pumps.

All pipes shall be blown through with compressed air before connection is made to instruments and other equipment. No point of passage of pipes through floors or walls shall be used as a point of support, except with the approval of owner's representative.

All necessary supports, saddles, slings, fixing bolts and foundation bolts shall be supplied to support the pipe work and its associated equipment in an approved manner. Valves and other devices mounted in the pipe work shall be supported independently of the pipes to which they connect. All brackets or other forms of support, which can conveniently be so designed, shall be rigidly built up of steel by welding and coated by paint after wielding works.

Flange adapters shall be supplied and fitted in pipework runs, wherever necessary, to permit the simple disconnection of flanges, valves and equipment. The final outlet connection of the pipework shall match the connecting point of the transmission main.

Flanged joints shall be made with minimum 3 mm thick full face, fabric reinforced rubber gaskets, pierced to take the bolts, and the face of all flanges shall be machined to give a true angle of 90o to the centre line of the pipe or

fittings.

Bolts for flange connection must be tightened with adequate force in comply with international standards or approved by the TPPA/PMC.

1.5 Mild steel (MS) Pipes

Material of construction of MS pipes and fittings shall confirm to the following specifications:

Description	**Size mm(NB)**	**Size mm(NB)**	**Size mm(NB)**
Pipes	Up to 150	IS:1239 PT-1, ERW Black	1239 PT-1 C1 Heavy
	200 & above	IS:2062, Gr. B	IS 3589, ASME B 36.10
Elbows	Upto 50	ASTM - A 105	ANSI B 16.11 3000 # S.W.
	65 to 300	ASTM - A 234 Gr WPB	ANSI B 16.9 LR. BE. Sch 40
	Above 300 (mitre)	IS : 2062, Gr. B	ANSI B 16.9 / AWWA C 208
Coupling	Upto 50	ASTM - A 105	ANSI B 16.11 3000 # S.W.
Tees	Upto 50 65 to 200	ASTM - A 105	ANSI B 16.11 3000 # S.W
		ASTM - A 234 Gr WPB	ANSI B 16.9 BE, Sch 40
	Above 200	IS:2062, Gr. B	ANSI B 16.9 / AWWA C 208
Reducers	Upto 50	ASTM - A 105	ANSI B 16.11 3000 # S.W.
	65 to 300	ASTM - A 234 Gr WPB	ANSI B 16.9 BE, Sch 40 / AWWA C 208

Reducers	Above 300	IS : 2062, Gr. B	ANSI B 16.9 / AWWA C 208
Flanges & Blind Flanges	Sizes upto 200	ASTM - A 105	IS 1538 / ASME B 16.5 / BS 1092-2
Flanges & Blind Flanges	Sizes 200 upto 2000	IS : 2062, Gr. B	IS 1538 / BS EN:1092-2 SORF / ASME B 16.5 /
			ASME B 16.34
Bolts & nuts	All	SS 316	-
Gaskets	MS	IS:638 (Rubber reinforced CAF: (air service)	3 mm thickness upto 900 mm pipe 5 mm for 900-1200 mm 6 mm above 1200 mm

Pipe fittings shall be as per AWWA C 208 standard. Facilities shall be provided for draining the pipe system and releasing air. Fluid velocities in delivery pipework leading from pumps shall not exceed 2.0 m/s. The whole of the jointing work and materials necessary to fix and connect the pipes, including adequate and efficient pipe support shall be provided.

Hydraulic shop test for pipes and fittings shall be conducted as per relevant code/standard requirement. After erection at Site, complete pipes and fittings shall be hydrostatically tested for a pressure of 1.5 times design pressure.

Flanges, if fabricated in segments shall be fully radiographed and stress relieved. If fabricated out of billets/bars by cold rolling, welded flanges shall be radiographed and normalized. Protection for pipes laid underground shall be by coating and wrapping system giving a final coat thickness of 4.5 mm shall be employed. Such protection shall comprise 1.5 mm of coal tar primer application on a thoroughly cleaned surface, to be followed with fiber glass wraps set in coal tar enamel coats conforming to American Water Works Association specification C/203/57 for a total thickness of 3

mm. Such lining shall meet a spark test to be approved with a holiday detector of 10000 Volts.

The Contractor shall indicate on his detailed drawings what thrust blocks are required to anchor pipework supplied by him. Particular care shall be taken to ensure that pipe work thrusts are, as far as possible, not transmitted to machinery or other associated apparatus. Puddle flanges shall be fitted to pipes where the structure through which they pass is required to take thrust resulting from the pipe. Puddle flanges shall also be fitted where a water barrier is required. All puddle flanges shall be clearly shown on the drawings and the resultant thrust clearly indicated.

Puddle flanges shall only be fitted with the prior approval of the TPPA/PMC.

1.6 High density polyethylene pipes (HDPE) General

The pipes will be High Density Polyethylene Pipes (HDPE). The pipe shall generally meet the specifications as per IS 4984 except mentioned otherwise.

Designation

Pipes shall be designated as per IS 4984/relevant ISO with latest amendments, according to the grade of material, followed by pressure rating and nominal diameter, Colour, The colour of the pipe shall be black.

Materials

The material used for the manufacturer of pipes should not constitute toxic

hazard, should not support microbial growth, should not give rise to unpleasant taste or odour, cloudiness or discoloration of water. Pipe manufacturers shall obtain a certificate to this effect from the manufacturers of raw material by any internationally reputed organization as per the satisfaction of the TPPA/PMC.

Maximum ovality of pipe

The outside diameter of pipes, tolerance on the same and ovality of pipe shall be as given in table 2 of IS 4984. Ovality shall be measured as the difference between maximum outside diameter and minimum outside diameter measured at the same cross section of the pipe, at 300 mm away from the cut end. For pipes to be coiled the ovality shall be measured prior to coiling. For coiled pipes, however, re-rounding of pipes shall be carried out prior to the measurement of ovality.

Wall thickness

The minimum & maximum wall thickness of PE100 grade pipes shall be as given in clause 6.2 of IS: 4984.

Length of straight pipeline

The length of straight pipe used shall be more than 6 m or as agreed by TPPA/PMC Engineer-in- charge.

Coiling

The pipes supplied in coils shall be coiled on drums of minimum diameter of 25 times the nominal diameter of the pipe ensuring that kinking of pipe is prevented. Pipes supplied in straight length should not be less than 6m.

Performance requirements

The performance requirements of the pipe shall meet the provisions given in clause 8 of IS: 4984.

Handling, transportation and storage of pipes

Handling, transportation and storage of HDPE pipes shall confirm to IS 7634 part-3

Lowering, laying of pipes

Each pipe shall be thoroughly checked for any damages before laying and only the pipes which are approved by the TPPA/PMC shall be laid.

While installing the pipes in trenches, the bed of the trench should be level and free from sharp edged stones. In most cases, the bedding is not required, as long as the sharp and protruding stones are removed, by sieving the dug earth, before using the same a backfill material. While laying in rocky areas suitable bedding should be provided as per the specification for bedding.

During the pipe laying of continuous fusion jointed systems, due care and allowance should be made for the movements likely to occur due to the thermal expansion/contraction of the material.

For summer time installations with two fixed connection points, a slightly longer length of PE pipe may be required to compensate for contraction of the pipe in the cooler trench bottom.

The final tie-in connections should be deferred until the thermal stability of the pipeline is achieved.

The flexibility of polyethylene pipes allows the pipe to be cold bend. The fusion jointed PE pipe is also flexible as the plain Pipe. Thus the total system enables directional changes within the trench without recourse to the provision of special bends or anchor blocks. However, the pipe should not be cold bend to a radius less than 25 times the OD of the pipe.

PE pipe is lighter than water. Hence care should be taken for normal installations where there could be a possibility of flooding of the trench thus the trench shall be kept free of water till the jointing has been properly done

When flooded, some soils may lose cohesiveness, which may allow the PE pipe to float out of the ground. Several design checks are necessary to see if groundwater flotation may be a concern. Obviously, if the pipeline typically runs full or nearly full of liquid, or if groundwater is always below the pipe, flotation may not be a significant concern.

However, weights by way of concrete blocks (anchors) are to be provided so that

the PE pipe does not float when suddenly the trench is flooded and the soil surrounding the pipe is washed away. Thus site conditions study is necessary to ensure the avoidance of flotation.

Jointing of pipes

Butt-fusion (Heat Fusion Process) joint shall be proposed for HDPE pipes.

Fittings & specials

All HDPE fittings/ specials shall be fabricated in accordance with IS: 8360 (Part I & III)/relevant ISO with latest amendments. PE Injection moulded fittings shall be as per IS: 8008 (Part I to IX)/relevant ISO with latest amendments. All fittings/specials shall be fabricated or injection moulded at factory only. No fabrication or moulding will be allowed at site, unless specifically permitted by the TPPA/PMC. Fittings will be joined by use of heat fusion.

Bends

HDPE bends shall be plain square ended conforming to IS: 8360 Part I & III/relevant ISO with latest amendments Specifications. Bends may be fabricated by jointing several small sections of pipes to reach the required angle.

Tees

HDPE Tees shall be plain square ended conforming to IS: 8360 Part I & II/relevant ISO with latest amendments Specifications. Tees may be equal tees or reduced take off tees. Tees may be moulded or fabricated from pipes elements.

Reducers

HDPE Reducers shall be plain square ended conforming to IS: 8008 Part I & VII/relevant ISO with latest amendments Specifications. Reducer must be moulded.

Flanged HDPE Pipe Ends

HDPE Stub ends shall be square ended conforming to IS: 8008 Part I & VII/relevant ISO with latest amendments Specifications. Stub ends will be welded on the pipe. Flange will be of slip on flange type as described below.

Welding Procedure

Jointing between HDPE pipes and specials shall be done as per the latest IS: 7634 part II. Method of jointing between the pipes to pipes and pipes to specials shall be with butt fusion welding which shall be in accordance with clause 2.4 of IS: 7634 part II.

1.7 Valves

Dual plate Check Valves

The valves shall be suitable for mounting on horizontal pipeline. Valves shall be quick closing type with non-slam characteristics. Hydraulic passage and doors shall be designed to avoid cavitation. The pressure drop in the valve at design flow shall be limited to 0.3 mwc. Dual plate check valves are much stronger, lighter in weight and smaller in size as compared to conventional swing check valve. The Dual Plate Check Valve employs two spring-loaded plates hinged on a central hinge pin. This design offers the twin advantages of No Water Hammer and Non Slam simultaneously. All features put together make the Dual Plate Check Valve one of the most efficient design.

Features of Construction

Valves shall be of dual plate check type. The valve shall have cylindrical body which has much more uniform distribution of stress compared to a conventional swing check valve. A cylindrical body of the pressure containing part of the Dual Plate Check Valve can be designed to withstand extreme much to the weight (thickness) of valve. The Dual Plate Check valve shall be provided with two springs to avoid disparate forces acting on each plate to ensure even closing. The plates are smaller in area and lighter in weight. The unique feature of plate opening ensures no rubbing actions against seat. This results in lower rate of wear and tear of seals. Flow direction shall be clearly embossed on the valve body. Valve flange faces shall be parallel to each other and shall be right angle to valve centerline. Flange back shall be machined or spot faced

for proper seating of bolt head and nut. Flanges shall be drilled as per BS EN 1092-2

/ IS 1538. Check valve shall be conforming to API 594. Valves inspection and testing conforms to API 598.

The pressure rating of valve shall be minimum 150#

Materials of Construction

(a) Body	DI IS 1865 Gr. 500/7
(b) Plates	CS ASTM A 216 Gr. WCB with 13% Cr SS
	Overlay
(c) Body Seat	EPDM rubber
(d) Hinge Pin & Stop pin	AISI 410
(e) Spring	SS 304
(f) Nuts and bolts	SS 304
Design parameters	
(a) Rating (bar)	150#

Dismantling joints

Dismantling joint shall be designed such that adequate space can be created by collapsing the dismantling joint, for removal and for reinstallation of adjacent valves. All parts of dismantling joints shall be amply proportioned to take care of all stresses that may occur during installation and in operation. Dismantling joints shall have end, thrust and follower flanges and rubber sealing ring. Tie rods shall be provided for rigid fixing after installation to enable transmission of thrust. Tie rods shall be provided for minimum 30% of the holes.

With the use of dismantling joints it shall be possible to have an approximate clearance of 25 mm with the adjoining fittings. All dismantling joints shall be designed for a pressure of 1.0 MPa.

Features of Construction

Outside of inner sleeve and inside of outer sleeve shall be machined to close tolerances. Inner sleeve end shall be chamfered for easy introduction of rubber

ring. Sleeves shall be of uniform bore and straight in axis. The flanges shall be square to the axis of sleeve. The faces of flanges shall be parallel. The bolt holes circle and outside periphery shall be concentric with the bore and bolt holes equally spaced. Bolt holes in one flange shall be located in line with those in other. Bolt holes on flanges shall be drilled with the help of drilling jig. Flanges shall be machined flat faced and shall be full or spot faced on the back side. Flange thickness shall be uniform throughout. Flange periphery also shall be finished smooth. Flanges shall be as per relevant applicable standard corresponding to design pressure. The flanges of dismantling joints mating with valves shall have drilling standard matching with that of the valve.

Materials of Construction

Description	Material of construction
Main shell	IS 2062 E250 BR
Pressing shell	IS 2062 E250 BR
Adaptor flange	IS 2062 E250 BR
Follower flange	IS 2062 E250 BR
Long studs & Nuts	IS 1367 4.6/4.8 Gr. GI plated
Short studs & Nuts	IS 1367 4.6/4.8 Gr. GI plated
Packing ring	EPDM Rubber
Sliding / Thrust flange	IS 2062 E250 BR

Flap gates General

The construction of Cast Iron Flap gates shall be in accordance with the specifications mentioned hereunder. The Flap gates shall be capable of performing the duties set out in this specification without undue wear or deterioration. They shall be constructed so that maintenance is kept to a minimum.

Cast Iron Flap gates should be designed so that they open automatically to allow

discharge through RCC pipes even with a small differential pressure of 200 mm approx. on the upstream side of flap. When the water level on downstream side of flap is more than that on the upstream side, the flap should close automatically to prevent back flow into the RCC pipes.

Cast Iron Flap gates shall be designed for water tightness for seating water head as per the actual site requirement.

Cast Iron Flap gates shall be supplied along with all accessories such as gates assembly, gasket between wall and gate assembly, anchor bolts /anchor fasteners for mounting gate frame on face of wall, Hinge Pins, Adjustable Hinge Bolts & Hinge Brackets.

The Flap gate will be offered from an approved manufacturer who has sufficient experience in its manufacture and is ISO-9001: 2015, ISO-14001:2015 & BS OHSAS 18001:2007 certified.

All the stainless steel material used on the assembled product shall be checked for correct chemical composition using Positive Material Identification equipment. This shall be re-verified at the time of inspection in presence of TPPA/PMC

After manufacturing the gates will be shot blast cleaned to remove any surface contamination and thereafter the gates shall be epoxy painted as per painting specification.

Design & constructional details:

The constructional features and details of components of the required types of Flap gates are to be as under:

Frame :

The frame will be made from Cast Iron and shall be sufficiently rigid to withstand the designated water head as well as the effects of pulsating motion. The frame shall be flange back type to suit the designated water head in meters.

Back flange of the gate aperture frame will be precisely machined and drilled to engage with the anchor bolts /mechanical anchor fasteners mounted on the wall.

A rubber gasket will be provided between the wall and the frame for ease in future dismounting of the flap gate for repairs / replacement.

The frame shall be provided with proper sealing arrangement to enable seating of flap on the seal while closing due to head from downstream and achieve reasonably leak tight closure.

The frame will be provided with adjustable hinge bolts to enable secure the flap on to the frame via hinge pins. The hinge bolts and hinge pins shall be made of corrosion resistant material as specified elsewhere.

Flap :

The Flap will be made from Cast Iron and shall be sufficiently reinforced with matrix to withstand the designated water head in meters.

The Flap will be provided with hinge brackets to connect it with the frame. The hinge bracket will be hinged on the frame as well as on the flap to increase the sensitivity of operation.

Seating / Sealing faces :

Materials : These should be of made of SS.

Fitment : Metal to metal sealing on the periphery of gate aperture. Sealing / seat facing fitted on plain surfaces / finished rectangular grooves of frame and shutter- using counter sunk screws.

Finish : The mating sealing faces on the frame and flap shall be precisely finished for proper contact. They should be so finished that the clearance or gap, if any, between the mating sealing faces, in flap closed position, does not exceed 0.1mm.

Safety stop :

The Flap shall be provided with a safety stop to prevent the chances of its opening while handling or while installation. This shall be removed only after installation and prior to field testing.

Material of construction :

The material of construction for various components of CI flap Gates shall be as mentioned hereunder.

Components	Material of construction
Frame, Shutter/Flap	Cast Iron IS: 210 grade FG 260
Seat facing	Stainless Steel ASTM A240 Type 316*
Hinge Pins, Adjustable Hinge Bolts	EN-8 / Stainless Steel 431*
Hinge bracket	Ductile Iron with bronze bush at both ends
Gate Assembly Fasteners, Nut & Bolts	Stainless Steel ASTM A276 Type 316
Painting	Black Coal Tar Epoxy Paint
Gasket	EPDM Rubber

* Positive Material Identification (PMI) test to be carried out for these components at manufacturer works during the inspection.

Auxiliary Equipment

Reduction Gear Units

Reduction gear units, wherever provided hall be double reduction units without V-belts and pulley, gear shall be cut from solid cast or forged steel blanks or shall be stress relieved welded steel construction. Pinions shall be of forged carbon or heat treated alloy steel. Strength quality of steel, heat treatment, face, pitch of teeth and design shall be confirm to BS:436 and BS:721. split gears shall not be used. Gears and pinions shall be pressed on and keyed to shafts.

All pinions and gears are to be of the totally enclosed type up to the last stage of reduction in all motions and shall be carried in fabricated steel gear cases

which must be dust-proof and firmly sealed to prevent oil leakages and shall be oil bath lubricated. The gear boxes shall have covers split horizontally and arranged so that top half can be removed for inspection. They shall be fitted with bolted type machined inspection covers and with cast steel cartridge housing for carrying roller bearings.

Dip sticks or indicator shall be provided for indicating the oil level. Guards shall be strong enough to retain the whole gear or any part that might otherwise fall. No overhanging gears shall be used. Drain plugs shall be provided on all gear cases. Lifting lugs shall be provided for handling purposing.

Axial Fans for ventilation

Casing shall be provided with suitable supports. Access door shall be provided in the casing for easy access to motor and impeller. Suitable arrangement for mounting of motors shall be provided.

The impeller shall have blades of an airfoil design. Blades shall be mounted on streamlined hub. Impellers with fabricated blades are acceptable up to 450 mm impeller diameter. The impeller shall be statically and dynamically balanced. Adjustable pitch blades shall be provided if specified in data sheet.

Guide vanes shall be provided on the discharge side for vane axial fans. Fan inlet shall be furnished with protective bird screening.

Common base frame for belt driven fans shall be with adjustable rails for motors. Bolts, nuts and washers used shall be of non-corrosive material and of superior quality. Bearings shall have minimum life of 50,000 hours. Fan bearings shall be sealed against dirt and dust intrusions and have permanently lubricated fittings of the self-aligning ball or roller type. Bearings and bearing races shall be of material suitable for use in a marine environment.

Drive motor housing a drip-proof design, Motors shall be shall be rated at least 15 % higher than the power requirement at duty point or 10 % higher than the maximum power requirement at selected speed, whichever is higher. Starting torque requirements of fan shall also be considered while selecting the motor. Connect fans to motors directly (or indirectly with “v” belt drive). Belt drives

shall be designed for no less than 150% of the connected drive capacity. Provide belt guards. The belt drive shall include a variable pitch pulley wheel (sheave) to permit fan speed adjustment. The belt shall be set at the approximate midpoint of the variable pitch sheave's adjustment range

Noise level produced by any rotating equipment individually or collectively shall not exceed 85 dB(A) measured at a distance of 1.5 metres from the source in any direction. The overall vibration level shall be as per zones A and B of ISO 10816-1. Balance quality requirement shall be G 6.3 conforming to ISO 1940/1.

1.8 Fire Extinguishers

- ✓ Portable fire extinguishers are to be provided for all units as per the requirement of Tariff Advisory Committee (TAC) or meeting the requirement of local regulations whichever is more stringent.
- ✓ All the extinguishers shall be of TAC approved.

Inspection and Testing

- ✓ Inspection of all the equipment shall be carried out by the manufacturer at their facility in the presence of purchaser or his representatives.
- ✓ Successful bidder has to intimate purchaser / his representative in writing (Inspection call), 7 working days before the scheduled date of inspection.
- ✓ All internal test reports (as per approved QAP/ contract Document) to be submitted along with the inspection call letter.

1.9 Ductile Iron pipes

The pipes for domestic water supply will be centrifugally cast (spun) Ductile Iron pipes for Water and Sewage confirming to the IS 8329: 2000. The pipes used will be either with push on joints (Rubber Gasket Joints), Flanged joints. The class of pipe to be used shall be of the class K-9. The ductile iron pipes are usually provided with cement mortar lining at the factory by centrifugal process to

ensure a uniform thickness throughout its length.

The ductile iron pipes have excellent properties of machinability, impact resistance, high wear and tear resistance, high tensile strength and ductility and corrosion resistance. DI pipes, having same composition of CI pipe, will have same expected life as that of CI pipes. They are strong, both inner and outer surfaces are smooth, free from lumps, cracks, blisters and scars. The ductile iron pipes stand up to hydraulic pressure tests as required by service regulations. These pipes are approximately 30 % lighter than conventional cast iron pipes.

The pipes will be supplied in standard length of 5.0, 5.50 and 6.00 meters length with suitably rounded or chamfered ends. Each pipe of the push on joint variety will also be supplied with a rubber EPDM gasket. Any change in the stipulated lengths will be approved by the TPPA/PMC. The gaskets will confirm to the IS 5382:1985 and IS: 12820- 2004.

The specials and gaskets should also be supplied by the manufacturer of the pipes. They should preferably be manufactured by the manufacturer of the pipes, in case they are not, it will be the responsibility of the manufacturer of the pipes to have them manufactured from a suitable manufacturer under its own supervision and have it tested at his/sub-contractors premises as per the contract. The pipe manufacturer will however be responsible for the compatibility and quality of the products. The flanged joints will confirm to the Clause 6.2 of IS 8329-2000. The pipe supply will also include one rubber gaskets for each flange.

1.10 VALVES

To isolate and drain pipe sections for test, installation, cleaning and repairs, a number of appurtenances or auxiliaries are generally installed in the line.

Sluice Valves

Sluice valves or gate valves are the normal .type of valves used for isolating or

scouring. They seal well under high pressures and when fully open, offer little resistance to fluid flow. There are two types of spindles for raising the gate; a rising spindle which is attached to the gate and does not rotate with the hand wheel, and a non rising spindle which is rotated in a screwed attachment in the gate. The rising spindle is easy to lubricate.

The gate may be parallel sided or wedge shaped. The wedge gate seals best, but may be damaged by grit. For low pressure, resilient or gunmetal scaling faces may be used for high pressure, stainless steel seals are preferred.

Sluice valves are not intended to be used for continuous throttling, as erosion of the seats and body cavitations may occur. If small flows are required the bypass, valve is more suitable for this duty.

Despite sluice valve's simplicity and positive action, they are sometimes troublesome to operate. They need a big force to unseat them against high unbalanced pressure and large valves take many minutes to turn open. or closed, for which power operated or manual operated actuators are also used. Some of these problems can be overcome by installing a valve with a smaller bore than the pipeline diameter.
In special situations variations of sluice valves suited to the needs are used; needle valves are preferred for fine control of flow, butterfly valves for ease of operation and cone valves for regulating the time of closure and controlling water hammer.

Design Requirements:
Sluice valves shall generally conform to IS 14846:2000.Body of the valve shall be designed for 1.5 times the rating of the valve. The pressure drop across valve shall be limited to 0.05 mwc. Valve flange faces shall be parallel to each other and flange face should be at right angle to the valve centreline. Back side of valve flanges shall be machined or spot faced for proper seating of bolt head and nut.

Features of Construction:

Valves shall have non-rising spindle. Valves shall have a back seating arrangement for replacement of packing without leakage. The valve shall incorporate an intermediate valve gear box connecting valve spindle to the actuator. Flanges shall be drilled as per ANSI B16.1, 150#. Valves shall be provided with shoe and channel arrangement. The gap between shoe and channel shall not exceed 1.5 mm. Valves shall be with gear arrangement so that force required on hand wheel shall be limited to 80 N (8 kg). Direction of closing the valve shall be clockwise.

Materials of Construction

i.	Body	:	CI IS 210 Gr. FG 220
ii.	Wedge	:	CI IS 210 Gr. FG 220
iii.	Spindle	:	SS Conforming to BS 970, Gr. 304 S11
iv.	Wedge rings	:	Bronze to IS: 318 Gr. LTB2
v.	Wedge nut	:	Bronze to IS: 318 Gr. LTB2
vi.	Internal Hardware	:	SS 316
vii.	External Hardware	:	SS 304

b) **Design parameters**

i.	Size (mm)	:	As per AS PER DESIGN.
ii.	Rating (bar (g))	:	10
iii.	Quantity	:	As per AS PER DESIGN.

c) **Testing as per IS 14846:2000:**

i.	Body hydrostatic test	:	15 bar (g)
ii.	Seat leakage test	:	10 bar (g)
iii.	Back seat pressure	:	5 bar (g)

Scour Valves

In pressure conduits, small gate off-take known as blow-off or scour valves are provided at low points above line valves situated in the line on a slope such that each section of the line between valves can be emptied and drained completely. They discharge into natural drainage channel or empty into a sump from which

water can be pumped to waste.

The exact location of scour valves is frequently influenced by opportunities to dispose off the water. Where a main crosses a stream or drainage structure, there will usually be a low point in the line, but if the main goes under the stream or drain, it cannot be completely drained into the channel. In such a situation it is better to locate a scour connection at the lowest point that will drain by gravity and provide for pumping out: the part below the drain pipeline.

There should be no direct connection to sewers or polluted watercourses except through a specially designed trap Chamber or pit. For safety, two blow off valves are placed in series.
The outlet into the channel should be above the high water line. If the outlet must be below high water, a check valve must be placed to prevent back flow.
The size depends on local circumstances especially upon the time in which a given section of line is designed to be emptied and upon the resulting velocity of flow, Calculations are based upon orifice discharge under a filling head, equal to the difference in elevation of the water surface in the conduit and the blow off less the friction head. Frequency of operation depends upon the quality of the water carried, especially on silt loads.

Air Valves

Air valves (DAKT type) shall be of the kinetic, double orifice type, suitable for releasing or admitting air in large volume when pipe is being charged or emptied and to release accumulated air under pressure.

Air valves shall comprise of cast iron body having faced and drilled flange at inlet and with two chambers each housing a ball. One chamber shall have small orifice plate and other a large orifice plate. Balls shall be of injection molded plastic with high impact strength.

Air valves shall be provided with a separate cast iron double flanged gate valve for isolation. Both the air valve and gate valve shall be rated for 10 bar (g).

The size of air valves shall be 50 mm. Air valves shall conform to IS: 14845-2000.

Pressure reducing valves

The Pressure Reducing Valve shall maintain a constant downstream pressure regardless of changing inlet pressure. It shall provide full and accurate pressure regulating capabilities irrespective of whether it is operated electrically or manually.

Pressure reducing valves shall be spring actuated direct acting type and should be easy to install with threaded end connections. All valve components shall be accessible and serviceable without removing the valve from the pipeline.

When flow begins, the pressure on the underside of the diaphragm will be lower than the set-point of the spring causing the diaphragm to move the valve seat away from the valve seal allowing flow to occur. As the flow increases downstream, the pressure acting on the spring pushes the diaphragm and the valve seat away from the valve seal to regulate outlet pressure to desired value. When there is no flow, the downstream pressure increases and acts against the underside of the diaphragm, pulling the valve seat up against the valve seal to close the valve.

At all times the difference between inlet and outlet pressure shall be at least 14.5 psi and maximum 150 psi, if the difference is greater than 150 psi use two valves in series. Body and cover shall be bronze, diaphragm of NBR (Buna-N), Disc shall be of EPDM and strainer to be SS with inline mesh. Spring shall be stainless steel.

Butterfly Valves

Butterfly valves shall be as per IS: 13095 / equivalent international standard, tight shut off, with double eccentricity. The time from fully open to fully closed position and vice versa shall be limited to about 2½ minutes. The valve shall be suitable for controlling flows by throttling.

Butterfly valves shall be suitable for bi-directional pressure testing with dead-tight shut off even after long period of operation of 5 years. The valves shall be of double flanged long body type. The valves shall be manually operated to suit the process requirement. The valve shall be free from induced vibrations. Valve shall be suitable for mounting in any position.

The disc shall be designed to withstand the maximum pressure differential across the valve in either direction of flow. The disc shall be contoured to ensure the lowest possible resistance to flow.

The valve seat shall be of integrally cast or replaceable design. When the valve is fully closed, the seal shall seat firmly so as to prevent leakage. The seat surfaces shall be machined smooth to provide a long life for the seal. All fasteners shall be set flush so as to offer the least resistance possible to the flow through the valve.

The shaft shall be designed to withstand the maximum torque that will be imposed by the operator. The shaft shall be stainless steel with stainless steel backed PTFE bearings. Disc pins shall be stainless steel. Rings shall be bi-directional self-adjusting suitable for pressure or vacuum service. Removal and replacement of seals shall be possible without removing the operating mechanism, valve shaft and without removing the valve from the pipeline. Valve shafts shall be a one-piece unit extending completely through the valve disc, or of the "stub haft" type, which comprises two separate shafts inserted into the valve disc hubs.

All valve spindles and hand wheels shall be positioned to give good access for operational personnel.

All hand wheels shall be arranged to turn in a clockwise direction to close the valve, the direction of rotation for opening and closing being indicated on the hand wheels. Valve shall be suitable for throttling purpose.

Valves shall be provided with position indicator to show the position of the disc, mounted on the driven shaft end.

Valves shall be provided with suitable stops to prevent movement of the shaft beyond the limits corresponding to fully open and fully closed position of the disc.

Valve of diameter 600 mm and above shall be provided with enclosed gear arrangement for ease of operation. The operation gear shall be such that they can be opened and closed by one man against an unbalanced head of 1.15 times the specified rating. Valve and any gearing shall be such as to permit manual operation in a reasonable time and not exceed a required rim pull of 400 N. Rubber sealing ring shall preferably attach to disc edge by means of sectional retaining ring. Flanges shall be drilled as per IS: 1538 and shall be rated PN 1 (1MPa or 10 bar). The materials of construction of valves shall be as follows

Item	Material of construction
Body	Ductile iron (S.G.Iron) (IS 1865 Gr.500/7)
Disc	Ductile iron (S.G.Iron) (IS 1865 Gr.500/7)
Shaft	Stainless Steel BS 970 Grade 431 S 29
Bearing	Stainless steel backed PTFE
Thrust pad	S.G.Iron (IS 1865 Gr.500/7)
Valve seal	EPDM
Seat ring	Stainless steel (ASTM A 240 type 316).
Gland plate / End cover	Carbon steel (IS 2062 Gr.B)
Clamping ring	Stainless steel (ASTM A 240

/segments	type 316)
Gland seal & 'O' rings	EPDM
Internal & External Fasteners	Stainless steel AISI 316
Handwheel	SS AISI 304

Non-Return Valve

Design requirements

- ✓ Non-return valve shall be as per IS 5312.The valves shall be suitable for mounting on horizontal pipe line.
- ✓ Valves shall be quick closing type with non-slam characteristics. Hydraulic passage and doors shall be designed to avoid cavitations. The pressure drop in the valve at design flow shall be limited to 0.3 mwc.
- ✓ Valve body shall be designed for 1.5 times the rated pressure.
- ✓ The face-to-face dimensions of valves shall conform to IS:5312.
- ✓ All non return valves shall be rated PN 1.0 as per IS:5312

Features of construction

- ✓ Valves shall be of swing check type. Valves shall be quick closing type with non-slam characteristics. The non-slam characteristics shall be achieved by providing suitable combination of door and hydraulic passages without any external damping arrangement, or counter weights.
- ✓ Valve flange faces shall be parallel to each other and shall be right angle to valve centerline.
- ✓ Flange back shall be machined or spot faced for proper seating of bolt head and nut. Flanges shall be drilled as per BS 4504
- ✓ Valves shall be free from sharp projections, which are likely to get clogged with stringy materials. The internal parts shall be easily accessible for inspection through inspection hole.

- ✓ Valves 450 mm and above shall be provided with supporting foot.
- ✓ Swing door valves of size 600mm and above shall be of multidoor type.
- ✓ Direction of the flow shall be clearly embossed on the valve body.
- ✓ Maximum allowable leakage rate shall be 7cc/hr/mm diameter.

- The material of construction of valve shall be as follows:

Component	**Material of construction**
Body and Door	SG Iron IS 1865 Gr. 400/15
Body Ring	SS AISI 316 / Bronze IS 318 Gr. LTB 2
Door Ring	SS AISI 316 / Bronze IS 318 Gr. LTB 2
Bearings	Bronze/Teflon
Hinge pin	Stainless Steel : BS970 431 S29
Internal Hardware	SS 316
External Hardware	SS 304

Air valve

The valve shall be capable of exhausting air from pipework automatically when being filled, the air being released at a sufficiently high rate to prevent the restriction of the inflow rate. Similarly the valve shall be capable of ventilating pipework automatically when being emptied, the air inflow rate being sufficiently high to prevent the development of a vacuum in the pipelines. The valve shall also automatically release air accumulating in pipework during normal working conditions. The design shall be such that, higher the rate of flow the greater the resultant down thrust, keeping the ball 'glued' to its seat until the last drop of air is expelled from the pipe system. Each air valve shall be provided with an isolating sluice valve with flanged end connection. Air valves shall thus

be designed to automatically operate so that they will;

- ✓ Positively open under internal pressure less than atmospheric pressure to admit air in bulk during pipeline draining operation;
- ✓ Exhaust air in bulk and positively close as water, under low head, fills the body of the valve during filling operation;
- ✓ Not blow shut under high velocity air discharge; and
- ✓ Exhaust accumulated air under pressure while the pipe is flowing full of water

All air valves shall be constructed so that internal working parts which may become necessary for repairs shall be readily accessible, removable, and replaceable without use of special tools and removing the valve from the line. Air valves shall be of double orifice type and tamper proof unless otherwise directed by the TPPA/PMC. A buoyant rigid float shall seal the large orifice and the chamber housing shall be designed to avoid premature closing of the valve by the air whilst being discharged. Small orifice shall discharge small air volume during operation under full internal pressures. All valve flanges shall be designed to withstand the stresses to which they would be subjected under hydraulic test. Flanges shall be machined flat with scurtings. The flanges shall be drilled in accordance with BS EN 1092-2 to suit the flanges of respective sluice valve. Threaded connections if required shall conform to the specifications for tapered pipe threads for general use, National pipe threads (NPT) as per ANSI/ASME B 1.20.1.The aperture of valves must be properly designed for which the Contractor shall submit design calculations for necessary approvals before the procurement of valves. All branched outlets including air valve tees will be provided with one ½" BSP coupling duly plugged for measurement of pressure in due course. The closing plug shall be in Stainless Steel (AISI 316 or equivalent) with Hex. Head and shall be provided with copper washer for sealing.

Material of construction of air valve shall comply with following requirement.

Description	**Material**
ValveBody, orifice chamber	Cast Iron / Gray Cast Iron IS 210 FG 260 / Epoxy coated internally

cover& cowl	
Small orifice floats	Stainless Steel SS 316 With rolling Seal mechanism preferred.
Small orifice floats	Stainless steel S.S. 316
Large orifice	Bronze or Stainless
Small orifice plug	Bronze or Stainless
Large orifice seat ring	Neoprene with Gunmetal Impregnation
Guides for small orifice float	P.V.C.
Joint Ring	Rubber - Neoprene
Fasteners	SS 316
Flanges	As per BS EN 1092-2

Electrical Component

For Electrical works - Please refer electrical specifications provided as part of tender document.

Method Of Starting

The panel shall be built to start the pumps in suitable starting modes, i.e. D.O.L., Star/Delta, or using Soft Starters.

All other Electrical items, panel & accessories for Plumbing shall be as per electrical make list

Basis Of Plc And Scada Based Control System

This specification covers design, material, construction features, manufacture, performance and testing at VENDOR'S/SUB-VENDOR'S works and delivery to site of PLC and SCADA System for Water Treatment Piping Network. The hot redundant PLC and SCADA based control system with required I/O modules to be located at Utility Area to monitor and control the water distribution network system. The I/O modules for this main PLC are based on I/O requirement for water distribution network, I/O spare philosophy and spare loading requirement.

SCADA, networking & other necessary software, required for smooth & satisfactory functioning of Water distribution system, to be installed shall have future up gradation facility with no extra costs to Purchaser during phase wise installation & commissioning and testing of water distribution network.

I/O Quantity: I/O channel as required considering the I/O spares philosophy specified below.

I/O Channel Redundancy: All I/O rack and I/O cards shall be redundant for control applications and non-redundant for monitoring applications.

Spare philosophy for PLC I/O channel provision for field signals shall be as follows:

a) 20% spare I/O Channel in each I/O module/ card
b) 20% hot spare installed I/O module/ card
c) 20% spare I/O slots in PLC Controller cabinet

Earthings connection within the panels, cabinets and between bidder's panels, cabinets for both frame and electronic earth to independent Instruments earthing pit are included in Bidder's scope The Bidder shall furnish the requirement of different earthing requirement for Power and PLC.

Field instruments shall be provided as follows but not limited to:

General field instruments requirement as mandatory:

- ✓ Pressure indicator (PG) at Pump and water distribution network for local supervision.
- ✓ Electro-magnetic type flow transmitters (FIT) at water common discharge header
- ✓ Electro-magnetic type flow transmitters (FIT) at water common discharge header at individual plot shall be installed by Plot developer and communicate signal to ICCC using Plot wide Fibre Optic Network.
- ✓ Motorised valve actuator at Municipal Water Inlet
- ✓ Pressure switch across the water network.
- ✓ Level transmitters in Water Tanks

Distribution network automation system shall be interfaced with main PLC through preferably Ethernet based or serial communication link.

Operation Philosophy

Complete operation & monitoring of the water distribution network system will be carried out from main PLC and SCADA located at utility control room (air conditioned).

All the online metering at each distribution line has been monitored at ICCC. Meter to be installed by Plot developer and communicate signal to ICCC using Plot wide Fibre Optic Network.

Plot Developer Scope – "Domestic Water and Recycled Water distribution network system shall have motorised control valve at each distribution end of building and this valve can be control in auto mode as per respective building UGT level status provided by control system of that building."

When operated from Operator Station operator shall be able to call for various types of displays for all parameters as required on the screen and to perform normal start-up, shutdown and emergency operations of the system/ equipment.

C.TECHNICAL SPECIFICATIONS - ELECTRICAL WORKS

1 Introduction Electrical

All Electrical works shall be carried out in accordance with following codes and standards.

- PWD Specifications – As per Local PWD
- Local By – laws
- National Building Code of India – 2016.
- Energy Conservation Building Codes.
- Relevant codes of National fire Codes.
- Relevant codes of Bureau of Indian Standards.
- Institute of Electrical & Electronic TPPA/PMCs (Design Hand Book).
- Illuminating TPPA/PMCing Society of North America (Design Hand Book).
- NEC – NFPA 70, National Electric Code.
- NFPA 101, Life safety code.
- NEC, National Electric Code of India.
- CEA, Central Electricity Authority regulations 2010.

HT Panel

This specification covers the requirements of metal enclosed switchgear (VCB) rated for 3.6 kV to 12 kV. (as per bidder design)

Codes and Standards

The codes and standards mentioned in the various specifications and requirements specified in the enquiry document shall be latest as on the day of award of contract of the works unless otherwise specified. Contractor shall be responsible to inform to the TPPA/PMC in case of any revisions/re-affirm/amendment in the relevant codes and standards after the date of award of contract within 30 days of the issue of such revision/re- affirm/amendment of the code/ standard. TPPA/PMC may approve use of the earlier code/ standard if the revisions do not materially affect the statutory requirements of the project or does not impact safety practices. Any cost impact arising out of such revisions shall be mutually agreed

Main Parameters

The major parameters of the switchgear and other required features are given in data sheet. The BIDDER shall in his offer specifically conform compliance to these

data in full. Deviation if any should be specifically brought out in the schedule of Technical Deviation.

Features & Design Criteria

The switchgear shall be indoor, metal clad with separate metal enclosed compartments for (a) control, metering and relaying devices (b) circuit breaker/ disconnecting switch (c) busbars (d) voltage transformers and (e) power cable terminations & current transformers. Doors with locking facility shall be provided for all compartments except for busbar compartment. Adjacent switchgear cubicles shall be provided with inter-panel barrier sheets on both sides to ensure complete isolation. The bottom of the switchgear shall be fully covered by sheet steel.

Separate removable gland plates shall be provided for power and control cables. The gland plate for the power cables shall be of non-magnetic material for single core cables.

All sheet steel work shall be thoroughly cleaned of rust, scale, oil, grease, dirt and swarf by pickling, emulsion cleaning etc. The sheet steel shall be phosphated and then painted with two coats of zinc rich primer paint. After application of the primer, two coats of finishing synthetic enamel paint oven baked / stoved, shall be applied. Powder coating method for above painting is preferable. For coastal areas, epoxy based painting shall be provided.

The circuit breaker / disconnecting switch shall be fully drawout type and re-strike free. The circuit breaker / disconnecting switch shall have distinct service and test positions. In the test position the circuit breakers / disconnecting switch shall be capable of being tested for operation without energising the power circuits. Four normally open auxiliary contacts shall be provided for each of the service and test limit position switches.

The test position should preferably be obtained without the need to disconnect normal control connections and use of extension cords for testing. The switchgear shall fully house the breaker both in the service position as well as in the test position.

The current transformers shall be mounted on the fixed portion of the switchgear and not on the breaker truck. The current transformer shall be placed in the cable chamber in such a way that its secondary terminals can be accessible without dismantling of current transformers & cable terminations.

The voltage transformers shall be drawout type & shall be mounted in such a way that it shall permit easy access, operation and maintenance. The cable compartment shall house all power cable connections along with associated cable terminations. Wherever CBCT's are provided for earth fault protection, these shall also be located inside the cable compartment. Inspection window shall be provided to facilitate viewing cable terminations.

Each switchgear cubicle shall be fitted with a label in the front and rear of the cubicle. The rear side label shall be fixed on the non removable part of the switchgear. Each switchgear cubical shall also be fitted with a rating plate clearly indicating the switchgear details such as designation, ratings, duty, etc. Each of the components such as relay, instrument, switch, fuse and other devices shall be provided with separate labels.

The switchboard shall have passed internal arc testing (A FLR) for 1 second at the rated switchgear fault current. Pressure relief flaps shall be provided at the top of the switchboard with suitable exhaust arrangement to release hot over-pressurised gases in case of an internal fault. The internal arc time could be 0.5 sec or 0.1 sec at switchgear rated fault current in case rapid fault clearance time initiated by detectors sensitive to light, pressure or heat or by bus bar differential protection is provided.

Notes:

A stands for : Authorised

F stands for : Front

L stands for : Lateral

R stands for : Rear

Base channel frame of the switchgear with hardware shall be considered.

The switchgear shall be used to supply power to HV motors, transformers and other

loads for various plants. The switchgear shall be located in a clean but hot, humid and tropical atmosphere. For continuous operation at specified ratings, temperature rise of the various switchgear components shall be limited to the permissible values stipulated in the relevant standards and/or this specification.

The Switchgear and components thereof shall be capable of withstanding the mechanical forces and thermal stresses of the short circuit current without any damage or deterioration of material.

Circuit breaker shall not produce any harmful over-voltage during switching off induction motors, unloaded lines and unloaded transformers. If required, surge protective device shall be considered in the scope of supply to limit over-voltage. Switchgear cubicle shall be so sized as to permit closing of the front access door when the breaker is pulled out to TEST position. The operating height of the switchgear shall be restricted within 750 mm to 1950 mm from floor level.

Earthing

An earthing bus shall be provided at the bottom and extended throughout the length of the switchgear. It shall be bolted / welded to the frame work of each unit and each breaker/disconnector earthing bus. The earth bus shall be suitable to receive the purchaser's earthing conductor size specified in the data sheet.

Busbar and circuit earthing facility shall be provided either through earthing switches or separate earthing trucks. These earthing devices shall be suitably interlocked with the circuit breaker / disconnector to avoid accidental earthing of live parts.

All non-current carrying metal work of the switchgear shall be effectively bonded to the earth bus. Hinged doors shall be earthed through flexible earthing braid. Positive earthing of the circuit breaker/disconnector frame shall be maintained both in service and test position.

Instrument Transformers

The ratings of instrument transformers specified in Data Sheet are estimated ratings. For Protection CT's, the minimum CT burden shall be 10VA with accuracy class of

5P20. For metering CT's, the accuracy class shall be 1.0 & ISF ≤ 5. Further for metering CT's, the actual connected burden shall be between 25 to 100%. CT VA burden & the accuracy class shall be valid for this range. BIDDER shall ensure that the specified ratings are adequate for the relays and meters furnished by him. If specified ratings are not adequate the BIDDER shall offer instrument transformers of required rating.

The CTs shall withstand momentary and short time current ratings of the associated switchgear. CTs & VTs shall be of the cast resin type and completely encapsulated. All CTs shall be window type. The CTs shall be provided with quick disconnecting type of shorting links at CT secondary terminals. The core balance CTs shall be suitable for the respective outgoing feeders and shall be suitably supported.

VTs shall be single phase, drawout type. VTs shall be provided with fuses on primary and MCB's on secondary side, except those terminals which are required to be connected to earth. These shall have an isolating link. Fuses on primary side shall have rupturing capacity equal to the switchgear rating. Suitable shutters shall be provided to seal off the HV live terminals when VT's are withdrawn. One additional open delta winding with damper resistance shall be provided for all VTs.

Tests And Reports

Type test reports for the switchgear and circuit breakers shall be furnished along with the tender. Type tests shall be carried out free of cost to prove the design if not tested in the previous five years. The switchgear, circuit breakers and all associated equipment shall be tested in accordance with relevant standards. All routine tests shall be carried out.

Type test and routine test reports shall be submitted for the PURCHASER's approval before the equipment is despatched. Bound copies of test reports shall be furnished along with the switchgear.

All meters and other reference devices used for testing shall have valid calibration from reputed national laboratories/institutes. Inspection by PURCHASER/TPPA/PMC will not be carried out unless the VENDOR furnishes calibration certificates at the time of inspection. Equipment shall not be despatched unless the test certificates

are duly approved by the PURCHASER/TPPA/PMC.

Ring Main Unit

Specific Requirements:

The scope of this specification covers the complete design, manufacture, testing at manufacturer's works, inspection at manufacturer's works, supply, packing, forwarding and delivery from place of storage/ manufacturer's works to erection site including transit insurance, supervision of erection, testing & commissioning, performance demonstration at site of one (1) outdoor metal enclosed RMU Supply of base frames / Steel structural supports for embedment in ground required for 11kV RMU in included in Bidder's scope.

PURCHASER reserves the right to add/delete different types of switchgear cubicles, breakers accessories, if found necessary during detailed TPPA/PMCing. Unit prices quoted by Bidder shall be binding on him for addition/deletion.

One set of spares recommended for three years of trouble free operation, such as closing & tripping coil sets, gaskets, spring charging motor, bus bar support insulators etc. & critical spares. List of all recommended spares along with unit rates shall be furnished by Bidder along with commercial offer.

11kV RMU shall be Type tested for internal arc at 21 kA for 1 sec. as per IEC 62271-200 RMU shall comply to all requirement indicated in the Tamilnadu Electricity board regulations in addition to the specification.

Codes And Standards:

The equipment shall fully comply with the requirements of enclosed specifications and the latest editions of codes and standards as specified in data sheet.

Other National Standards will be acceptable only if they are established to be equal to or superior to standard listed above and in data sheet. In all such cases copies of English translation of all standards shall be enclosed with the BID.

In the event of any conflict between the codes and standards referred to in the

specification and more stringent shall govern. The RMU, Switchboard (Switchgear), Instrument Transformers and other associated accessories shall conform to the latest revisions and amendments thereof to the following standards :

- ✓ IEC 62271-1 / IEC 60694 – Common specifications for switchgear & control gear.
- ✓ IEC 62271-200 - General requirement for Metal Enclosed Switchgear & Control gear.
- ✓ IEC62271-102 – High Voltage AC disconnectors and earthing switches.
- ✓ IEC 62271-100 - Specification for High Voltage alternating current circuit breakers.
- ✓ IEC 60044-1/ IS 2705:1992 - Current Transformer
- ✓ IEC 60265 - High voltage switches.
- ✓ IEC 376 - Filling of SF6 gas in RMU.

IEC 60273/IS :2099 - Characteristics of Indoor & Outdoor post insulators
IEC 60529/IS 13947(Part-1) - Degree of protection provided by enclosures Bidder shall note the site conditions of Fintech city , Chennai, as Seismic Zone III as per IS 1893 (Part 1) – 2002. Bidder shall take due care while design of all equipment/ components used in entire electrical system covered in this specification. Bidder shall furnish list of additional design parameters considered in design to fulfil above requirements. Seismic qualification certificate shall also be furnished by Bidder.

Bus bar material for RMU shall be electrolytic grade Copper. All bus bars shall be covered with heat shrinkable flameproof black PVC sleeves. Bus bar insulation at joints shall be non flammable and shrouds used shall have anti-fire properties. One Surge Arrestor shall be provided at the BUS.

Outdoor Enclosure

The Outdoor enclosure shall be made up of CRCA of 3 mm thickness or galvanized of minimum 1.6 mm thickness, high tensile steel which must be tropicalised to local weather conditions, grit/sand blasted, thermally sprayed with Zinc alloy, phosphate or should follow the 7 tank pre-treatment process and be subsequently Painted with polyurethane based powder paint. The overall paint layer thickness shall be not less than 80 microns. Bidder shall produce QA plan and controlled document when

demanded by GCSC/ Consultant.

The metal base shall ensure rigidity for easy transportation and installation. The protection degree of the Enclosure shall be IP55.

The enclosure should have two access doors one for the operation and relay monitoring and other for the cable access. The doors shall be provided with proper interlocking arrangement for safety of operator. The doors shall be Internal arc proof.

All doors shall be provided with locking facility or it shall not be possible to open or remove them before doors used for normal operation have been opened. When they are closed, they shall provide the degree of protection specified for the enclosure.

The doors shall open outward at an angle of at least 90 Deg & be equipped with a device able to maintain them in an open position. Ventilation openings if provided, shall be so arranged or shielded that same degree of protection as specified for enclosure is obtained. All metallic components shall be earthed to a common earthing point. It shall be terminated by an adequately sized terminal intended for connection to the earth system of the installation, by way of flexible jumpers/strips & Lug arrangement. The continuity of the earth system shall be ensured taking into account the thermal & mechanical stresses caused by the current it may have to carry.

There shall be an arrangement for internal lighting activated by associated switch. Labels for warning shall be specified in min three languages including English, Hindi and Local Language. All the labels and manufacturer's operating instructions etc. shall be durable & clearly legible. They should be located within operating height of the equipment. The paints shall be carefully selected to withstand tropical heat and rain. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling.

Switchgear

11kV outdoor type RMU to be located near to utility building. The breakers, Busbars should be mounted inside a robotically welded sealed for life, 3 mm thick AISI 304 unpainted stainless steel tank. The enclosure shall meet the "Sealed Pressure System"

criterion in accordance with IEC 60694 standard. The degree of protection for gas tank should be IP67.

The gas tank shall be made of stainless steel, grade shall be as per type tested design. The tank should be filled with SF6 gas at 0.2 bar relative pressure to ensure insulation and breaking function and the gas pressure shall be indicated by a pressure gauge. The Pressure gauge shall be with temperature compensation and auxiliary contacts for Alarm and Trip. No handling/ refilling of gas shall be required throughout the service life of the equipment. BIDDER shall also confirm that the maximum leakage rate of SF6 gas is lower than 0.1% per year.

Separate gas tank along with manometer shall be provided for each feeder. The gas shall provide full insulation, making the switchgear insensitive to the environmental/ climatic conditions.

It is preferable to fit an absorption material in the tank to absorb the moisture from the SF6 gas. Each switchboard shall be identified by an appropriate sized label which clearly indicates the functional units and their electrical characteristics.

The switchgear and switchboards shall be designed so that the position of the different devices is visible to the operator on the front of the switchboard along with the operations.

Every cubicle shall be equipped with a mimic diagram reproducing the single line diagram and with clear indicators to show the position of the switches. The lever operating direction shall be clearly indicated in the mimic diagram.

Each panel shall be provided with voltage detection system mounted on the front panel. Provision to check the synchronization of phases with the use of external device shall be provided.

The switchboard shall be so designed that all live parts during operation shall be made inaccessible without the use of proper tools. All the protection relay, indicating meters etc. shall be mounted on the LV panel made of CRCA metal

enclosure mounted on the RMU switchboard panel. There shall be continuity between the metallic parts of the switchboard and cables so that there is no electric field pattern in the surrounding air, thereby ensuring the safety of the people.

The switchboard shall have provision for testing of cable without opening the front door by a suitable arrangement of cable test rod and terminal boots. Doors shall be unlocked and opened only when the earth switch is in closed position.

The cable shall be earthed by an earthing switch with short circuit making capacity, in compliance with IEC standards. The earthing switch can only be operated when the main circuit breaker is open. The earthing switch shall be fitted with its own operating mechanism and manual closing shall be driven by fast acting mechanism, independent of the operator action. The moving contacts of the earthing switch shall be visible in the closed position through transparent covers. Mechanical interlocking system shall prevent access to the operating shaft to avoid all operators' errors such as closing the earthing switch when the Main Circuit breaker is closed.

The circuit breaker shall be fully drawn out type in horizontal with test, service and isolated positions. In test position, the circuit breaker shall be capable of being tested for operation without energizing power circuits. Additional 2 (Two) normally open (NO) contacts of test and service positions shall be available for PURCHASER's use, after meeting all the interlocks / permissive.

If required, Breaker handling trolley shall be provided. This shall be complete with all necessary accessories.

Routine Test:

Bidder shall also include cost towards factory testing of switchgear as per IEC 62271-200/100 in presence of PURCHASER/ CONSULTANT.

Test at factory as follows but not limited to:

- Power frequency high voltage test as per IEC 60060 & IEC 60071.
- DC resistance test as per IEC 60228.
- HV test on control circuit (2kV for 1 minute.)

- CT/PT testing as per IEC 60044
- Operational & interlock test like
- Close / trip / auto trip operation with electric supply (with given voltage tolerances)
- Spring charging of motor (Electric as well as manual)
- Manual close / trip test
- Interlock & anti pumping operation
- Vendor shall carry all test sets/kit accessories required for site test and carry out following site tests but not limited to:
- Operational & interlock test for open/close operations, tripping, interlocks & anti-pumping.
- Insulation resistance test - Megger For 1Min with 1.0 kV(taking value for 10 sec & 60 sec)
- Power frequency withstand test
- Relay setting as per relay co- ordination and off line relay testing.
- Acceptance testing of individual relays over complete range.
- Any other tests deemed necessary by the PURCHASER
- Panel system communication test (For Data Acquisition & Monitoring System only)
- Vendor shall submit his standard format for testing and commissioning of all individual relays and equipment along with Vendor drawings to be submitted by him to enable proper testing and commissioning at site.

Type Test

The Bidder shall furnish type test certificates and descriptive & illustrative technical literature along with all catalogues for circuit breaker, HT panel, CTs / PTs, relays and other equipment's supplied by him along with the BID.

The Bidder shall submit Type Test report of same rating (not older than five (5) years) from CPRI or other independent agency for PURCHASER's/ CONSULTANT's review. Type tests shall be as follows:

- Ingress protection test.
- Heat run test.
- Lightning impulse voltage withstand test.
- Short circuit test

- Internal arc test

If type tests report shall be submitted for purchaser review.

MV Panel

This specification covers the design, material, construction features, manufacture, inspection and testing at VENDOR's/SUB-VENDOR's works, delivery to site and performance testing of metal enclosed Low Voltage switchgear for voltage not exceeding 1000 V A C.

Codes and Standards

The design, manufacture, testing and performance of equipment shall comply with all currently applicable standards, codes of practice, regulations and safety codes in the locality where the equipment will be supplied. Nothing in this specification shall be construed to relieve the VENDOR of his responsibility. In case of conflict between these standards and this specification, more stringent of the two requirements shall govern. Some of the currently applicable standards are indicated in Data Sheet.

All codes and standards referred to in the specification shall be understood to be the latest version on the date of offer made by the Bidder unless otherwise indicated. The VENDOR shall ensure that instruments and gauges to be used for testing and inspection shall have valid calibration and the accuracy can be traced to National and International Standards as applicable

Constructional Features

The major parameters of the switchgear and other required features are given in Data sheet. The bidder shall in his offer specifically confirm compliance of these data in full. Deviation if any should be specifically brought out in the schedule of Technical Deviation.

The switchgear shall be indoor, metal enclosed, floor mounted of uniform height not more than 2450 mm, made up of the requisite vertical sections, dust and vermin proof construction with IP - 52 degree of protection, unless otherwise stated in Data Sheet. The degree of protection provided by enclosures against external mechanical impacts shall be IK08 minimum. Panels shall be supplied with base channel (Minimum

ISMC 75/ 100) which will be an integral part of the panel.

Adjacent switchgear cubicles shall be provided with side sheets on either side to ensure complete isolation. The switchgear shall be easily extendable on both sides by the addition of vertical sections.

Removable gland plates shall be provided for power and control cables. The gland plates shall be 3mm thick for panel with circuit breaker cubicles (ACB/ MCCB) and 2mm thick for other cubicles. The gland plates for single core cables shall be of non-magnetic material The Painting shall be carried out with Powder coating which includes following main activities:

- Panel shall be complete with all fabrication work like drilling, punching, shearing and welding etc. before proceeding to pre painting processes
- Pre-treatment of all sheet steelwork, including degreasing, acid pickling, de-rusting, phosphating, passivation including repeated rinsing in between each process shall be carried out as per applicable standard. .
- After Pre-treatment, the panel shall be provided with protective coating including compatible primer with the shade as indicated in Data Sheet for exterior and interior with minimum thickness of 80 microns DFT.
- After coating, Curing shall be carried out as per the required process. Any post painting fabrication activity like drilling, cutting, welding may liable for rejection of complete panel

Each switchgear cubicle shall be fitted with a label in the front and back of the cubicle. Each switchgear shall also be fitted with label indicating the switchgear designation, rating and duty. Each relay, instrument, ACB, MCCB, switch, fuse and other devices shall be provided with separate labels. These shall be with Aluminium anodized / 3 ply Lamicold/ Acrylic name plates (with white letters on Black background) at front, inside & rear side. Operating devices shall be incorporated only in the front of the switchgear. No equipment needing manual operation shall be located less than 300 mm or more than 1800 mm above ground level. The switchgear shall be divided into distinct vertical sections comprising of : Individual feeder module which shall be integral multiples of basic module, containing all associated equipment, enclosed in sheet steel enclosure on all sides and the rear except cable

alley side and provided with hinged door on the front. Cable alley side of the feeder enclosure shall be as per the Form specified in Data Sheet.

A completely metal enclosed, busbar compartment running horizontally, and a vertical busbar compartment serving all modules in vertical section Wherever a vertical cable alley covering the entire height except horizontal busbar compartment is provided, the width shall be minimum 300 mm with adequate number of slotted cable support arms

A horizontal separate enclosure or enclosures separated by Hylam/FRP sheets for power and control buses with tap off connections to each vertical section.

The exposed bus / live parts in the cable alley shall be totally covered against accidental contact by a shroud (not by PVC sleeve) to protect the workmen working on the switchgear The circuit breakers shall be fully draw out type if specified In Data Sheet /SLD. These circuit breakers shall have distinct service, test, isolated and maintenance positions. In the test position the circuit breakers shall be capable of being tested for operation without energising the power circuits. Four normally open auxiliary contacts shall be provided for each of the service and test limit switch positions.

The test position should preferably be obtained without the need to disconnect normal control connections and use extension cords for testing. The current transformers shall be mounted on the fixed portion of the switchgear but not directly on buses or the breaker truck. The chassis housing feeder for motor control equipment except circuit breakers/common control transformers of big size, shall be of the fully draw-out, semi-draw-out, or fixed type as specified in the Data Sheet.

Fully Drawout Type Withdrawable Chassis

In this type of construction it shall be possible to drawout the withdrawable chassis without having to unscrew or unbolt any connections to the equipment mounted on the withdrawable chassis. The power and control drawout type connections shall be of the stab-in or sliding type. All drawout contacts, including for auxiliary and control wiring shall be of self aligning type.

Semi-Draw-out Type Withdrawable Chassis

In this type of construction, it shall be possible to draw-out the withdrawable chassis after manually unplugging at the terminal blocks the control circuit connections of the equipment mounted on the withdrawable chassis, without having to unbolt any power connections of the equipment. The power connections shall be of the stab-in or sliding type and shall be disconnected when the chassis is withdrawn.

Fixed Type Withdrawable Chassis

In this type of construction all power connections to the equipment mounted on the withdrawable chassis shall be of the bolted type. All control circuit connections to equipment mounted on the withdrawable chassis shall be carried out through conventional terminal blocks mounted in the respective chassis. It shall be possible to draw-out the chassis after unbolting/ unscrewing all the power and control circuit connections to the equipment mounted on the withdrawable chassis.

All identical equipment and corresponding parts including chassis of drawout modules of the same size shall be fully interchangeable, without having to carry out modifications

The draw-out contacts shall be made of copper/ copper alloy/aluminium faces, which shall be silver or tinplated. If ventilating louvers are provided they shall be provided with fine-screened brass or GI meshes from inside to prevent entry of vermin and dust.

Main And Auxiliary Buses

Busbars shall be of uniform cross section throughout the length of the switchgear, and up to the incoming terminals of the incoming feeder circuit breaker/ switch. Busbars shall be of Aluminium or Copper as specified in Data Sheet / SLD.

All busbars shall be provided with heat shrinkable type PVC sleeves, all bus taps, joints shall be insulated with moulded caps. If insulating sleeve is not colored, busbars shall be color coded with colored bands at suitable intervals. Busbars shall be adequately supported on insulators. These shall withstand dynamic stresses due to short circuit currents specified.

Auxiliary Buses

Auxiliary buses for control power supply, space heater power supply or any other specified service shall be provided. These buses shall be insulated, adequately supported and sized to suit specific requirements. The material of control power supply buses shall be electrolytic copper. The material for space heater power supply buses shall be same as that for the main power buses. Supply transformer(s), auxiliary busbars and necessary connections to the supply transformers and associated circuits shall be in the VENDOR'S scope, The bus-bars shall be designed considering the following criteria:

- Sleeving made of insulating material on all bus bars.
- Site ambient and final temperature of the bus-bars as specified in Data sheet.
- Bus bars being inside the panel - duration for enclosure and ventilation.
- Bus bars carrying rated current continuously.
- Configuration of bus bars and Proximity effect
- Bus bars shall withstand the short time rating of the panel for given duration
- Main Horizontal bus-bars of PCC above 4000A with Aluminium bars shall be interleaved type if required
- The Bidder shall furnish calculations establishing the adequacy of the bus bar sizes to meet the continuous and short time current ratings specified for approval before manufacturing

Bus bar supports shall only be SMC irrespective of bus bar size. The span between the two insulators shall be as per the approved type test report for short time rating. Joint positions and insulators shall be properly adjusted so that they don't interfere. Bus bar bending shall be carried out on appropriate machines designated for the same rather than doing manually All bus-bar shall be treated with anti-oxide paste wherever bi-metallic contact is required Size of the vertical busbars in each vertical section shall be such that it shall carry minimum 80% of the sum of the connected load to that vertical bus

BIDDER shall ensure that incoming feeder shall be suitably designed for terminating the required no. of runs of 1.1kV grade XLPE insulated armoured cables with 20% spare capacity. BIDDER shall consider the necessary arrangement (dummy panel, adapter panel, rear extension etc.) if required, for terminating the cables.

In case of busduct termination at the incomer, flange arrangement as per requirement of busduct Vendor shall be considered. Phase crossover arrangement shall be considered if specified in Data Sheet.

Neutral bus-bars of different panel boards shall be as indicated in the corresponding SLDs DP MCB shall be provided for all control circuits where the fault level is less than fault withstand capacity of MCB. Else the control supply shall be tapped through a control transformer of adequate capacity supplied with MCCB/ MPCB / SFU of adequate short time rating. Independent DP MCBs shall be provided for each circuit such that tripping due to fault in one circuit should not affect other functions adversely. The insulation class for control transformer shall be Class B Where control transformer has been provided, a separate control bus shall be run maintaining adequate clearance of atleast 300mm from the power bus with provision of tapping at each vertical column section. The control bus should be preferably a bus bar with Heat shrinkable sleeve.

All electrical panels (internal components & arrangement) shall have finger touch protection, for human safety viz. working on one component shall not cause shock to the personnel due to any other live component in the panel. Also, the terminal live parts shall not be accessible by fingers (finger cannot come in contact with live parts of the terminals) No openings/ holes meant for fixing hardware shall be left open. All the hardware (esp. screws, nuts, bolts, and washers) shall be in all appropriate positions & properly tightened Phase separators, shrouds, falling tool barriers shall be suitably provided. Any additional requirements as observed at any stage up to handing-over shall be provided (for safety and ease of maintenance)

Safety Interlocks And Features

Withdrawal or engagement of circuit breakers or switch (isolator) shall not be possible unless it is in the open position. Operation of circuit breaker shall not be possible unless it is fully in service positions or in test position or is fully drawn out. Circuit breaker cubicles shall be provided with safety shutters operated automatically by the movement of the circuit breaker carriage, to cover the exposed live parts when the breaker is withdrawn.

Caution name plate with inscription "Caution - Live Terminals" shall be provided at all

points where the terminals are likely to remain live and isolation is possible only at remote end, e.g. incoming terminals. A breaker of given rating shall be prevented from engaging with a stationery element of higher rating. Padlocking provisions shall permit locking the circuit breaker in either the “test” or “disconnected” position.

Each door and cover shall have adequate reinforcement of suitable ribs and stiffeners from inside. All doors shall be with concealed type hinges and captive screws. Side covers of panels shall be with removable panels. Rear doors of panels requiring rear access shall be provided with removable hinged doors. All door locks shall be provided with special keys to ensure opening by authorized personnel only

Feeder shall have hinged openable (more than 90˚) type door with panel locks. All bus-bar covers and other panel covers shall be screw fixed. Etched Aluminium Caution boards for 433V written in three languages (English, Hindi and Marathi) shall be riveted on the panel on all four sides at locations where live bus bars are present and need isolation before any access to it. In case secondary covers have been provided inside the panel, then caution boards shall be also marked on these boards in addition to the external covers. Stickers are not acceptable.

Feeder and board name plates to be provided at front and rear of switchboard Stud type terminals and ring type lugs shall be used for control cables Equipment nameplates shall be fixed by screws/ rivets and shall not be pasted.

Drawing pocket shall be provided on the inside of incomer feeder door. Self explanatory wiring diagrams with terminal and wire numbers, component numbers shall be provided on the inner face of the door of each feeder. Drawing set in the panel shall be laminated

All hardware e.g. Nuts, bolts, gasket, anchor fasteners, etc, are included in the Bidder’s scope. Atleast 10% extra hardware shall be considered for any installation/fixing work. This is to ensure ready availability of hardware in case of loss of some hardware during installation. All hardware shall be hot dip galvanised. Gaskets shall be EPDM type All PVC/ TPPA/PMCing plastic based items (including but not limited to trough, trunking, enclosures, covers, plugs, etc) shall be with FR properties.

The Vendor shall supply switchgear in various shipping sections comprising incomer, etc. Maximum single shipment section shall not be more than 2000 mm in length. Lifting hooks/ eyes shall be provided in each shipping section of the equipment and shall be removable type Breaker up to 1600A shall be installed in two tiers and above 1600 A, it shall be mounted in single tier unless otherwise specified in Data Sheet.
Panel shall be Salt spray tested for minimum duration of 500 hours if specified in Data Sheet. Component mounting plate thickness shall be minimum 2.0mm
The current transformers shall be mounted on the fixed portion of the switchgear but not directly on buses or the breaker truck.
All identical equipment and corresponding parts including chassis of drawout modules of the same size shall be fully interchangeable, without having to carry out modification

Air Circuit Breakers

Circuit breakers shall be provided with following accessories: Accessories as asked in Data sheet.
Mechanically operated targets to show 'Open', 'Closed', 'Service' and 'Test' positions of the circuit breaker. Padlock devices shall be provided in order to control opening/closing and racking in/out of the circuit breaker. Mechanically operated, red 'trip' push button, shrouded to prevent accidental operation. Circuit breaker main contacts should be separate from arcing contacts.

Locking facilities in the 'Service', 'Test', and 'Isolated', positions. In test position the breaker will be tested without energizing the power circuits. The breaker shall remain fully housed inside the compartment in the test position. Complete operation of the circuit breaker and trip unit must be accessible without opening the circuit breaker door
Minimum 6 NO and 6 NC potential free auxiliary contacts, rated 10 A at 240V AC and 1A inductive breaking at 220 V DC. Following indicating lamps for ACBs shall be considered:

- On
- Off
- Trip
- Test Position

- Service Position
- Spring Charged
- Trip Circuit healthy
- Control Supply Healthy

R, Y, B indication lamps, Lamp test push button, Emergency trip push button shall be considered at incomers.

Trip shall be independent of local/remote. Emergency trip push button shall be mushroom type with lockable key Closing and trip coil shall operate satisfactorily under the following conditions of supply voltage variation:

- Closing coils - 85% to 110% of rated voltage.
- Trip coils - 70% to 110% of rated voltage.
- When series trip circuit breakers are specified the following micro processor releases with adjustable settings shall be provided:
- Overload
- Short circuit
- Under voltage
- Earth fault

For four pole breaker the microprocessor based earth fault release shall be in built. For TPN breaker the microprocessor based earth fault release shall be in built with input from a separate neutral CT.

In addition to the adjustable current setting range specified in the Data Sheet short circuit releases shall be provided with at least four adjustable time delay settings, If it is not possible to provide the specified adjustable current setting range for the short circuit releases, shunt trip circuit breakers together with necessary protective relays shall be offered and shall be indicated in Data Sheet by the VENDOR.

Facilities shall be provided for blocking the under-voltage release, if so required at Site. Each of the foregoing releases shall be provided with a single pole, double throw, potential free alarm contact rated for 0.5A, 220V D.C / 10A, 240V AC.

The breakers controlling motors shall operate satisfactorily under following conditions:

(a) Direct-on-line starting of the specified motor.

(b) Breaking no load current of the specified motor.

Spring Operated Mechanism

The operating mechanism shall be manually operated spring charging stored energy type or with motor, opening and closing springs, limit switches for automatic charging and all necessary accessories. Facility for manual charging of the closing spring shall be provided. The operating mechanism shall be trip-free and non-pumping electrically.

Power operated mechanism shall be provided with facilities for remote panel closing and opening operations whenever specified in Data Sheet as per breaker module designation and respective enclosed control scheme drawings if attached. The control scheme will be as follows for remote control:

Breaker Position Selector Switch	**Service**		**Test**	
	Local	**Remote**	**Local**	**Remote**
Switchgear Protection Tripping	Yes	**Yes**	Yes	Yes
Remote Interlock Tripping	Yes	**Yes**	-	-
Switchgear Manual Closing	-	**-**	Yes	-
Remote and Auto Closing through Interlocks	-	**Yes**	-	Yes
Switchgear Manual Tripping	Yes	**-**	Yes	-
Remote Manual Tripping	Yes	**Yes**	-	Yes

Local P.B. Station of Motor (For breaker Operated motors)				
(i) Closing for trial run	Yes	-	-	-
(ii) Tripping	Yes	**Yes**	Yes	Yes

Power operating mechanisms shall be provided with the following additional features:

(a) Closing of the circuit breaker shall automatically initiate recharging of the spring ready for the next closing stroke.

(b) The motor shall be mechanically decoupled as soon as the emergency manual charging handle is coupled. All ACBs shall be with Icu=Ics=Icw=100%. The ACBs shall be suitable for remote communication (SCADA control) if specified in Data Sheet.

Protection Coordination

It shall be the responsibility of the Vendor to fully coordinate the overload and short circuit tripping of the circuit breakers with the upstream and downstream circuit breakers/fuses/motor starters, to provide satisfactory discrimination. Protective releases shall be EMC compliant. The release shall be protected against non-linear loads and shall not cause nuisance tripping due to harmonics. All protective components esp. ACBs and MCCBs installed in PCC and at Incomer of downstream Panels shall be with Utilisation Category "B" (i.e. offering time discrimination with downstream devices)

Fuses

Fuses generally shall be of the HRC cartridge fuse-link type having a certified rupturing capacity of not less than 80 kA at 440V. Fuses shall be provided with visible indication to show that they have operated. Fuse ratings chosen by the VENDOR for application in various circuits shall be subject to the PURCHASER'S approval. Fuses shall preferably be mounted in moulded plastic carriers and shall be complete with

fuse bases.

Wherever it is not possible to mount fuses on carriers, fuses shall be directly mounted on plug-in type of bases. In such cases an insulated fuse pulling handle shall be provided for each size of fuse for each switchboard. Current time characteristics of fuses shall be furnished along with bid.

Earthing

An earthing bus shall be provided at the bottom and extended throughout the length of the switchgear. It shall be bolted / welded to the frame work of each unit and each breaker earthing bar. Earth bus-bar shall be extended outside the Panels/DBs at both the ends. The size shall be selected based on the rated symmetrical short circuit rating of the associated switchboard/ panel. The same shall be properly supported to withstand stresses induced by the rated symmetrical short circuit current.

All non-current carrying metal work of the switchgear shall be effectively bonded to the earth bus. Hinged doors and detachable components inside the feeder shall be earthed through individually flexible earthing braid. The earth wire shall be green colour (with yellow band), FRLS PVC insulated, multi stranded copper conductor wire of size 4 sq.mm duly crimped with ring type lugs and to be looped & connected to horizontal earth bus Positive earthing of the circuit breaker/ disconnector frame shall be maintained both in service and test position.

Instrument Transformers

The ratings of instrument transformers specified in SLD or A3 are approximate. The BIDDER shall ensure that the specified ratings are adequate for the relays and meters furnished by him. If specified ratings are not adequate the BIDDER shall offer instrument transformers of required rating.

The CTs and VTs shall be cast resin type or nylon encapsulated as specified in Data Sheet with insulation Class B or better and withstand momentary and short time current ratings of the associated switchgear. For feeders with fuse, CTs shall have withstand capacity equal to let-through current of associated fuse.

Unless otherwise specified in SLD or Data Sheet minimum performance requirements of CT's & VTs shall be as follows :

Current Transformers:

(a) Measuring CTs - 10VA, accuracy Class 0.5 and ISF of 5 Protective CTs - 5 VA , accuracy class of 5P-10

(b) CTs shall be provided with test links in both secondary leads for carrying out current and phase angle measurement.

Voltage Transformer

(a) Measuring VT's - 50 VA per phase with accuracy class of 0.5

(b) Protective VT - 50 VA per phase with accuracy class of 3.0.

(c) Dual purpose VT - 100 VA per phase and dual accuracy of 1.0/3.0 for metering and protection respectively

(d) Voltage transformer shall have continuous over voltage factor of 1.2 and short time over voltage factor of 1.5 for 30 seconds for effectively earthed system and 1.9 for 8 hours for non-effectively earthed system.

(e) Voltage transformers shall be complete with suitable rated protective devices like Fuse / MPCB/ MCB for primary, secondary and tertiary winding. Primary protective device shall have a rupturing capacity equal to the rupturing capacity rating of the associated switchgear. Protective device shall be provided on each sub circuit.

(f) It shall be possible to replace voltage transformers without having to de-energies the main bus bars.

(g) The terminals of VT secondary and tertiary windings which are required to be connected to earth shall be earthed by an isolating link without a fuse.

(h) Current transformers shall have polarity markings indelibly marked on each transformer and at the lead terminations at the associated terminal block

(i) Current transformers shall be able to withstand the thermal and mechanical stresses resulting from the maximum short circuit and momentary duties of the switchgear, as indicated in the Technical Specification. CT core laminations shall be of high grade silicon steel. Identification labels shall be fitted giving type, ratio, rating, output and serial numbers

Tests And Reports

Type test reports for the switchgear panel of similar rating for the following tests

shall be submitted along with the Bid (not older than 5 years):

(a) Temperature rise
(b) Degree of protection
(c) Internal arc
(d) Short circuit
(e) Salt spray test for a minimum duration of 500 hrs (if asked for in Data Sheet)

The switchgear, circuit breakers and all associated equipment shall be tested in accordance with relevant standards. All routine tests shall be carried out. Type tests shall also be carried out if not tested previously.

Type and routine test report shall be submitted for the PURCHASER's approval before the equipment is dispatched. Bound copies of test reports shall be furnished along with the switchgear.

All meters and other reference devices used for testing shall have valid calibration from reputed national / international laboratories / institutes as applicable. Inspection by Purchaser/ TPPA/PMC will not be carried out unless the Vendor confirms that calibrated equipment are ready for proceeding with the tests. Equipment shall not be dispatched unless the test certificates are duly approved by the PURCHASER/ TPPA/PMC.

Vendor shall carry out all routine tests as specified in relevant IS/ IEC standards on all major components and furnish copies of test reports for PURCHASER's approval. Wherever required, Vendor shall conduct the necessary type tests in the presence of PURCHASER's representative based on the unit prices available in the bid.

Vendor shall also carry out all routine and functional tests as specified in the relevant IS/IEC on the assembled switchgear panels in the presence of the PURCHASER's representative at works before despatch and furnish copies of test reports for approval. If required stage inspection, will be carried out by the Purchaser. VENDOR shall furnish copies of routine test report for all bought out items for PURCHASER's approval.

APFCR Panels

This specification covers the design, material, principle of operation, manufacture, inspection and testing at the Vendor's works, delivery to site and performance testing of capacitor controller for automatic switching of capacitor banks sequentially as required to give a desired power factor.

The relay shall be numerical type giving signal to contactors/ TSC (thyristor switched capacitors) for switching on/off preset number of capacitor units. The relay shall have sufficient output contacts to switch on required number of capacitor as required.

Codes & Standards

The codes and standards mentioned in the various specifications and requirements specified in the enquiry document shall be latest as on the day of execution of the works unless otherwise specified. The revisions in the relevant codes and standards after the date of award of contract shall be informed by the Contractor to the TPPA/PMC within 30 days of the issue of such revision of the code/ standard. TPPA/PMC may approve use of the earlier code/ standard if the revisions do not materially affect the statutory requirements of the project or does not impact safety practices. Any cost impact arising out of such revisions shall be mutually agreed.

Basic Requirements

It would be digital electronic device for the automatic/manual control of power factor correction capacitors on three phase system. It shall detect the power factor lagging and leading reactive power (kVAr) component above preset levels, and then switch the appropriate number of capacitors 'IN' or 'OUT' to achieve the optimum average power factor without system operating under leading power factor condition.

The digital relay would have low VA burden and final switching of appropriate capacitor banks would be achieved by switching on/off of Contactors/TSC, through initiation of this device.

Principle Of Operation

On deviations from set power factor, the controller shall release command signals to

switch on/switch off capacitor bank stages and maintain the set power factor.The dead band shall be provided in the inductive and capacitive region of the set power to avoid frequent switching operations. The dead band limit shall be adjustable depending upon the switching steps.

The device shall have various programming steps to set different switching combinations to take care of varying load conditions.

Standard Features

(a) To measure/monitor power factor and VAr continuously. Status of switching step shall be displayed through LED.

(b) Following adjustment shall be provided.

- Power factor
- Dead band capacitive region with respect to set power factor (pf).
- Inductive region with respect to set pf
- Operating time for programmable switching steps.
- Auto/manual selector switch.
- Manual step control.

(c) All control knobs, LEDs for display and selector switches shall be mounted on the front face of relay casing/panel.

(d) It shall be fully programmable.

(e) There shall be a choice for customer to select operating sequence upto 4 to 5 which will have maximum number of steps of capacitors equal to sixteen (16 Nos). The sequence shall be arithmetic 1,2,3…..6,7,8.

(f) Operating time selection of time interval designation between switching stages shall be possible using time selector switches. The device shall take care that any stage which has just been switched out, will only be reconnected by the pulse counter, after 60 secs. has elapsed so that it has safely discharged. This is a requirement for 415V capacitors; for 11kV or 6.6 kV capacitors the time interval for any stage to be switched again shall be 10 minutes (corresponding to the safe discharge time for 11kV or 6.6 kV capacitors).

(g) Loss of voltage element. This would prevent abnormal switching surges on loss of supply. Also it would control the switching on/off surges.

(h) Dead band features – Relay response sensitivity adjustable using dead band so

that hunting is prevented.

Auto/Manual control – This would help testing and commissioning at site as well as ease in operation when either mode fails during service time

Data to te Furnished by the Vendor after the Award of Contract

DOCUMENTS	PURPOSE
Instruction manuals	For Information
Test Reports	- do -
Schematic diagram for PF control	- do -
Essential spares	- do -
General Arrangement drawing of controller panel showing main dimensions, type of mounting, weight etc.	For Further TPPA/PMC

BRIEF NAME	REFERENCE STANDARDS		
APPLICABLE STANDARDS			
Electrical relays for power system protection	▫ IS-3231	▫ BS	▫ IEC-60255
Environmental test s for electronic & elec. equipment	▫ IS-9000	▫ BS	▫ IEC 60068-2
Shunt capacitors for power systems	▫ IS 13585 & 13925	▫ BS	▫ IEC-60871 & 60931

Transformer

This specification covers the requirements and tests including standard loss levels of oil immersed, natural air-cooled, outdoor type, double wound distribution

transformers up to and including **800 kVA/11kV** and accessory equipment.

Codes and Standards

The design, manufacture and performance of equipment shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The codes and standards mentioned in this specification shall be latest as on the day of execution of the works unless otherwise specified. The revisions in the relevant codes and standards if any after the date of award of contract shall be informed by the Vendor/Contractor to the TPPA/PMC within 30 days of the issue of such revision of the code/ standard. TPPA/PMC may approve use of the earlier code/ standard if the revisions do not materially affect the statutory requirements of the project or does not impact safety practices. Any cost impact arising out of such revisions shall be mutually agreed. Nothing in this specification shall be construed to relieve the VENDOR of this responsibility.
In case of conflict between the applicable standards and this specification, the more stringent of the two shall govern.

General Constructional Features

All material used shall be of best quality and of the class, most suitable for working-under the conditions specified and shall withstand the variations of temperature and atmospheric conditions, overloads, over-excitation, short-circuits as per specified standards, without distortion or deterioration or the setting up of undue stresses in any part, and also without affecting the strength and suitability of the various parts for the work which they have to perform.

The transformer construction shall be suitable for seismic data as specified in section B or elsewhere in the specifications.

Tests

Routine Tests

- ✓ Measurement of winding resistance
- ✓ Measurement of voltage ratio and check of phase displacement
- ✓ Measurement of short circuit impedance (principal tapping, when applicable) and load loss at 50 percent & 100 percent load

- ✓ Measurement of no load loss and current
- ✓ Measurement of insulation resistance
- ✓ Induced over voltage withstand test
- ✓ Separate source voltage withstand test

Bus Duct

This specification covers the design, material, construction features, manufacture, supply, inspection and testing at the VENDOR's/his SUB-VENDOR's Works, delivery to site and performance testing of Bus Bar Trunking (BBT) and accessories at site.

Codes & Standards

The design, material, construction, manufacture, inspection, testing and performance of bus duct shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall be construed to relieve the VENDOR of this responsibility.

The codes and standards mentioned in the various specifications and requirements specified in the enquiry document shall be latest as on the day of award of contract of the works unless otherwise specified. Contractor shall be responsible to inform to the TPPA/PMC in case of any revisions/re-affirm/amendment in the relevant codes and standards after the date of award of contract within 30 days of the issue of such revision/re- affirm/amendment of the code/ standard. TPPA/PMC may approve use of the earlier code/ standard if the revisions do not materially affect the statutory requirements of the project or does not impact safety practices. Any cost impact arising out of such revisions shall be mutually agreed.

General

The busbar trunking (BBT) system shall be of low impedance and sandwiched construction, i.e. no air gap shall exist between bus-bars except at plug-in opening. It shall be possible to mount the BBT in any orientation, without affecting the current rating. The length of each section will be limited to max. 3 meters.

It shall be totally enclosed pre-painted galvanized steel and be of the non-louvered type maintaining an overall degrees of ingress protection as specified in Data Sheet.

Busbars

Busbars shall be of electrolytic grade copper / Aluminium as specified in Data sheet with purity not less than 99.9% and 99.9% conductivity for copper and >60% for Aluminium. The bus bar joints shall be silver plated copper/silver plated or tin-plated Aluminium. The busbars shall have rounded or radial edges.

Neutral shall be 100% of cross-sectional area of the phase conductor.A continuous external earth busbar of material as specified in Data Sheet shall be provided. Flexible connections shall be provided with Cu braided / multi leafed conductors for termination at both the ends

The busbars shall be individually insulated with by minimum 2 layers of insulating film. Bus bar conductors shall be insulated with insulation Class F material or as specified in Data Sheet. All the insulation materials shall be halogen free, non-hygroscopic, high thermal conductivity and fire retardant.

Housing

The busbar trunking housing shall be totally enclosed, non-ventilated, natural cooled. The enclosure shall be of hot dip galvanized and pre-painted sheet steel or Aluminium. The housing shall be made of minimum 1.6 mm galvanized sheet steel / 1.6mm CRCA / 2.5mm Aluminium with an epoxy powder coated paint finish. It shall pass at least 1000 hours salt spray test to ensure the anticorrosion ability.

The housings shall be profiled, to provide higher strength, tested for IK-10 and efficient heat dissipation.

The width of the housings shall be preferably the same for all ratings of busbars, in order to provide interchangeability of tap off boxes.

Inspection cover shall be provided over joints to inspect the tightness of the connection. Space heaters shall be provided in the BBT wherever the manufacturer considers required based on site conditions to prevent moisture condensation.

Joints

The electrical joints shall be of one to four bolt type designed for even distribution of contact pressure. Bolts shall be accessible without removing covers. The joints between sections shall be made so as to provide flexibility during installation and

expansion / contraction of busbar during operation. The joints shall be of the Uniblock Joint. The joint construction must have the following features.

a) Shear off nut: To ensure tightness of joint at desired torque.
b) Tamper proof cap over shear off nut to prevent opening of nut after achieving desired torque.
c) Heat expansion of atleast 3 mm per joint.
d) The joint insulation must be of one-piece mould design and not have any cut edges which can absorb moisture.
e) Joint assembly shall be removable as separate sub-assembly so that it can be inserted or removed without disturbing the adjacent sections.
f) The busbars ends shall not have any holes or slots at the joints – the electrical continuity shall be through pressure plates, achieving a high area of joint cross section and expansion capability.

Expansion Joint

Busbar expansion units shall be used in cases to reduce the stress on the system by differential expansion between the busbars and the casing; particularly for long run of the busbar. It shall consist of a flexible joint in the middle on the conductors and a sliding casing in 2 sections which can absorb the relative movements of each section of the length.

Tap-Off Units

Tap-off units of suitable rating shall be provided for bus trunking. Necessary provision for tapping on bus trunk at maximum 1 meter interval on one side & 0.5 meter interval on both the side shall be made on bus trunking. Tap-off units shall be of dust and damp-proof version, degree of protection IP54 and sprinkler proof. Tap-off unit enclosure shall be same as the BBT enclosure.

Tap-off units shall be suitable for any brand of MCCB, shall be interchangeable, to suit site requirements.

The tap off units shall have all safety features like mechanical interlocking so as to prevent installation or removal of the unit when the MCCB is in ON condition. Also, it shall not be possible to open the cover of the tap off box when the MCCB is ON.
Tap-off units shall be suitable for terminating armoured cables.

The plug-in tap-off units shall be connected to the busbar trunking whilst live via silver plated copper spring jaw connections.

The earth contact of the tap-off unit shall always be made before that of the live conductors and the last to break during removal. The tap off box shall be equipped with door isolating facility to carry out any maintenance of the circuit breaker without removing the tap off box from the main busbar system

Tap-off outlets shutter shall be able to open and close automatically when plug-in units are plugged in or removed.
The live parts or terminals inside the tap-off box unit shall be guarded with transparent visible sheet / insulated barrier to prevent accidental physical touch.
Bidder shall submit full discrimination charts for the selection of MCCB for the deployed BBT rating. The MCCB shall be current limiting type and the protection functions shall be as per SLD.

End Feed Unit / Centre Feed Unit:
End/Centre feed unit (EFU/CFU) with off load isolator / MCCB with RYB & ON / OFF/TRIP indications shall be provided as per indicated in SLD or as specified in Data Sheet.
Door interlock shall be same as per described for tap-off box.

EFU/CFU shall be suitable for termination of cables as per indicated in SLD. Colour shade of tap-offs & EFU/CFUs shall be same as that of main bus trucking. **ACCESSORIES**
The bus trucking system shall be complete with all the accessories such as straight run lengths, bends/elbows / flat elbow/ edge elbow/ T sections, vertical anchors, expansion joints, flexible connections, flange ends, reducer, end covers etc. All the accessories as required to suit site conditions are deemed to be included in straight length of the bus trunk.

Flanged end boxes shall be provided to accommodate flange end for connecting the bus trunking with flanges of panels, transformers & DG sets etc. At every terminal point at flanges the connection shall be done using flexible connections.

Any other item/ accessory not specifically mentioned above but deemed necessary by the bidder for successful implementation.

Tests

All routine tests as specified in IS/IEC shall be conducted at the works and all site tests shall be conducted as per IS/IEC at site after the complete bus bar is assembled. Certified copies of reports/certificates with final conclusions of type tests carried out as per relevant standards on similar type and rating of the equipment within last five years shall be furnished for review along with the Bid. Type test reports older than 5 years may be acceptable only if there were no change in relevant standard & manufacturer's product design and subject to purchaser's approval. In case the type test reports are not found to be meeting the specification requirements or older than five years with change in design, then the VENDOR shall conduct all such tests free of cost and submit the reports for approval without any cost and time implication to the PURCHASER.

Type test assembly shall comprise of all the major components such as Insulations, joints, Tap-off units, etc., and shall depict the actual site installation. The components used in the type test assembly shall not be used in the bus bar sections being supplied for the project. The busbars shall be type tested at a reputed national / International test laboratory (ASTA / KEMA /CPRI/ERDA/LOVAG) for short circuit withstand. The test shall be for a minimum duration of one second.

Degree of ingress protection (IP rating) shall also be tested at any reputed independent laboratory. This test shall be for IP54 / IP 55 for indoor and IP 65 / IP 67 FOR OUTDOOR application.

Type Tests

The Bidder shall furnish type test certificate for the following tests conducted on similar equipment:

a) Temperature Rise Limits
b) Dielectric Properties
c) Short Circuit Strength

d) Degree of Protection

Routine Tests

Following routine tests shall be conducted on the Bus trunking:

a) Physical verification check
b) Megger Test
c) Power frequency withstand test
d) Any other tests as stipulated by the relevant standards

Cable

This specification covers the requirements of Power Cables up to 33kV, Control, Instrumentation (up to 400 degree centigrade), Communication and Lighting Cables with general purpose insulation and sheaths. Requirement of special outer sheaths with Heat Resistant (HR), Fire Survival (FS) and Flame Retardant Low Smoke (FRLS) characteristics are also covered in this specification.

Codes and Standards

The codes and standards mentioned in the various specifications and requirements specified in the enquiry document shall be latest as on the day of award of contract of the works unless otherwise specified. Contractor shall be responsible to inform to the TPPA/PMC in case of any revisions/re-affirm/amendment in the relevant codes and standards after the date of award of contract within 30 days of the issue of such revision/re- affirm/amendment of the code/ standard. TPPA/PMC may approve use of the earlier code/ standard if the revisions do not materially affect the statutory requirements of the project or does not impact safety practices. Any cost impact arising out of such revisions shall be mutually agreed.

General Constructional Features

The following aspects are applicable for all types of cables covered in this specification.

Conductor

(a) Aluminium conductor, circular, compacted stranded, grade H4, Class 2 as

per IS mentioned in data sheet for power cables. 'Ó' grade aluminium shall be used for solid conductor of the welding cable conductor.

(b) Annealed, stranded Copper Conductor, Class 2 as per relevant IS for control cables. For flexible cable, class shall be 5 or 6 and for CU welding cable, class shall be 6.

Conductor Screen

All cables rated above 3.3/3.3 kV shall be provided with conductor screening. Conductor screening shall be provided over the conductor by applying non-metallic semi-conducting tape or by extrusion of semiconducting compound or a combination of the two.

Insulation

Insulation for cables shall be XLPE for HV power cable (above 1100V grade) and PVC/ XLPE for LV power (1100V grade), control / lighting / instrumentation and communication cable applied by extrusion.

Core Identification

Colour coding shall be acceptable for all cables up to 5 cores. Cables with more than 5 cores shall have printed numerals every 50mm on each core.

Inner Sheath

Inner sheath when specified shall be extruded type PVC and shall be compatible with the insulation provided for the cables as per IS mentioned in data sheet.

Armour

Armouring for the cables shall comprise galvanised steel or hard drawn aluminium, in the form of round wires or strips following IS mentioned in data sheet.

W	-	Galvanised round steel wire
F	-	Galvanised flat steel strip
AW	-	Hard drawn single aluminium wire
AS	-	Hard drawn single aluminium strip

Insulation Screening

- All cables rated above 3.3/3.3 kV shall be provided with insulation screening. The screening shall consist of one or more of the following, as Specified
- Non-metallic part – it shall be applied over the insulation of each core and shall consist of either semiconducting tape or extruded semi conducting compound or a combination of the two.
- Metallic part – it shall consist of either tape, or braid, or concentric serving of wires or a sheath. It shall be non-magnetic and shall be applied over the non-metallic part.

NOTE-The semi-conducting tape and semi-conducting compound shall be suitable for the operating temperature of the cable and compatible with the insulating material.

Outer Sheath

The outer sheath shall be of an extruded layer of PVC (poly vinyl chloride) compound with the specified ambient and operating temperature of the cables. The sheath shall be heat resistant, resistant to water, ultra violet radiation, fungus, termite and rodent attacks. The colour of the outer sheath shall be black. PVC sheath shall meet the requirements of standards covered under 3.1.5 above. Requirement of special sheath with Fire Survival (FS) and Flame Retardant Low Smoke (FRLS) characteristics shall be as per clause 5.0. Requirement of Fire Protective Paint on outer sheath of the cable shall be as per Data Sheet.

Cable Drums

Cables shall be supplied in non-returnable wooden or steel drums as applicable. The wood used for construction of the drum shall be properly seasoned and free from defects and wood preservative shall be applied to the entire drum. All ferrous parts shall be treated with a suitable rust preventive coating to avoid rusting during transit or storage. Cable drums shall conform to standard mentioned in datasheet.

The BIDDER shall indicate in the offer, the maximum length for each size of cable, which can be supplied on one drum. The actual length supplied on each drum shall be within tolerance limit of +5 % with an overall ceiling of +5% on total ordered quantity of each size of cable. Negative tolerance is not acceptable. However, before winding

the cables on drums, VENDOR shall obtain PURCHASER's approval for the drum lengths so as to minimise the number of joints to the extent possible. Cable ends shall be sealed by non-hygroscopic sealing caps. Cable drums shall carry following details in printed form:

IS code

- Manufacturer's name and trade mark
- Type of cable and voltage grade
- Year of manufacture
- Type of insulation
- No. of cores and size of cables
- Cable code
- Length of cable on drum
- Inner Diameter and Outer Diameter of Drum

Tests and Test Equipment

Cables shall be subjected to routine and acceptance tests in accordance with standards specified. Test methods shall conform to relevant IS. Bidder shall furnish all test certificates for Purchaser's approval. BIDDER shall ensure use of calibrated test equipment having valid calibration test certificates from standard laboratory traceable to National/ International Standards.

Construction details including type of material used and thickness of each material for each type of cable in a tabular form and cross section drawings.

Technical catalogues and manuals Installation and termination instructions.

Test Certificates

Type/Routine test certificates for all types of cables included in the order and special tests on FRLS/FS/ FRLSZH cables in line with applicable standard. Technical particulars of all cables QAP for all cables

ITEM	**APPLICABLE STANDARDS**
Type of conductor	IS 8130 IEC 60228

Conductor Screening	IS 7098 IEC 60502
Insulation	IS 5831 IS 7098 IEC 60502
Armoring	IS 3975
Test and test equipment	IS 10810
Oxygen Index test	ASTM-D-2863
Temperature index value	ASTM-D-2863 / NES 715

ITEM	**APPLICABLE STANDARDS**
Cable drums	IS 10418
Flammability	IS 10810 IEC 60331 IEC 60332 IEEE 383 SS 424-1475
Test for smoke generation	ASTM-D-2843
Test for acid gas generation	IEC 60754-1
Tests for Resistance to Ultra Violet Radiation	DIN 53387
Telecommunication cable, Low frequency cables and wires with PVC insulation and sheath - General Tests and measuring methods	IS 5831 IEC 60189-1 IEC 60189-2
Instrumentation cable	IEC 60189-1 IEC 60189-2
Construction, performance and testing of XLPE Insulated HV Power Cables	IS 7098 IEC 60502

Construction, performance and testing of 1100 V Grade PVC Insulated Power and Control Cables	IS 1554 IEC 60502
Construction, performance and testing of 1100 V Grade light duty unarmoured cables	IS 694
Instrument cable for operating temperature up to 400 deg centigrade	JSS 51034
NOTES : Equipment, Accessories, Components /Parts Raw materials and tests shall in general conform to:ISBS IEC CBIP	

Cable Tray

Cable Trays shall be hot dip Galvanized and factory fabricated out of G.I. channels, angle iron, tee, bends, sections, flats and perforated sheet for different loads and number and size of cables as per design.

Cable Trays - Installation Notes

Cable trays shall be installed generally at the elevations shown in respective cable tray layout drawings. If any major modifications in the drawings are envisaged in the field, these should be carried out after getting approval from design office.

Before laying the trays, contractor shall submit the shop drawing & take the approval from TPPA/PMC. It shall be the responsibility of the electrical contractor to mark up all the field modifications on the latest issues of the drawings and return two copies of all such " as constructed " drawings to TPPA/PMC's design office. The type and size of tray to be used shall be as mentioned in the individual layout drawings. Cable trays shall be welded to the mounting/carrier structures. Trays shall be supported with suitable angle/hitech rod supports.

Each continuous laid out length of cable tray shall be earthed at minimum two

places by GI flats of minimum size 25x6 mm (unless otherwise noted) to the TPPA's earthing system. The distance between earthing points shall not exceed 10 meters.

The following shall be checked before laying the cables on trays.

- Check for proper identification nos. of the trays.
- Check for continuity of cable trays over the entire route.
- Check that all sharp corners, burrs, and waste materials have been removed from the tray.
- Obtain clearances from piping contractor / TPPA/PMC that no piping will be taken in the way of cable trays.
- Check for earth continuity & earth connection of cable trays.
- Cable tray installation work shall comply with all currently applicable statutes, regulations, and safety codes in the locality/country where the installation is to be carried out.

Earthing

Each luminaire and control gear box shall be provided with an earthing terminal suitable for connection to the PURCHASER's earthing conductor of 12 SWG GI wire unless otherwise specified in Data Sheet. All metal or metal enclosed parts of the luminaire / control gear box shall be bonded and connected to the earthing terminal so as to ensure satisfactory earthing continuity.

Painting / Finish

All surfaces of the luminaire / control gear box housing accessories shall be thoroughly cleaned and degreased. It shall be free from scale, rust, sharp edges and burrs.

The luminaire housing shall be stove-enamelled / epoxy stove-enamelled/vitreous enamelled or anodised as indicated under various types of fittings. Aluminium paint on flame proof fittings is prohibited.

The finish of the luminaire shall be such that no bright spots are produced either by

direct light source or by reflection.

General Requirement For Led Light Fixtures

All LED luminaire shall be provided with toughened glass and shall have thickness of sufficient strength and high efficiency prismatic diffuser under the LED chamber to protect the LED and luminaire.

Suitable reflector / lenses may also be provided to increase the illumination uniformity and distribution for LED.

The fixture shall be designed so as to have lumen maintenance of at least 70% at the end of minimum 50000 hours (L70) at design temperature of 35 degree C.
Adequate heat sink with proper thermal management shall be provided such that LED soldering point temperature shall not go beyond 75 degree centigrade.

Minimum view angle of the LED shall not be less than 120 degree.

Power factor of complete fitting shall be more than 0.95 at full load 240V and THD<8%.

The LED luminaire shall be free of glare. Colour rendering index (CRI) shall be ≥ 75. System luminous efficacy for indoor area shall be ≥80.

The luminaire shall be provided with inbuilt surge protection of not less than 4 kV to prevent damage to the driver in case of sudden voltage surge.

Lumen maintenance report as per LM 80 guidelines shall be produced for the LEDs used. The test report shall contain description of the source tested/Ambient Condition (Airflow, Temperature etc.)/Electrical Condition/Lumen Maintenance Data/Observation of failure (Lumen depreciation monitored every 1000 hours)/LED Monitoring Interval/Chromaticity shift over time. The LED chips shall have system luminous efficacy of 100 lm/W or more and LED fixture shall have system efficacy of 70 lm/W or more.

Bidder shall submit LM 79 (Electrical & Solid State measurement of solid state lighting products/fixtures). The test report shall contain Total lumen output of the fixture/luminaire intensity distribution/electrical power/luminous efficacy/colour characteristic of the fixture i.e. CCT & CRI.

Each luminaire shall be provided with an earthing terminal suitable for connection to the PURCHASER's earthing conductor of 12 SWG GI wire unless otherwise specified.

Conduit, Wires, Switches & Accessories

Conduit & Its Accessories

For CONDUIT & ITS ACCESSORIES please refer to the respective CPWD and KBS specifications.

Wires & Cables

For WIRES & CABLES please refer to the respective CPWD and KBS specifications.

Switches, Sockets & Accessories

This specification covers the design, material, manufacture, testing, inspection and delivery to site the Indoor and Outdoor lighting system equipment. The indoor equipment include lighting distribution boards, panels (Single phase/Three phase), switches, power receptacle units, lighting wires, junction box, conduits and its accessories, ceiling fans etc,. The outdoor equipment includes outdoor lighting distribution boards/panels, lighting poles (Street light/Flood light/High mast), LT power cables, etc. Separate specification when enclosed, cover the requirements of lighting system installation works.

Diesel Generator

The scope of this section consists of but not necessarily limited to the following in accordance to Technical specification prescribed in tender:

- The contractor shall supply, deliver to site, hoisting into position, install, test and commission the Prime rated power generating set together with the necessary controls and switchboards as specified and indicated in the Drawings.

Protection circuits, control wiring and interlock circuits not specified or indicated in the Drawings, but deemed necessary for the safe operation of the generating system shall be provided without any additional cost to complete the system.

- Provide manufacturer's factory representative's services, including coordination, and start-up and testing supervision.
- Testing (factory and field), start-up supervision, training and providing necessary documentation and tools for operation.
- Carry out performance test run at site with Load bank & Lube oil etc. arranged by contractor.

Engine

Engine shall be multiple cylinder vertical, 4 stroke cycle, Prime rated, multi-cylinder direct injection, compression ignition type operating at a speed of 1500 rpm and shall be silent, vibration free while in operation and comply Center / State Pollution Control Board , turbo charged after cooled as BS 5514/ISO 3046, 1500 RPM. Engine shall deliver not less than 400kW at site at 0.8 lagging power factor and shall be suitable for sustaining of 10% overload for 1 hour in every 12 hours of continuous operation at full load without damage. Engine shall be with the following accessories:

- Flywheel to suit flexible coupling.
- Dry type air cleaner. Replaceable air cleaner elements with mechanical air restriction gauge mounted on air cleaner. The filter shall be suitable for operation under dusty conditions.
- Exhaust Residential Type silencer with flexible connections and thermal lagging.
- Electronic Instrument panel comprising of Power Command Control Module or equivalent (for AMF System)
- Sensors
- Fuel control actuators
- Fuel shut-off valves
- Starting switch with key.
- Lube Pressure Gauge.
- Water temperature gauge.
- Battery charging ammeter & voltmeter.
- Hour meter with RPM indicator.

- Safety control for low lube, oil pressure, high water temperature and over speed.
- Lube oil cooler with all standard accessories.
- Lube oil filter with replaceable type filter element as required.
- Fuel oil system comprising.
- 5 mm thick epoxy coated from inside MS Steel sheet daily service fuel tank of 990 liters capacity including with glass type level indicator and level controllers with potential free contacts.
- Fuel transfer pump including piping, fitting valves, strainers, filters between day tank and engine.
- All instrumentation and control for day tank.
- 2 No. 12 volt 25 plate lead acid batteries in series and parallel connection to make 24 volts, 4 x 180 Ah batteries duly charged along with connecting leads mounted on acid resistant frame work.
- Anti vibration mounts as per manufacturer recommendation.
- Electronic Governor with governing class 'A' direct.
- All moving parts to be mechanically guarded to minimize hazard to people around.

Air intake and exhaust systems with filters, residential type silencers, ducts, pipes, dampers, fittings, supports and other necessary accessories. The exhaust gas expulsion system shall be in accordance with the drawings. The exhaust piping shall be fitted with hospital type silencer in order to limit the sound level. Expansion joints shall take care of thermal deformations. The pressure drop in exhaust piping including silencer, bends, expansion joints etc., shall be compatible with exhaust gas leaving the engine. The exhaust piping shall be duly covered throughout the length from engine outlet upto the outlet point with mineral wool insulation and aluminium sheet cladding. The exhaust piping shall be independent for each engine and shall be with minimum bends. The bending radius of bends shall be not less than 3-internal diameters of chosen piping. A drain plug shall be fitted at the lowest point of piping for condensate extraction. The exhaust pipe shall meet the following regulations of pollution board as mentioned. Suitable supports shall be provided for proper installation of exhaust pipes.

Limits Of Noise For Power Generating Sets Manufactured On Or After The 1st January, 2005

Requirement of Certification

Every manufacturer or importer of Power Generating set must have valid certificates of Type Approval and also valid certificates of conformity of production for each year, for all the product models being manufactured or imported after 1st January, 2005 with the specified noise limit.

All Power Generator shall have a valid Type Approval certificate and conformity of production certificate.

All Power Generator shall have conformance label meeting the requirements. The conformance label shall contain the following information:

- Name and address of the supplier (if the address is described in the Client's manual, it may not be included in the label).
- Statement "This product conforms to the Environment (Protection) Rules, 1986"
- Noise limit viz. 75 dB(A) at 1 m.
- Type approval certificate number.
- Date of manufacturer of the product.
- Authorized agencies for certification
- The following agencies are authorized to carry out such tests as they deem necessary for giving certificates for Type Approval and Conformity of production testing of Generator and to give such certificates :
- Automotive Research Association of India, Pune.
- National Physical Laboratory, New Delhi.
- Naval Science & Technology Laboratory, Palghat
- National Acrospace Laboratory, Bangalore

Alternator

The alternator shall be brushless synchronous and suitable for 3 phase, 415 volts, 50 Hz., 0.8 p.f. and 1500 RPM. The alternator shall be suitable for coupling directly to the engine described in clause no. 1.3 It shall be drip proof screen protected as per IP23.

The alternator shall be continuously rated and shall have class "H" insulation designed and built to withstand tropical conditions. It shall be confirming to IS:4722-

1992. The output of the alternator shall be 400 KW rated output at site conditions at 0.8 lagging power factor and shall be suitable for sustaining of 10% overload for 1 hour in any 12 hours period without damage. Six nos. embedded Resistant Temperature Detector (RTDs) of plantinum, 100 ohms resistance at 0 degree to measure the winding temperature and 2 Nos. BTDS to measure bearing temperature shall be provided.

The leads of embedded RTDs shall be wired upto the terminal block in a separate terminal box. Manufacturer shall indicate the setting values for each RTD/ BTD for alarm and trip. Greasing facility with grease nipples and grease relief device shall be provided. All external nuts and bolts shall be of high tensile steel only.

Alternator shall be provided with anti-condensation space heater of adequate rating suitable for 240 V, 50 Hz, 1 Phase AC supply and shall be wired upto a separate terminal box. The independent earth terminals on the frame complete with nuts, spring washer and plain washer shall be provided. Alternator shall be provided with suitable adaptor box for termination of cables. Suitable arrangement shall be provided in the terminal box for formation of star point for Alternator neutral earthing.

QDCT for synchronizing relay i.e. DG Set shall be capable of working in synchronizing with other DG sets. The supply of any relays, contactors, CT's etc required for this purpose shall be included. Alternator shall be suitable for bearing the starting current of Transformer after changeover.

Excitation System

The alternator shall be provided with a complete rotating diode type brushless excitation system, capable of supplying the excitation current of the generator under all conditions of output from no load to full load and capable of maintaining voltage of the generator constant at one particular value. The exciter shall have class 'H' insulation.

The excitation system shall comprise a shaft driven AC exciter with rotating rectifiers. The rectifiers shall have in-built protection for over voltage. The exciter

shall be fast response type and shall be designed to have a low time constant to minimize voltage transients under severe load changes. The excitation voltage response ratio shall be at least 0.8.
The rated current of the main exciter shall be at least 10% more than the alternator rated exciter current and it shall have 40% overload capability for 10 seconds.
No external supply shall be required during starting and normal running of the alternator. Automatic Voltage Regulator

An automatic high speed, dead band type voltage regulator shall be provided, complete with all accessories. The regulation system shall be provided with equipment for automatic and manual control.

The regulator shall regulate the output voltage from generator current and potential signals. Series compounding transformer shall be provided to enable maintaining adequate terminal voltage in the event of terminal faults. Alternatively excitation system shall be provided with arrangement for field forcing. Contractor shall coordinate suitability of protection relays for generator with the operational characteristics of automatic voltage regulator, specially under short circuit conditions. Voltage regulation and steady state modulation shall be within +/- 0.5% of the line voltage.

Necessary equipment for field suppression and surge protection shall be provided as integral part of alternator. The response time of exciter and the generator shall be properly matched to avoid hunting. AVR system shall be provided with equipment for automatic and remote operation / control. AVR shall be suitable for 24 V supply. Necessary equipment shall be furnished for the following. To prevent automatic rise of field voltage in case of failure of potential supply. Acoustic Enclosure For Diesel Generator
Acoustic Enclosure for DG Set shall be as given below:

DG Set Capacity	1 x 1010kVA
Structure	
Panels	NA
Thickness of panels	NA
Outer sheet	NA

Inner Sheet	NA
Frame & Strainer	NA
Insulation	Mineral Wool as per IS 8183-1993
Thickness	100 mm thick
Density	64 kg/m3
Air Circulation system	
Air Intake	As per OEM
Air Exhaust System	
Finishing	Weatherproof polyurethane paint
Noise Level	75 dBA at a distance of one meter (as per CPCB)
Insertion Loss	25 dBA
ΔT inside enclosure	should not exceed from 7 Deg C above ambient temp
Location	Out door Type
Parallel Operation	Yes
Lighting / Switch	Proper arrangement shall be Provided inside
Wiring	
Protection requirements	As per OEM

Microprocessor Based Auto Starting & Auto Mains Failure. General the auto synchronizing shall be provided as mentioned below and as per Schedule of Quantity.

i) Protection Through Relays (For DG Set)

Following protection shall be provided through Numerical relay both for the stator side and the rotor side if not provided in the controller:

- Voltage restrained over current protection (50/51)
- Relay shall not work when a over current fault occurs, due to higher current levels. There shall be drop in terminal voltage for the same fault impedance, the fault current shall reduce (with respect to terminal voltage) to a level below the pick-up setting. Consequently, relay shall not pick-up. It shall be necessary to have a relay whose pick-up setting shall be automatically reduce in proportion to terminal voltage. Hence, the over current protection shall be voltage restrained. Two levels over current protection shall be provided i.e. low set and high set (for short circuit protection)
- Thermal overload (49)
- It monitors the thermal status of machine for current between 105% to the low set O/C level (normally 150%).
- Under / Over Voltage (27 / 59)
- This will protect the machine from abnormal voltage levels, particularly during synchronization and load throw off conditions.
- Under / Over Frequency (81)
- This will protect the machine from abnormal frequency levels, particularly during synchronization and load throw of conditions. This will also help in load shedding scheme for the generator.
- Breaker Failure Protection (52 BF)

This protection detects the failure of breaker to open after receipt of trip signal. Another trip contact is generated under breaker fail conditions, with which more drastic measures (like engine stoppage, etc.) can be taken.

Metering For Each DG

As mentioned in the Schedule of Quantities.

Annunciation

Annunciators with Hooter, Test, Accept and Reset P.B. and Annunciator. 16 Window Solid State Annunciator for each DG sets.

Channel No.	Inscription
01	Set fails to start (only alarm)

02	Over current (breaker trip)
03	Earth Fault (Breaker trip)
04	Excitation Failure (Engine should be stop with breaker trip)
05	Reverse Power (Breaker trip)
06	Over speed (Breaker will trip with engine stop command)
07	Low Lube Oil pressure (Breaker will trip with engine stop command)
08	High Water Temperature (Breaker will trip with engine stop command
09	Over / Under Voltage (Breaker trip)

PRE-COMMISSIONING CHECKS

All standards checks including the ones elaborated in the specifications to ensure that the installation of the DG sets and associated systems has been carried out satisfactorily shall be done on completion of installation. These shall include.

DG sets

- Checking of piping interconnections
- Checking electrical interconnections
- Checking of insulation resistance
- Checking of earthing
- Checking of instruments and controls.
- Checking of alignment
- Checking of vibration transmission to building a structure.
- Checking of expansion joints.
- Exhaust system
- Checking of silencer operation
- Checking of surface temperature of exhaust piping
- Fuel system
- Checking of automatic operation of fuel transfer pumps.
- Upon completion of work the performance test shall demonstrate the following among other things:

- Equipment installed complies with specification in all respects and is of the correct rating for the duty and site conditions.
- All items operate efficiently and quietly to meet the specified requirements.
- All circuits are correctly protected and protective devices are properly coordinated.
- All non current carrying metal parts are properly and safely grounded in accordance with the specifications and appropriate codes of practice.

DG Sets – Test Procedure

The Tenderer shall enclose copies of type test certificates, wherever applicable, for all the equipment's and materials, quoted by him, along with the bid for TPPA's reference as per the relevant standards specified. All the type tests, if not conducted earlier on similar type of equipment, covered under the relevant standards, shall be conducted, wherever required, by the suppliers for all the equipment and materials at manufacturer's works in the presence of the TPPA's representative. The test certificates of all the equipment's / materials shall be approved by the TPPA's representative before dispatch / acceptance of the equipment and materials. Routine tests for all equipment will be witnessed by TPPA/PMC's Representative. The following tests shall be carried out on Generator and Excitation system:

- Insulation Resistance Tests
- Winding Resistance Test
- Phase sequence Test
- Open and Short Circuit Characteristic Test
- AVR response / Regulation Test.
- Load TEST Generator at both unity and 0.8 PF.
- Excitation at full load and under specified variation of voltage and speed
- Measurement of voltage dips at the generator terminals while feeding the base load 75% and on simultaneous starting of the largest motor.
- TPPA reserves the right to reject the equipment if the guaranteed performance is not met with.
- All instruments required for performance testing of the equipment covered in this specification shall be provided by the TENDERER at no extra cost to the TPPA for entire duration of the performance test.
- The TENDERER shall ensure that instruments and gauges to be used for testing and inspection of critical parameters as identified in the specification shall have

valid calibration and the accuracy can be traceable to National Standards.

- In addition to the above guarantees, TENDERER shall also guarantee the period for completing supply, erection, testing and commissioning as six (6) months for DG set and accessories from the date of Letter of Award.

Load / Run Test at Site :

DG sets shall be tested at different loads at site after dispatch and installation at site. In case at any point of the test a trip should occur the test shall be conducted again. The necessary fuel oil, lube oil & consumables required for the test shall be provided by contractor. No extra payment shall be made in this regard.

Copies of manufacturer's type test for the engine and the alternator of all ratings shall be enclosed along with the dispatch of the DG sets as per relevant standard/ codes.
The contractor shall provide all necessary instruments and labour for testing. He shall make adequate records of test procedures and readings and shall repeat any tests requested by the TPPA/PMC. Test certificate duly signed by an authorized person shall be submitted for scrutiny.

If it is proved that the installation or part thereof is not satisfactorily carried out then the contractor shall be liable for the rectification and retesting of the same as called for by the TPPA/PMC. All tests shall be carried out in the presence of Client inspection team. These tests shall form part of this contract. Above tests shall be conducted for all DG sets. The test results shall match with the technical requirements specified in the technical data sheet. The TPPA/PMC shall have the right to accept or reject the modules if it does not meet the technical requirements.

The load test shall be conducted through resistive load bank at unity power factor. Before conducting test, following shall be recorded on test report:

a) Engine serial No.
b) Engine model & make No.
c) Alternator serial No.
d) Engine & alternator rating
e) Date of testing
f) Rated speed, voltage & kW

Loads & duration: Engine shall be given a test run for at least six hours with alternator supplying full rated load at site and overload test to the extent of 10% over the rated load shall be conducted immediately after the full load run test

No load : 5 mins 25% load – 30 mins 50% load – 30mins 75% Load – 30 mins

100% Load- 4.5 hrs

110% Load – 1 hr

The following parameters shall be noted on the test report Description Time (After start of Load test)

1 hr 2hrs 3hrs 4hrs 5hrs 6hrs 7hrs

- Load in kW
- Power factor
- Voltage
- Current
- Frequency
- Alternator winding temperature
- Alternator bearing temperature
- Lube oil pressure
- Lube oil temperature
- Fuel consumption though flow meter
- Cylinder head temperature Impact test:
- A block load of at least 50% shall be put on the DG from no load condition & similarly when DG is 100% loaded, the load is removed & the parameters like voltage, frequency & RPM is noted. The readings should be with in acceptable limits.
- Performance Tests
- The following items of performance shall be guaranteed during site performance tests in respect of the DG and the auxiliaries for the specified site conditions:
- Net electrical output (continuous)
- Freedom from vibration and noise
- Governor response, over-speed trip and speeder gear capability
- Voltage regulator response
- Excitation at full load and under specified variation of voltage and speed.
- Start-up & testing at site
- A equipment manufacturer's representative approved by the Project Manager

- / Client shall be engaged to perform start-up and load test upon completion of installation with the Project Manager / Client in attendance. A certified test record shall be provided.
- Tests shall include, but are not be limited to, the following:
- Check fuel, lubricating oil, and antifreeze in liquid cooled models for conformity to the manufacturer's recommendations under environmental conditions present.
- Test, prior to cranking of engine, for proper operation of accessories that normally function while the set is in a standby mode. Check, during start-up test mode, for exhaust gas leaks outside the building, cooling air flow, movement during starting and stopping, vibration during running, line-to-line voltage and phase rotation.
- Test by means of simulated power outage, automatic start-up by remote-automatic starting, transfer of load, and automatic shutdown. Engine generator sets are to be synchronized and paralleled during tests. Monitor throughout the test, engine temperature, oil pressure, battery charge level, generator voltage, amperes, and frequency.
- Tests shall demonstrate capability and compliance of system with operating requirements. Where possible, correct malfunctioning units at site then retest to demonstrate compliance; otherwise remove and replace with new units, and proceed with retesting. Retesting to be at no cost to the Project Manager
- / Client.
- This section includes a very basic outline of the start-up sequence. The actual sequence will be determined after the final design is completed. The commissioning of the new generators will occur on weekends and after-hours depending upon the scheduling requirements of the business.

Rejection

The TPPA may reject any DG Sets during tests or service any of the following conditions arise and the provision under the relevant clause of the general conditions of contract shall immediately become applicable: If it is not adhere to:-

- Guaranteed Technical Particulars- Diesel Engine.
- Guaranteed Technical Particulars- Generator
- DG Sets fails on performance guarantee test at works.
- DG Sets fails on performance guarantee test at site.

- Proven performance in number of running hours for the type / Model of the DG set
- DG Sets is proved to have been manufactured not in accordance with the agreed specification.

The TPPA reserves the right to retain the rejected DG Sets and take it into service until the tenderer replaces the defective DG Sets by a new acceptable DG Sets at no extra cost. The tenderer shall repair or replace the DG Sets within a reasonable period mutually agreed time to the satisfaction of the TPPA at no extra cost.

EXHIBIT 5

SECTION - 8

LIST OF APPROVED MAKES

LIST OF APPROVED MAKES - CIVIL WORKS		
S. NO	**ITEM**	**APPROVED MAKES / VENDORS**
1	Chemical Admixtures & Additives	Penetron/ Fosroc/ Dr Fixit/ Hyperdesmo/ BASF/ Pidilite/ Sika/ Ecmas/ Sunanda Chemicals/ Mapei/ Hycrete/ Bal-Endura/ MC Bauchemie/ MYK Schomburg
2	Anti-Termite Pesticides -(Chloropyriphos)	DE – Nocil/ Bayer/ Biflex-TC from FMC/ Hilban from HIL
3	Cement OPC/ PPC	Ultratech/ ACC/ Lafarge/ Birla/ Ramco/ Chettinadu/ Arasu/ Coramandal/ Bharathi/ Zuari/ Penna/ Maha/ Decca/ Sankar/ L&T Ultra Tech/ Dalmia
4	Cement - White	Birla white / JK
5	Bitumen	Indian Oil, Hindustan Petroleum, Bharat petroleum, Shalimar Tar, Shell
6	Expansion Filler board – Premoulded compressible	Supreme Industries Ltd./ Shalitex -STP
7	Anchor Fastner, Rebar, Chemcial/ Mechanical fastner, Core - cutting,Dry stone cladding clamp, Expandable fastners	Hilti/ fischer
8	Backer rods	Supreme Industries Ltd./ Fosroc
9	Non shrink cementious precision (anchoring) grout	Fosroc/ Sika/ Mapei/ Ardex Endura/ BASF
10	Reinforcement Steel	SAIL/ TATA (TISCO)/ RINL/ JSW steel/ Jindal / Kothari/ Thirumala/ Triple Power/ PMP/ Agni/ TATA/ Surya Dev/ DSRM/ Vizag/ Amman TRY/ Pulkit/ TSRM
11	Ready Mixed Concrete (RMC)	CLIENT / ENGINEER Approved RMC Suppliers
12	Silicon Sealants	Dow Corning/ GE Silicon/ Wacker Silicon/ Pidilite/ Dr. Fixit/ MC-bauchemie
13	Polysulphide Sealant	Pidilite/ Fosroc/ Dow corning/ Sika/ MC-bauchemie
14	Structural Steel	SAIL/ Jindal/ TATA (TISCO)/ RINL / Kothari/ Thirumala/ Triple Power/ PMP/Agni/ TATA/ Surya Dev/ DSRM/ Vizag/Amman TRY/ Pulkit/ TSRM
15	Waterproofing Compound	Penetron/ Fosroc/ Dr Fixit/ Hyperdesmo/ Sika/ BASF/ Ecmas/ Pidilite/ Shalimar TarProducts (STP)/ CICO/ Firestone/ Roffee
16	Crystalline Integral Waterproofing	Kryton/ Penetron/ Pidilite/ BASF/ Fosroc/Sika/ Xypex
17	Membrane Waterproofing system	Carlisle/ SIKA/ Dr Fixit/ Fosroc/ AquasmartPB/ Hyperdesmo/ BASF/

LIST OF APPROVED MAKES - CIVIL WORKS		
S. NO	**ITEM**	**APPROVED MAKES / VENDORS**
		Pidilite/ Mapei/ Ecmas/ MYK Schomburg
18	Elastomeric Waterproofing system	Carlisle/ SIKA/ Dr Fixit/ FOSROC/ HyperDesmo/ BASF/ Pidilite/ Mapei/ Ecmas/ MYK Schomburg
19	Water Stops - Hydrophilic Swellable rubber strip	SIKA/ Hydrotite/ Ecmas/ BASF/ Fosroc/Penetron
20	Blockwork-AAC Blocks	Xtralite from Ultratech/ Aerocon fromHIL/ ECOREX/ BILTECH
21	Blockwork-AAC block joining mortar	Fixoblock xtralite from Ultratech/ Smartfix from Aerocon/ MYK Laticrete/Ardex Endura
DOOR FINISHES		
22	Wood	1st quality sal or teak wood Well-seasoned wood free from knots. Moisture content report to be submittedby the vendor.
23	Commercial ply	Greenply/ Archidply/ Century/ Uniply/Kitply/ Sharon
24	Commercial/Marine Plywood	Greenply/ Archidply/ Century
25.	Flush Door Shutter (Factory pressed laminated)	Greenply/ Archidply/ Century/ Kutto duro/ Interwood
26.	Laminates	Greenply/ Marino/ Century/ Sharon/ Greenlam/ Formica/ Sunmica/ Centura
27.	Laminated Shuttering Ply	Greenply/ Archidply/ Century
28.	Fire Doors	Shakti Horman/ Pacific/ Navier/iCLEAN - IHMS/ Promat/Bangalore Protech/tesco/kutty
29.	Fire Rated Hardware	Dorma/ Hafele/ Geze/Horman/Assa Abloy (Yale)
30.	Fire Seal, Fire smoke Seal	3M/Hilti/Dorma/Sealz/Lorient/Kelargo/ Raven
31.	Fire-rated Glass	VetrotechSaint-Gobain/ Pyroguard/Glaverbel/Schott - Pyran/ Pyroswiss/Pilkington
32.	Fire-rated Glass fixing gasket, tape	3M/Karfani
33.	Floor Springs	Dorma (XLC)/ GEZE/ Haffle/ Assa Abloy (Yale
34.	Metal Doors (Non Fire rated)	Shakti Horman/Naviar/ Ahlada/
35.	Rolling Shutters	INDIANEntrance Automation/Indogerma/AMVEL/Swastik/ Gandhi Automation
DOORS/HARDWARE AND IRON MONGERY		

LIST OF APPROVED MAKES - CIVIL WORKS		
S. NO	**ITEM**	**APPROVED MAKES / VENDORS**
36	Aluminium Accessories	Classic/Argen/Oxford/ Nulite/ Crown/EBCO
37.	Aluminium Sections	Hindalco/ Jindal/Bhoruka/ Indalco/Sapa/Global
38.	Aluminium System Windows	Kaluco/ Technal/Domal/ALCOI/Geeta Aluminium/Eternia from Hindalco/ Alumak/
39.	Aluminium Systems Glazing/ Curtain wall (Façade system)	Domal/Technal/ Schuco/ SAPA Building Systems/Reyners/Kawneer/ NCL Alltek & Seccolar/ Plectra/VS1/ F1 /Bhoruka
40.	Aluminium D/W hardware	Alualpha/Lavaal/Giesse/Cotswold/ Securistyle/Polismar
41.	Powder coatings	Berger/nerocoat/jenson & nicholson
42.	Aluminium Louvers	Hunter Douglas/ Armstrong/ Luxalon
43.	Automatic Sliding doors/ Revolving Doors	Dorma/Geze/Hafele
44.	Door Closer	Dorma (XLC)/ Hafele/ Geze/Yale
45.	Door Locks,Access Control Lock	Dorma (XLC)/Geze/ Kich/ Hafele/ Assa Abloy (Yale)
46.	Door Hardware & Accessories (other than Floor spring/ Closer)	Dorma (XLC)/Kich/ Hafele/ Assa Abloy (Yale)/ Dorset/Classic/Crown/JHAL
47.	Door Seal – Wool pile Weather S	Reddiplex/Osaka rubber/Enviro Sealz/ Anand
48.	EPDM Gaskets	Anand/Osaka Rubber/Roop/Bohra/Hanu/Maharashtra polymer
FALSE CEILING		
49.	Metal ceiling	Bumada/ Hunter Douglas/Armstrong/USG Boral.
50.	Suspended ceiling system	Armstrong/Anutone Saint Gobain/USG Boral/Knauf
51.	Calcium Silicate Board	Armstrong /Hilux/ Aerolite
52.	Mineral Fiber board	Armstrong /Hilux/Aerolite/knauf amf/rockfon
53.	Mineral Fibre Grid Ceilings	Armstrong/ Saint Gobain (Ecophon)/ Anutone/USG Boral/Knauf/AMF/ Dexune
54.	Moisture Resistant Boards	Armstrong/Anutone/Saint Gobain (Ecophon)/USG Boral

LIST OF APPROVED MAKES - CIVIL WORKS		
S. NO	**ITEM**	**APPROVED MAKES / VENDORS**
55.	Access panel in False ceiling	Saint Gobain/ USG Boral/ Knauf Denoline/ Anutone
FLOOR FINISHES		
56.	Tiles/ Stone Adhesive	Pidilite/ MYK- Latricrete/ Ardex Endura/ KeraKoll/ Ultratech
57.	Epoxy Grout/ Cementitious Grout for Flooring	Ardexl Endura/ MYK Latricrete/ Kerakoll/ Pidilite
58.	Tile joint filler	Bal adhesives & grouts / roff rainbow tilemate of roff Construction Chemicals Pvt ltd. / winsil 20 m silicon sealant of gebayer silicon m zentrival fm of mc -
59.	External Paving Tiles (Cement based)	Pavit/ Basant baton/ Vyara/ Ultra/ Eurocon/ Super
60.	Floor hardening compound	JBA/ Ardex endura/ Fosroc/ Basf/ Sika/ Sunanda chemicals
61.	Concrete Cover Blocks	Astra/ Ramtec or approved equivalent. For exposed concrete, only pointed type shall be approved
62.	Precast concrete tiles, Interlocking Paving, Brickpaver	Vyara/ Basant betons/ Super Decorative floorings/ Ultra /NITCO
63.	Ceramic Tiles	Kajaria/ RAK/ Restile/ Somany/ Jhonson/ Asian/ Nitcor
64.	Vitrified Tiles	Kajaria/ RAK/ Restile/ Somany/ Jhonson/ Asian/ Nitco.
65.	Glazed tiles	Johnson/ Kajaria/ Nitcor
66.	Exterior Tiles	Johnson(Endure) /Kajaria
67.	Antistatic Vinyl Flooring	Armstrong/Tarkett/Polyflor/Lg/forbo/squarefoot
68.	Antiskid Tiles	RAK/Kajaria/ Johnson
69.	Granite flooring	Shall be from thre quary and the grains and the texture of the stone shall be the same
70.	Acid Alkali Tiles	Arcoy/Coromondal
71.	Kota Stone	Shall be from thre quary and the grains and the texture of the stone shall be the same
72	Glass wool	Up twigs/ Owens corning or approved equivalent.
MISCELLANEOUS		
73	Glass, Tinted Glass, High-Performance Glass	Saint Gobain/ AIS/ Modiguard (Gujarat Guardian)/Pilkington/ Asahilective Glass

LIST OF APPROVED MAKES - CIVIL WORKS		
S. NO	**ITEM**	**APPROVED MAKES / VENDORS**
74	Glass Processing	Saint Gobain/GlassTech/ FG/Fuso/ Asahi/Nishu Glass Processor/ GSC Toughened
75	Glass Doors (Motorized systems / sliding system)	Auto door Industries/DORMA/ Manusa/ Haffle/Geze
76	Mirrors	Saint Gobain/Modi Guard (Gujarat Guardian)/Asahi/HNG/Pilkington
77	Patch Fitting	Dorma (XLC)/Haffle/ Geze/ Hettich/ Kinlong
78	PVC continuous fillet for periphery Packing of Glazings/ Curtain Wall	Roop/ Anand/ Forex Plastic or approved equivalent
79	Acoustic Insulation (Mineral Wool)	Lloyd/ Ecophone from Saint Gobain/ U.P. Twiga Ltd/ Rockwool India/ Anuton/ Knauf/ Siderise
80	Acoustic Seal	Lorient/ Raven/ Dorma/ Kelargo/ Reddiplex
81	Air transfer grills	Trox/ Ruskin Titus/ Systemair India
82	Grab Bars and Disabled Hardware	Dline/ Cera/ Jaquar/ Hindware/ Dorma
83	Stainless Steel	SAI/ Jindal/ Salem steel
84	Stainless Steel Bolts, Washersand Nuts, Pressure plates, screws	Kundan/ Puja/ Atu/ GKW/ knettlefoldl
85	SS clamps, pins	Hafele/ Dorma
86	Adhesives	Laticrete/ KeraKoll/ Pidilite.
87	PVC cover block, plastering mesh, PVC tile spacer	Arpitha exports
88	Precast Concrete Landscape elements, gratings, kerb, Drain cover	Vyara, Basant betons/ Super Decorative floorings/ KK Manholes & Gratings/ Nimco
89	Plastic-coated plywood for shuttering	Evergreen Plywood Industries
90	Spacers for Wall and Floor Tiles	MM2MM/LyfWeb
PAINT FINISHES		
91	PAINT - Cement Based	ICI Dulux/ Ultratech/ Berger Paints/Asian/ Nerolac
92	Paint - Acrylic, Acrylic emulsion-interior and exterior	Berger paints/Asian paint/ICI/ Nerolac/Akzo Nobel (Dulux)Jotun/Sherwin

LIST OF APPROVED MAKES - CIVIL WORKS		
S. NO	**ITEM**	**APPROVED MAKES / VENDORS**
		Williams/Kensai- Nerolac / Asian - Apex Ultima /Surfa -
93	White cement-based putty	Birla/ JK/ utsav putty/Berger
94	Red Oxide Primer Paint	Asian/Berger
95	Duco Paint	Asian brand /apex
96	Synthetic enamel	Asian brand/apex
7	Solar Reflective paint	Thermatek/eurocon/everest
PARTITION BOARDS AND FINISHES		
98	Aluminum composite panel	Alucobond/ Alstone/ Alubond/ Eurobond/ Aludecor/ Alstrong/Hunter douglas/ durobuild
99	Gypsum Board	Indian gypsum/ lafarge/ st gobain
100	Glazed partition	Wideline/Optima / jeb /deko /dorma
101	Acoustic wall panel	Anutone / Knauf /Armstrong
SANITARY WARES & C.P FITTINGS		
102	Vitreous China Water closet	Hindware, CERA, Jaquar, Kohler
103	Vitreous China Wash basin	Hindware, CERA, Jaquar, Kohler
104	Urinal with sensor	Hindware, CERA, Jaquar, Kohler
105	C. P. Fittings / Mixtures/Sensor	Hindware, CERA, Jaquar, Kohler
106	Liquid Soap Dispenser	Euronics, Toshi, UTEC
107	Hand Drier	Euronics, Toshi , UTEC
108	Aroma Dispenser	Euronics, Toshi , UTEC
109	Tissue Dispenser with Trash	Euronics , Toshi , UTEC, Jaquar, Kohler
110	Hand Towel Dispenser	Euronics , Toshi , UTEC, Jaquar, Kohler
111	Water cooler	Bluestar, Voltas, Aquaguard

112	Janitor Sink	Jayna , Nirali , Franke , Prestige
PLUMBING WORKS		
113	PVC Pipes	Supreme /Prince /Ashirvad /Astral /Finolex/Kissan /Arya / Jawan
114	CPVC Pipes	Supreme /Prince /Ashirvad /Astral /Finolex
115	SWR Pipes	Prince /Supreme /Kissan /Finolex /Ashirvad /Astral /Arya / Jawan
116	UPVC Pipes	Supreme/prince/Ashirad/Astral/Finolex/Kissan
117	G.I.Fittings	Jindal /Tata/ R Brand
118	Over Head Tank	Sintex /Infra /Aquatech
119	Tap	Jaguar /Metro /Parryware /Waterman
120	HDPE Pipe	Jain, Sangir, Plast, Time Techno Plast
121	Valves	Kirloskar, BEW, Krishna, Shaurya
122	Pump	Grundfos, Kirloskar,Aqua pumps, Lubi,
123	R.C.C. Pipes	Indian Hume Pipe, KK, Alcock
NOTE 1: Contractor to proceed for procurement with preferred make, only upon approval from TPPA/PMC. Without written consent from TPPA/PMC, no procurement should be affected even if it is from the list of approved makes.		

NOTE 2: In case during the execution of the Contract, makes mentioned in the list becomes unavailable, then it will be under an obligation of the bidder to execute the project as per the makes approvedby TPPA/PMC

LIST OF APPROVED MAKES / VENDORS – PUMPS		
Sl.No	ITEM	APPROVED MAKES / VENDORS
1	Electrical Hoist & Chain Pulley Block1	1. Brady & Morris Engineering Co.Ltd
		2. Hercules Mechanical Works Cranedge India Pvt Ltd
		3. Indef
		4. RMS Industries
		5. Tuobro Furguson (India) Pvt Ltd
		6. Consolidated Hoist Pvt Ltd
		7. EDDY Cranes Pvt Ltd
2	Submersible Pumps	1. KSB Kirloskar Mather & Platt Aqua Pumps Grundfos ylem
		2. Wilo
3	Knife Gate Valves	1. Jash Engineering Foruess
		2. Vass (Dejuric) Vag
		3. Orb Inox
		4. H Sarkar & Co ltd Flowtek
		5. Madhav Fluid Solutions
4	Dual Plate Check Valve	1. 1KBL
		2. R&D Mutiples Hawa
		3. Advance Values
		4. BBDK Valves
5	Dismantling Joint	1. Viking Johnson Duga Valves
		2. Anant Engineering & Fabricators
		3. Makali Engineering Corporation
6	Flap gates	1. Jash HWE
		2. Hydro Gate
7	HDPE Pipes	1. Finolex Supreme Duraline
		2. Jain Irrigation
8	MS Pipes	1. Tata Pipes
		2. Jindal Pipes SAIL
9	Gearbox	1.Greaves Elecon Alen Berry
10	Actuator	1. UMA
		2. Rotork Marsh
NOTE 1: Contractor to proceed for procurement with preferred make, only upon approval from TPPA/PMC. Without written consent from TPPA/PMC, no procurement should be affectedeven if it is from the list of approved makes.		
NOTE 2: In case during the execution of the Contract, makes mentioned in the list becomes unavailable, then itwill be under obligation of the bidder to execute project as per the makes approved by TPPA/PMC		

LIST OF APPROVED MAKES / VENDORS		
S.No	**ITEM**	**APPROVED MAKES / VENDORS**
1	Horizontal split case pumps	1. Kirloskar 2. Mather & Platt 3. WPIL 4. Flowmore pumps 5. MBH pumps
2	Horizontal mono block sump pump	1. Kirloskar 2. Pullen pumps 3. CRI pumps 4. MBH pumps 5. Crompton Greaves 6. Prima pumps 7. Uneel pumps
3	Horizontal End Suction Centrifugal Pumps	1. KSB 2. Kirloskar 3. Mather & Platt 4. MBH Pump
4	Sluice Valves	1. Kirloskar Brothers Ltd 2. IVC 3. R & D Multiples 4. Durga valves 5. A.V.Valves LTD 6. Delval Flow controls PVT LTD. 7. Valtech Industries.
5	Butterfly valves	1. Kirloskar Brothers Ltd 2. IVC 3. R & D Multiples 4. Durga valves 5. Advance Valves Pvt Ltd 6. B.D.K.Engineering Industries Ltd 7. Inter Valve 8. Fouress Engg.India Ltd
6	Non-return valves	1. Kirloskar Brothers Ltd 2. Durga valves 3. IVC 4. R & D Multiples 5. A.V.Valves LTD 6. ATAM Valves Pvt Ltd 7. Fouress Eng. India Ltd 8. GM Engineering Pvt Ltd
7	Air release valves	1. Kirloskar Brothers Ltd 2. Indian Valve (P) Ltd 3. VAG valves 4. Taalis
8	Dismantling joints	1. Durga valves 2. Anant Engineers & Fabricators 3. Makali Engineering Corporation 4. Viking Johnson
9	Actuator	1. AUMA

LIST OF APPROVED MAKES / VENDORS		
S.No	**ITEM**	**APPROVED MAKES / VENDORS**
		2. Rotork
		3. Marsh

10	DI Pipes	1. Electro Steel Castings 2. Jindal 3. Kejriwal 4. SriKalahasti pipes 5. Tata Metaliks
11	HDPE Pipes	1. George Fisher 2. Sangir 3. Supreme
12	Flow Element Nozzle	1. Dynafluid Valves and Flow Controls Ltd 2. Instrumentation Ltd 3. Micro Precision Products Pvt 4. Minco (India) Flow Elements Pvt Ltd
13	Flow Element- Orifice	1. Dyn fluid Valves and Flow Controls Ltd 2. Instrumentation Ltd 3. Micro Precision Products Pvt 4. Minco (India) Flow Elements Pvt Ltd
14	Rotameter	1. Flow Star Engineering Pvt Ltd 2. Eureka Industrial Equipment's Pvt Ltd 3. Instrumentation Engineers Pvt Ltd 4. Scientific Device Pvt Ltd
15	Solenoid Valves	1. Rotex Automation – Baroda 2. ASCO-Chennai
16	Simplex Strainer	1. ACME FLUID Systems 2. Bhatia Engineering Co. 3. Bombay Chemical Equipment's 4. Filteration Engineers Pvt Ltd 5. Gujarat OTOFILT
17	Oil Skimmer	1. Jeet Engineering 2. Jash Engineering
18	Turbidity meter	1. Hach 2. Tose Mount 3. Yogokawa
19	TDS Analyzer	1. Emerson/Hach
20	Clarifier	1. Jash Engineering & Distington

LIST OF APPROVED MAKES / VENDORS - WATER SUPPLY SYSTEM		
Sl.No	**ITEM**	**APPROVED MAKES / VENDORS**
1	GRP cover	1. Simtex 2. Vikrant 3. Thermodrain
2	Level Sensor & Indicator	1. Bells Controls 2. ABB Forbes Marshal 3. Pune Techtrol 4. Level Tech 5. Elegant
3	Electromagnetic Flow Meter	1. Emerson 2. E&H 3. Siemens 4. Jumo 5. Forbes Marshall
4	Pressure Transmitter	1. Siemens 2. Emerson 3. E&H 4. Jumo
5	Level Switch / Controller	1. Pune Techtol 2. Nolta 3. Jumo
6	Level Indicator	1. Levcon 2. Pune Techtrol 3. Cirrus
7	Limit Switches	1. Siemens 2. BHC 3. Jai Balaji 4. L&T
8	Terminals	1. Elmex 2. Connect well 3. Wago 4. Phoneix

LIST OF APPROVED MAKES / VENDORS - WATER SUPPLY SYSTEM		
Sl.No	**ITEM**	**APPROVED MAKES / VENDORS**
9	Electrical Wiring	Refer Electrical Specification
10	24 V DC Power Supply Units	Refer Electrical Specification
11	Junction Boxex (Thermoplastic)	Refer Electrical Specification
12	Cables	Refer Electrical Specification
13	Cables Glands	Refer Electrical Specification
14	Gi Cable Trays	Refer Electrical Specification
15	Relays	Refer Electrical Specification
NOTE 1: Contractor to proceed for procurement with preferred make, only upon approval from TPPA/PMC. Without written consent from TPPA/PMC, no procurement should be affected even if it is from the list of approved makes.		
NOTE 2: In case during the execution of the Contract, makes mentioned in the list become unavailable, then it will be under an obligation of the bidder to execute the project as per the makes approved by TPPA/PMC		

LIST OF APPROVED MAKES / VENDORS – ELECTRICAL WORKS		
SL.No.	**ITEM**	**APPROVED MAKES / VENDORS**
1	11 kV Vacuum Circuit Breaker (VCB) and Indoor panels	1. ABB / Siemens/ Schneider (OEM panel only) 2. M/s Electrovast Solution 3. Medium Voltage Technologies, Universal Power Equipment's Pvt Ltd, Chennai.
2	11 kV Vacuum Circuit Breaker (VCB) Outdoor Panels	1. ABB / Siemens/ Schneider (OEM system Integrator panel) - Design Approval by OEM. 2. Medium Voltage Technologies, Universal Power Equipment's Pvt Ltd, Chennai. 3. M/s Electrovast Solution
3	11kV RMU	1. ABB/Schneider/Siemens 2. M/s Electrovast Solution 3. Medium Voltage Technologies, Universal Power Equipment's Pvt Ltd , Chennai.
4	Distribution Transformer Oil filled - Level 2	1. EMCO / Raychem / Schneider/ Crompton 2. greaves/BBL/Voltamp/Kirloskar

LIST OF APPROVED MAKES / VENDORS - ELECTRICAL WORKS		
SL.No.	**ITEM**	**APPROVED MAKES / VENDORS**
5	Type tested MV panels IEC 61439	1. Siemens (Sivacon panels): 2. Schneider (Blockset panel): 3. ABB (ArTuK Panel): 4. L&T (Ti Panel): 5. Legrand (XL3 Panels): 6. M/s TechAmp Switchgear and Controls, Hosur 7. M/s Electro Tech Power Engineers, Chennai 8. M/s.Formoplastic Controls Private Limited 9. M/s.Power Control Equipments 10. M/s.Vee Vee controls. 11. M/s.Elins switchboards M/s.Pragathi Controls 12. M/s. Stahlform Technik Private Limited, 13. Hosur M/s. Balaji Electro Controls, Bangalore 14. Adlec power pvt ltd Panel Incomer - 15. 630 A & above shall be as per IEC 61439.(Only 16. OEM panel accepted)
6	Air circuit breakers (ACB)	1. Siemens / Schneider/ ABB/L&T/Legrand
7	MCCB's	1. Siemens / Schneider / ABB/Legrand/L&T/Hager
8	LV VFD	1. Siemens / Schneider / 2. Danfoss/ABB/L&T/Allenbradley/
9	LV capacitors (APP double layer)	1. Epcos / Schneider/ Circutor
10	CTs (Epoxy Resin cast type)	1. Pragati / ABB / Kalpa / Kappa/ECS/Schneider
11	VTs (Epoxy Resin cast type)	1. Pragati / ABB / Kalpa / Kappa/ECS/Schneider
12	APFC Relay / Controller	1. Beluk/Conzerv/ Epcos/ Circutor
13	Indicating meters digital & analogue	1. Conzerv / Circutor / Siemens/ Rishabh/ Secure/, Elmeasure/AE
14	Multi-Function Meter	1. Conzerv / Circutor / Siemens/ Rishabh/ Secure/AE

LIST OF APPROVED MAKES / VENDORS - ELECTRICAL WORKS		
SL.No.	**ITEM**	**APPROVED MAKES / VENDORS**
15	Power quality analyzer (if required)	1. A-eberle / Power measurement (ION) / Conzerv/Chino - Laxsons / Yokogawa / / Rishabh / Fluke/Hioki
16	Indicating lamps (Clustered/Chip LED type)	1. Siemens / Teknic/ BCH / Schneider/L&T
17	Pushbuttons	Siemems /Telemecanique /Teknic /L & T
18	Cables	HT Cables - RPG / Univesal /Nicco /KEI
		LT Power Cables -Universal /RPG/ Polycab/NICCO / KEI/RR cable /Uniflex/Paragan
		LT Control Cables -Nicco / Univesal / RPG/Finolex/RR cable /Lapp KEI/ Paragan/Q-Flex / Asmon /Polycab/Anchor/Havells
		Wire PVC copper wires-Finolex / RR cable / LAPP / Powerflex/ Anchor /Panasonic
19	Annunciators (solid state type)	Minilec / Alstom /Alan
20	HRC fuse	Siemens / Cooper Bussman/Schneider/L&T/ABB
21	Contactors	AC Power Contactor-Siemens / ABB /Schneider Electric/L&T/ABB DC Power Contactor-BCH / BHEL / Siemens Auxiliary contactors-Siemens / L & T / Telemecanique / ABB / Schneider electric
22	Time switch	GIC / Theben / Siemens / Schneider / Legrand
23	Timers	GIC / Theben / Siemens / Minilec / L&T / Schneider / Legrand
24	Time Delay Relay	Areva / ABB / Siemens / Omron / PLA
25	Overload relay	Electronic / Microprocessor based overload relay -Siemens / ABB / Schneider/L&T
26	Cable Glands (Double seal cone grip type)	Comet / Braco / Baliga /SMI/ Dowells/3M
27	Cable lugs (tinned copper)	Dowells / Comet / SMI/3M
28	Connector	Phoenix / Wago Controls /ESSEN/Connectwell
29	MCB / RCCB / RCBO / MPCB	Siemens / Schneider /ABB / Legrand / Hager/L&T/Panasonic/MDS/Havells/Standard/ Bentac/Indo asian
30	Distribution board	Siemens / Schneider / ABB/Legrand/L&T/Hager/Panasonic
31	Switches & sockets	Wipro (Artisa)/ Legrand (Arteor)/ Panasonic (Vision)/Schneider (Zencelo)/Havells
32	3Ph 32A Receptacles & 1Ph 32A Receptacles (industrial type and non- metallic)	Legrand / Schneider / ABB/L&T/Cape Electric
33	Protective relays (Numerical Type)	Siemens/ Alstom (MICOM) / ABB/Schneider
34	Auxiliary Relay	Schneider / ABB / Siemens
35	Control / selector switch	Kaycee / Siemens / Areva / ABB / Schneider/L&T
36	Terminals	Phoenix / Wago Controls/Connectwell

LIST OF APPROVED MAKES / VENDORS - ELECTRICAL WORKS		
SL.No.	**ITEM**	**APPROVED MAKES / VENDORS**
37	Cable Jointing Kit/ termination kits	Raychem/ Birla-3M /M-Seal
38	Cable trays	Indiana / Profab / OBO / Legrand/Elins
39	Floor Raceway	Indiana / Profab / OBO / Legrand/Elins
40	Wall Raceway	OBO/Legrand
41	Voltage / Power / Current / Frequency /	ABB / Siemens/ Areva
42	GI Conduit / Pipes/ FRLS PVC conduit/MS conduit	SAIL / TATA Steel / Jindal/BEC/AKG/OBO/ Precision/VIP/Bajaj Plast/Avon Plast/Indian Tube/Meera Kunj/Polycab
43	Insulating Mats	National / Jyoti / DL miller & company / Premier poly film ltd / RMG Polyvinyl India Ltd.
44	Winding and Oil Temperature Indicator	Preci Measure / Perfect Control / Prayog
45	Magnetic Oil Level Indicator	Sukrut
46	Single Phase Preventer	L & T / Minilec/ Siemens
47	SMF/VRLA battery	Exide / Amara Raja / Panasonic
48	Battery Charger & DCDB	Chhabi / Mass-Tech Controls / Universal / HBL
49	Earthing Strip, and accessories	Sterlite Engineering Ltd. / Finolex Cables
		Ltd/OBO
50	Lightning protection conventional type	OBO / DEHN
51	Light Fixture	Outdoor Light Fixtures - Philips/Wipro/Neri/Keselec/Panasonic
		Indoor Light fixtures - Wipro/Philips/Lightning Technologies /Panasonic/ Regent/Bajaj/Anchor/Crompton Greaves /
		Havells
		Flame-proof light fixture-Bajaj Electricals
		Ltd.(Flame proof)/ Baliga(Flame proof)
52	Power Pack	Mahamai (MM max power) / Alan / Nutek
53	Bus Ducts / Rising Mains	Siemens/ Schneider /L&T/Legrand
54	Change Over Switch	ABB/ Schneider Electric/ Siemens / HPL
55	Automatic Transfer Switch (ATS)	ASCO/ SOCOMEC
56	Bus Bar Support	Powermat /Electro flores
57	Fasteners	Hilti/ Fisher
58	Welding Rod	Advani/ Esab
59	Paints	ICI/ Asian/Berger
60	Fire Sealant	3M / Hilti

LIST OF APPROVED MAKES / VENDORS – ELECTRICAL WORKS		
SL.No.	**ITEM**	**APPROVED MAKES / VENDORS**
61	Occupancy Sensors / Daylight Sensor	Wipro/ Panasonic/Legrand/Philips
62	Lighting Poles	WIPRO / Bajaj Electricals / Keselec/ K-Lite/Philips/Neri
63	PLC	Allen Bradley / Siemens / ABB / Schneider
64	Earth Leakage Relay	PROK DVS / Alstom
65	Motors	Siemens / ABB / Kirloskar
66	Surge Arrestors,SPD	Cape/Siemens / ABB / Schneider/L&T/Legrand
67	Panel ventilation fans	Rittal / EBM nadi