HARYANA URBAN DEVELOPMENT AUTHORITY

DETAIL NOTICE INVITING TENDERS

On behalf of Haryana Urban Development Authority Online bids application for “Post Qualification and Financial Bid” on lump sum rate basis on the prescribed form on the website: http://huda.etenders.in are hereby invited from the eligible contractors/firms enlisted in appropriate class/category on the approved list of HUDA, PWD, PHED, MES, CPWD & other Govt. Department and undertakings of central & State Govt. for the works as mentioned below:-

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<tr>
<th>Job No.</th>
<th>Name of Work</th>
<th>Bid Document Cost</th>
<th>EMD (Rs.)</th>
<th>Tender to be opened on</th>
<th>Time limit</th>
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<td>99</td>
<td>Providing external Sewerage Scheme for Zone – III, Hisar “Design, Construction, Supply, Erection, Testing &amp; Commissioning of 15 MLD Capacity MPS &amp; Cyclic Activated Sludge Process / SBR technology based 15MLD Sewage Treatment Plant including 3 months successful trial run, operation &amp; maintenance for 12 months during defect liability period, and thereafter operation &amp; maintenance for 4 years at Zone – III, Hisar.</td>
<td>Rs. 7500/-</td>
<td>Rs. 26.00 Lacs</td>
<td>02.09.11 10:30 AM to 5:00PM</td>
<td>15 months for completion of work 3 Months trial run 12 Months defect liability &amp; Mtc. period 4 Years Operation &amp; Maintenance with Cost</td>
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1. Tenders will be received online at the website http://huda.etenders.in and will be opened by the Executive Engineer, Haryana Urban Development Authority, Division No. I, Hisar on 02.09.2011 at 10.30 AM to 5.00 PM in the presence of tenderers or their authorized agent who may like to be present.

2. Tenders must be submitted online on the Electronic Tendering system of HUDA. The Technical bids / Envelopes which cannot be submitted online are required to be delivered in person by the intending contractor or his agent to the Executive Engineer, Haryana Urban Development Authority, Division No. I, Hisar.
3. The earnest money in shape of Deposit At Call Receipt / Bank Draft only in favour of Executive Engineer HUDA Division No. 1 Hisar, drawn on any Scheduled Bank payable at Hisar shall only be accepted.

4. Tenders should be submitted online on the prescribed Form/Template which can be downloaded from the website http://huda.etenders.in. The prescribed form contains the conditions of contract to be executed with the contractor whose tender is accepted.

5. The Executive Engineer, Haryana Urban Development Authority reserves the right of issuing the material to the contractor as per list enclosed for use on works at the places and rates noted against each, plus 3% storage charges. The materials are to be issued from the reserve stock. The contractor shall be responsible for obtaining the material (required for the work) from Haryana Urban Development Authority, and for making payment thereof by deduction of the same from his bills at the rates specified in these bid documents.

6. As the Bids that are to be submitted online are required to be encrypted and digitally signed, the Bidders are therefore advised to obtain the same (Digital Signature Certificate) at the earliest. For obtaining Digital Certificate, the Bidders may contact the representative of Nextenders (The service provider of Electronic Tendering System).

7. **Key Dates**

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<tr>
<th>Sr. No.</th>
<th>HUDA Stage</th>
<th>Contractor Stage</th>
<th>Start Date and Time</th>
<th>Expiry Date and Time</th>
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<tr>
<td>1</td>
<td>Release of Tender</td>
<td>-</td>
<td>28.07.2011 10.00 AM</td>
<td>29.07.2011 05.00 PM</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>Download Tender Document</td>
<td>29.07.2011 05.01 PM</td>
<td>26.08.2011 09.00 AM</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>Pre-bid meeting with intending tenderers</td>
<td>10.08.2011 11.00 AM</td>
<td>10.08.2011 03.00 PM</td>
</tr>
<tr>
<td>4</td>
<td>Technical &amp; Financial Lock</td>
<td>-</td>
<td>26.08.2011 09.01 AM</td>
<td>26.08.2011 05.00 PM</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>Re-encryption of Online Bids</td>
<td>26.08.2011 05.01 PM</td>
<td>28.08.2011 05.00 PM</td>
</tr>
<tr>
<td>6</td>
<td>-</td>
<td>Manual Submission of (Technical)Documents &amp; EMD</td>
<td>29.08.2011 10.30 AM</td>
<td>29.08.2011 05.00 PM</td>
</tr>
<tr>
<td>7</td>
<td>Open EMD &amp; Technical/PQ bid</td>
<td>-</td>
<td>30.08.2011 10.30 AM</td>
<td>30.08.2011 05.00 PM</td>
</tr>
<tr>
<td>8</td>
<td>Technical bid Evaluation</td>
<td>-</td>
<td>01.09.2011 10.30 AM</td>
<td>01.09.2011 05.00 PM</td>
</tr>
<tr>
<td>9</td>
<td>Open Financial / Price-Bid</td>
<td>-</td>
<td>02.09.2011 10.30 AM</td>
<td>02.09.2011 05.00 PM</td>
</tr>
</tbody>
</table>

8. The Bidders can download the bidding documents from the Portal http://huda.etenders.in. Tender Documents Fees has to be paid online during the Bid Preparation (Hash Submission) stage but the Earnest Money Deposit has to be submitted in a separate sealed envelope (Marked ED). The physical EMD envelope should reach in the office of Executive Engineer, HUDA Division I, Hisar, on or before **29.08.2011 upto 5.00 P. M.** As the details of the EMD are required to be filled at the time of Bid Preparation & Hash Submission stage, the Bidders...
are therefore required to keep appropriate EMD details ready for online uploading on the e-
tendering system also.

9. The tender shall be submitted by the tenderer in the following three separate envelopes online:-
   a. Earnest Money - Envelope ‘ED’
   b. Post Qualification Documents - Envelope ‘TI’
   c. Tender in Form – A (Price Bid) - Envelope ‘CI’

Note: Online Bidders may submit the EMD in a physical EMD Envelope – ‘ED’ and any other document related to Technical Bid, Post Qualification Documents which cannot be submitted online in a physical Technical Envelope – ‘TI’. Price Bids are to be submitted mandatory online and shall not be accepted in any physical form.

Reference of the EMD is to be mentioned online. Also, in case of Technical Bids, the lists of documents being submitted physically are required to be uploaded online.

Above envelopes, (as applicable) shall be kept in a bigger outer envelope, which shall also be sealed.

10. In the first instance, the Envelope – ‘ED’ of all the Bidders containing the Earnest Money shall be opened online and physically. If the Earnest Money is found proper and in order, the Envelope ‘TI’ containing Technical Bid/Post Qualification Documents shall be opened in the presence of such contractors who choose to be present. The Financial Offer in Envelope ‘CI’ shall be opened only of those tenderers who meet the qualification criteria as per the Bid documents. The date of opening of Financial Bid shall be fixed after the opening of Technical Bid.

11. The Contractual Agencies will submit the necessary documents as under:-
   a. Envelope ‘ED’ – Earnest Money Deposit Envelope
      Physical EMD Envelope – Earnest Money in shape of demand draft in favour of Executive Engineer, HUDA, Div. II, Hisar.
      Online EMD Envelope — Contractor shall also provide online, the details of the Earnest Money / Deposit instrument.
   b. Envelope ‘TI’ – Technical Bid Envelope
      Physical Technical Envelope – The Information and Documents / Certificates which are required to be submitted as per the conditions of the Tender documents that cannot be submitted online, if any, should be submitted in a separate envelope.
**Online Technical Bid Envelope** – All the information and scanned copies of the Documents / Certificates are required to be submitted online in accordance with the Tender documents.

Point wise details of Technical documents required to be upload online.

c. **Envelope ‘CT’ – Price Bid Envelope**

   The intending Contractors shall fill the lump sum rate / item rate / Percentage rate online in the templates of the online tender. The Price Bid has to be submitted mandatory online.

12. In case, the Bidders have online submitted all the information and documents/ certificates required as a part of Technical Bid then, physical Envelope “TI” shall not be required. However the Executive Engineer has the right to verify the authentication of the documents submitted by the bidder online or physically.

13. The contractual agencies should submit their tender documents (Online and physical) strictly as per the Key Dates mentioned in these bid documents.

14. In case financial bid is submitted by a bidder and technical bid, earnest money deposit or other documents as required in accordance with the bid documents, are not submitted, then the bidder would be debarred from further tendering in HUDA for a period of minimum 2 years.

15. DNIT & Pre-qualification eligibility criteria can also be seen on any working day during office hours in office of the executive Engineer.

16. In case the day of opening of tenders happens to be holiday, the tenders will be opened on the next working day. The time and place of receipt of tenders and other conditions will remain unchanged.

17. Tender which is not accompanied with the earnest money or not accompanied with full amount of earnest money depicted in the NIT shall not be considered / opened.

18. The tender of the bidder who does not satisfy the qualification criteria in the bid documents are liable to be rejected summarily without assigning any reason and no claim whatsoever on this account will be considered.

19. If any tenderer, modifies or withdraws his tender subsequent to submitting it to the Executive Engineer, HUDA, while on one hand he is liable to be blacklisted, on the other hand his earnest money shall be forfeited without prejudice to other rights and remedies available to the Executive Engineer.

20. The rates of the contractors shall remain open for a period of three months from the date of opening of the price bids and if a contractor submits a tender limiting the period of validity to a date earlier, then he shall be liable to be blacklisted and his earnest money shall stand forfeited without prejudice to other rights and remedies available to the Executive Engineer.
21. The contractor whose tender is accepted will be required to execute a contract deed in the prescribed form and will be required to furnish 5% security for the due fulfillment of this contract or alternatively at the discretion of the Engineer-in-charge it will be deducted from the running payments to be made on account of work done. (The earnest money will be treated as part of security).

22. The approval of the acceptance of tender will rest with the C.E / S.E who does not bind himself to accept the lowest tender and reserves to himself the authority to reject any or all of tenders received without assigning any reason.

23. No conditional tender should be given. A conditional tender is liable to be rejected out rightly at the discretion of the accepting authority. In the alternative the accepting authority may treat the conditions as null and void and make a counter offer to the tenderer to do the work at the premium or rebate/rates quoted by him without conditions. If the tenderer refuses to accept the said counter offer to do the work at the premium or rebate/rates quoted by him without the condition within one week of the counter offer having been made by the accepting authority, his earnest money shall stand forfeited and the tenderer shall have no claim to the same whatsoever.

24. The successful tenderer shall have to sign an affidavit to the effect that he has no relation or connection with firm/contractor blacklisted by HUDA/Haryana Govt./Govt. of India, from time to time as per the form of affidavit attached with these bid documents.

25. The earnest money deposited for the tender will not be returned to the contractor’s/firm’s till the acceptance of tender or three months, whichever is earlier.

26. Pre – bid Conference for the applicants seeking any clarifications shall be held on __________ at 11.00 a.m. In office of the Executive Engineer HUDA Division No.1 Hisar.

27. Sales / Works Tax, Income Tax, Labour cess or any other tax will be deducted from the bills of contractor as per the instructions of the Govt.

28. Eligibility Criteria for Post Qualification shall be as follows :-

   a. Contractors Enlisted for Special Category for construction of STP by HUDA / PWD Water Supply and Sanitation Department Haryana subject to the following conditions:-

      i. The applicant shall have completed and Commissioned, during the last five years, at least one work of Design, Construction & Commissioning of Sewage Treatment Plant of not less than One Plant of 10 MLD capacity based on Activated Sludge Process / SBR (Cyclic Activated Sludge Process) / UASB / MBBR on Turnkey basis for any Government organization. The Applicant shall produce authenticated certificate in this regard from the client department.

      ii. The average Annual Financial Turnover on construction works should be at least Rs. 13.00 Crores during the last Three Financial Years ending 31.03.2011. The Audited Balance sheet and relevant accounts certified by the
Chartered Accountant shall be produced alongwith the application for issue of blank tender forms.

iii. The Contractor shall produce a certificate of Net Worth of Rs. 2.60 Crores duly certified by Chartered Accountant.

b. The applicant shall necessarily tie up with a Technology Provider for Providing Designing Performance Guarantee / key equipments for Cyclic Activated Sludge Process/SBR Technology. The Technology Provider must meet the following minimum criteria.

d. The Technology Provider must have provided technology for minimum one Sewage Treatment Plants not less than of 15 MLD capacity should have been completed and commissioned for one year in India based on Cyclic Activated Sludge Process/SBR Technology for Government Organization.

e. Technology Provider must have a registered Company in India fully equipped with trained manpower to extend services as and when required.

Organization chart and other relevant documents to be submitted.

The applicant shall produce Authenticated Certificate regarding all the above conditions from the client department.

vi. All the documents, certificates submitted shall be attested by Gazetted Officer / Notary

29. Firms / Contractors who have been black listed by any Govt. / Semi Govt. / Board / Corporation / shall not be eligible to bid for this work.

30. The Department reserves the right to verify the particulars furnished by the applicant independently. If any information furnished by the applicant is found to be incorrect at a later stage, the firm / contractor shall be liable to be debarred from future tendering in Department and legal action will also be initiated and allotment is liable to be cancelled besides black listing the contractor / firm.

31. All disputes concerning this work shall be with in the jurisdiction of Hisar only.

32. Conditional Tenders, Tender without Earnest Money, Tender not furnished on Prescribed Form and Tender By Post / Telegram and received after due date and time shall not be entertained.

33. Department reserves the right to reject any / all the applications without assigning any reason. Over all bid will be the criteria for finalization of Tender.
34. For further details, terms & conditions please contact the office of undersigned or log on website: http://huda.etenders.in.

EXECUTIVE ENGINEER,
HUDA DIVISION No. 1, HISAR
SECTION-1

CONDITIONS OF E-TENDERING

Instruction to Contractor on Electronic Tendering

These conditions will over-rule the conditions stated in the tender documents, wherever relevant and applicable.

1. Registration of contractors on E-tendering Portal:

All the Contractors intending to participate in the tenders processed online, are required to get registered on the Electronic Tendering System on the Portal http://huda.etenders.in. For more details, please see the information on the Registration info link on the home page.

2. Obtaining a Digital Certificate:

2.1 The Bids submitted online should be encrypted and signed electronically with a Digital Certificate to establish the identity of the bidder bidding online. These Digital Certificates are issued by an Approved Certifying Authority, by the Controller of Certifying Authorities, Government of India.

2.2 A Digital Certificate is issued upon receipt of mandatory identity (i.e. Applicant’s PAN Card) and Address proofs and verification form duly attested by the Notary Public / Charted Account / Any Gazatted Officer whose stamp carrying emblem of Ashoka. Only upon the receipt of the required documents, a digital certificate can be issued.

2.3 The contractors may obtain Class-II digital certificate from any Certifying Authority or Sub-certifying Authority authorized by the Controller of Certifying Authorities or may obtain information and application format and documents required for the issue of digital certificate from:

M/s NexTenders (India) Pvt. Ltd.
YUCHIT, Juhu Tara Road,
Mumbai – 400049
Email: Chandigarh@nextenders.com or

M/s NexTenders (India) Pvt. Ltd.
HSRDC Building, Bays No. 13-14, Sec-2,
Panchkula-134151
Contact No.: +919815034028 / +919878012160
E – Mail ID – chandigarh@nextenders.com

2.4 Bid for a particular tender may be submitted online using the digital certificate, which is used to encrypt the data and sign the hash during the stage of bid preparation & hash submission. In case, during the process of a particular tender, the user looses his digital certificate (be it due to virus attack, hardware problem, operating system or any other problem) he will not be able to submit the bid online. Hence, the users are advised to keep a back up of the certificate and also keep the copies at safe place under proper security (for it’s use in case of emergencies).

2.5 In case of online tendering, if the digital certificate issued to the authorized user of a firm is used for signing and submitting a bid, it will be considered equivalent to a no-objection certificate/power of attorney /lawful authorization to that User. The firm has
to authorize a specific individual through an authorization certificate signed by all partners to use the digital certificate as per Indian Information Technology Act 2000. Unless the certificates are revoked, it will be assumed to represent adequate authority of the user to bid on behalf of the firm in HUDA tenders as per Information Technology Act 2000. The digital signature of this authorized user will be binding on the firm.

2.6 In case of any change in the authorization, it shall be the responsibility of management / partners of the firm to inform the certifying authority about the change and to obtain the digital signatures of the new person / user on behalf of the firm / company. The procedure for application of a digital certificate however will remain the same for the new user.

2.7 The same procedure holds true for the authorized users in a private/Public limited company. In this case, the authorization certificate will have to be signed by the directors of the company.

3 Opening of an Electronic Payment Account:

For purchasing the tender documents online, contractors are required to pay the tender documents fees online using the electronic payments gateway service. For online payments, please refer to the Home page of the e-tendering Portal http://huda.etenders.in

4 Set up of machine:

In order to operate on the electronic tender management system, the user’s machine is required to be set up. A help file on setting up of the system can be obtained from M/s Nextenders (India) Pvt. Ltd. or can be downloaded from the home page of the website - http://huda.etenders.in.

5 Online Viewing of Detailed Notice Inviting Tenders:

The contractors can view the detailed N.I.T and the time schedule (Key Dates) for all the tenders floated through the electronic tendering system on the HUDA’s e-tenders website http://huda.etenders.in

6 Download of Tender Documents:

The tender documents can be downloaded from the Electronic Tendering System through the Portal http://huda.etenders.in

7 Key Dates:

The contractors are strictly advised to follow dates and times as indicated in the Notice Inviting Tenders. The date and time will be binding on all contractors. All online activities are time tracked and the system enforces time locks that ensure that no activity or transaction can take place outside the start and end dates and the time of the stage as defined in the Notice Inviting Tenders.

8 Bid Preparation (Technical & Financial) Online Payment of Tender Document Fee and Submission of Bid Seal (Hash) of online Bids:

8.1 The Payment can be made by eligible / contractors online directly through Credit Cards / Internet Banking Accounts / Cash Cards. The contractors have to pay the cost
of the tender documents online by making online payment of tender document fees using the service of the secure electronic payment gateway. The secure electronic payments gateway is an online interface between contractors and credit card / online payment authorization networks.

8.2 Submission of bids will be preceded by submission of the digitally signed bid seal (Hash) as stated in the time schedule (Key Dates) of the Tender.

9 **Generation of Super Hash:**

After the submission of Bids (Hash) by the Contractors, the bidding round will be closed and a digitally signed Super Hash will be generated by the authorized HUDA officers. This is equivalent to sealing the tender box.

10 **Submission of actual online bids:**

Contactors have to submit their encrypted bids online and upload the relevant documents for which they generated the hash at the stage of hash generation & submission after the generation of Super Hash. The process is required to be completed within the date and time as stated in the Notice Inviting Tenders (Key Dates). The electronic bids of only those contactors who have submitted their bid seals (Hashes) within the stipulated time, as per the tender time schedule (Key Dates), will be accepted by the system. A contractor who does not submit his bid seal (Hash) within the stipulated time will not be allowed to submit his bid.

**Note:** *Bidders participating in e-tendering shall check the validity of his/her Digital Signature Certificate before bidding in the Tenders floated online at e-tendering portal of HUDA’s website [http://huda.etenders.in](http://huda.etenders.in).*

Executive Engineer,
Haryana Urban Dev. Authority.
Division No. I, Hisar.
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1. **PRICE SCHEDULE**

**1.1 Name of the Work:** Providing external Sewerage Scheme for Zone - III, Hisar. "Design, Construction, Supply, Erection, Testing & Commissioning of 15 MLD Capacity MPS & Cyclic Activated Sludge Process/SBR technology based 15MLD Sewage Treatment Plant including 3 months successful trial run, operation & maintenance for 12 months during defect liability period, and thereafter operation & maintenance for 4 years at Zone - III, Hisar.

**1.2 General**

The price Schedule shall be with reference to the Notice Inviting Tender, Instruction to Bidders, Conditions of Contract, Scope of Work and Technical Specifications of the Tender Documents and minutes of pre bid meeting.

The Price Schedule, Notice Inviting Tender, Instruction to Bidders, Conditions of Contract, Scope of Work and the Technical Specifications for Civil, Electrical, Mechanical and operation & maintenance which form an integral part of this Contract, shall be read in conjunction.

The price Schedule given here is broadly for the following works:
- Civil Works
- Electrical & Mechanical Works
- Trial Run
- Operation, maintenance & monitoring Works.

Each item in the price Schedule shall be individually priced in ink and the same shall be added up to the Bid Cost. No column in the price Schedule shall be left blank. The price quoted by the Bidder must allow for all works as per the detailed specifications and for all contractual obligations whether separately specified or not.

The rates and prices in the price Schedule shall, except in cases separately provided for, be deemed to cover all the contractual obligations under this contract.

Detailed break-up of payment, to be approved by Competent Authority, for different components of the works shall be submitted by successful bidder within before the award of the work.

Any other item to be executed as per scope of work but not covered in the sub-head under broad break-up of payment should also be specified separately along with price Schedule by the bidder.

**1.3 Civil Works**

The Civil works shall include all the works indicated on the Drawings and as specified in the Scope of Work and Technical Specifications given in Volume I & II. Any additional item if required from process point of view and for better performance of the plant shall be considered while quoting offer.

All items under Civil works are inclusive of all excavation in any type of strata and required depth, including dewatering of Sub-soil Water for Concreting and other works, refilling the sides of excavation after construction of structure, disposing of surplus soil etc. complete as detailed in Volume I & II and as directed by the Engineer in Charge.

__________________________  _______________________
Company Seal               Signature of the Bidder
All items of Piping works for STP shall be inclusive of excavation in any type of strata, including supply, laying, jointing and testing of all pipelines, specials, valves, all types of labour, construction of sewer appurtenances and valve chambers, pipe support pedestals complete in all respects as detailed in Volume I and as directed by engineer-in-charge.

1.4 Electrical, Mechanical and Instrumentation works
The scope of work under the contract shall include all the work indicated on the Drawings and as specified in the Scope of Work and Technical Specifications given in Volume I & II.

1.5 Performance Run, Operation, Maintenance & Monitoring Works
The scope of work under the contract shall include all the work as specified in the Scope of Work and Technical Specifications given in Volume I & II.

1.6 Currency
The Bidder shall quote all prices in the price Schedule in Indian currency in both words and figures.

1.7 Validity of Offer
The Price Offer is valid for a period of 90 days from the date of submission of the tender document and till the bidder withdraws his offer in writing beyond 90 days.

1.8 Earnest Money Deposit
The EMD of the successful Bidder, as per Notice Inviting Tender (NIT), shall be adjusted against the Security Deposit for this job.

1.9 Security Deposit
Total security deposit amount is 5% of the agreement amount.

Security Deposit Amount
EMD amount of 2% will be converted into part of security deposit. Balance 3% of security deposit shall be deducted at the rate of 5% per RA Bill. Security Deposit shall be released 12 months after successful commissioning of 3 months trial run period and submission of Performance Bank Guarantee of equivalent amount valid for the period for O & M period in favour of E.E. HUDA, Division No. I, HISAR.

1.10 Taxes, VAT
Income Tax, Works Contract Tax and any surcharge or any other taxes as applicable from time to time will be deducted from the payments of the contractor, at source, as applicable.

The Bidder shall include in his price Bid, trade tax, income tax, works contract tax, any surcharge, sales tax, and all other Central Govt. and State Govt. taxes / duties as applicable. No additional payment will be reimbursed towards any new taxes or any increase in tax during execution of the work.

_________________________  ____________________________
Company Seal                Signature of the Bidder
1.11 Cost Break Up

1. As the tender is of lump sum type, total cost of works has been split into units and the percentage cost of each unit is stipulated to facilitate the unit wise payments. Cost of an individual unit shall be worked out on the basis of the stipulated percentage and accepted cost of the work. The percentage value stipulated for the unit is for completion of the entire work related to the unit as per detailed specifications and requirements mentioned in the tender document. In case any addition or deletion in these units items takes place after designs are approved for the unit, the actual cost for the purpose of payment will be worked out on the basis of quantities as per the approved drawings and prevailing schedule of rates in HSR. If the work of a unit is deleted by the department, from the scope of contract before approval to the detailed drawings, the cost of such deleted unit will be decided on the basis of the stipulated percentages in Table 1.

2. It shall be explicitly noted by the bidders/contractor that the tables given shall be referred only for facilitating the payments to the contractor and shall not be any way referred to, for defining and restricting the scope of work under the contract.

___________________________
Company Seal

___________________________
Signature of the Bidder
**PRICE BREAKUP SCHEDULE FOR 15 MLD MPS**

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Unit and Stage of Construction</th>
<th>% of Cost of Unit</th>
</tr>
</thead>
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<td>2</td>
<td>Process and Hydraulic Design and Detailed Engineering</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Civil Works</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>i) Screen Chamber = 40 % of 55% = 22% of total cost.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ii) Collecting Tank &amp; Pipe Gallery = 60 % of 55% = 33% of total cost.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Sub Total</strong> = 55%</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Electrical &amp; Mechanical Works</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>i) Submersible pumping Sets &amp; Gantry Gurder = 60 % of 43% = 25.80 % of the total cost.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ii) Panel for Submersible Pumps = 25 % of 43% = 10.75 % of the total cost. = 10.75%</td>
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<tr>
<td></td>
<td>iii) C.I pipes, Sluice Valves, Non Return Valves &amp;Specials etc. = 10 % of 43% = 4.30 % of the total cost. = 4.30%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>iv) Miscellaneous = Electrical &amp; Mechanical Works = 5 % of 43% = 2.15 % of the total cost. = 2.15%</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Sub Total</strong> = 43%</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

**STAGE WISE PAYMENT SCHEDULE FOR CIVIL WORKS**

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Unit and Stage of Construction</th>
<th>% of Cost of Unit (Refer Price Breakup Schedule )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sewage Pumping Station</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Excavation</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Concreting of Raft</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Concreting of Walls (1/2 height)</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>Concreting of Walls (full height)</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>Entire Completion of Civil Works</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Successful Hydraulic Testing and Commissioning</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Consistent Performance of the Plant</td>
<td>6</td>
</tr>
</tbody>
</table>

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Company Seal

Signature of the Bidder

15
STAGEWISE PAYMENT SCHEDULE FOR MECHANICAL / ELECTRICAL / INSTRUMENTATION / INTERCONNECTING PIPING / TRANSFORMER / AUTOMATION FOR BLOWER ROOM / MISCELLANEOUS OFFICE EQUIPMENT WORKS

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Stage of Progress</th>
<th>Percent of cost of unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>On receipt of equipment / material on site</td>
<td>70</td>
</tr>
<tr>
<td>2</td>
<td>On erection / installation</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>Testing and successful commissioning including 3 months trial run</td>
<td>15</td>
</tr>
</tbody>
</table>

Payment for O & M shall be made in equal installments at the end of each quarter.

Company Seal  

Signature of the Bidder
### PRICE BREAKUP SCHEDULE FOR 15 MLD STP HISAR.

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Unit and Stage of Construction</th>
<th>% of Cost of Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Process and Hydraulic Design and Detailed Engineering</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>Inlet Chamber</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Screen Chamber</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A Civil</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>B Mechanical including</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Screens</td>
<td>1.5</td>
</tr>
<tr>
<td>4</td>
<td>Grit Chamber</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A Civil</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>B Mechanical including</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Grit Mechanism with all associated accessories</td>
<td>1.5</td>
</tr>
<tr>
<td>5</td>
<td>Distribution Box and Bypass arrangement</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Civil</td>
<td>1.5</td>
</tr>
<tr>
<td>6</td>
<td>Cyclic Activated Sludge / SBR Basin</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A Civil</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>B Mechanical including</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Decanters</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Diffusers</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Diffuser Grid</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Air Blower with accessories</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Sludge Recirculation &amp; Waste Sludge Pumps</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>Chlorination System</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A Mechanical including</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chlorinator along with booster pumps and accessories</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>B Civil including</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chlorination Tank</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Chlorinator Shed</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>Sludge Sump and Pump House</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A Civil</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>B Mechanical including</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sludge Sump Blowers and Air Grid</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Centrifuge Feed Pumps</td>
<td>1</td>
</tr>
</tbody>
</table>

Company Seal

Signature of the Bidder
<table>
<thead>
<tr>
<th>Sr.</th>
<th>Unit and Stage of Construction</th>
<th>% of Cost of Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Centrifuge House</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.00%</td>
</tr>
<tr>
<td>A</td>
<td>Civil</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mechanical including</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.00%</td>
</tr>
<tr>
<td></td>
<td>Dewatering Polymer Dosing System</td>
<td>Centrifuge</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Administrative Building including Furniture and Laboratory Equipments</td>
<td>Civil</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Furniture &amp; Lab. Equipment</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Blower and MCC cum Control Rooms, Staff Quarters</td>
<td>Civil</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Internal Roads, Pathways, Payments, Storm Water Drainage</td>
<td>Civil</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Site Clearance, Disposal/ Plot Development – Landscaping etc.</td>
<td>Civil</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>*Electrical Works including</td>
<td>Substation and Allied Works</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Power Transformer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>415 V Switchgear including PCC, MCC, DBs, etc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Automatically Controlled Capacitor Bank</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cabling for entire plant</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Earthing and Lighting Protection system for entire plant</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Street Lighting system for entire plant</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Instrumentation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PLC</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

* The department will provide power up to LT panel and thereafter all the arrangement will be made by the agency at its own cost.

**Note:** Incase any of the above items is not executed, the percentage allocation for that item shall be distributed to other item(s) as directed by engineer in charge and payment for that will not be made.

The contractor shall submit the running bills to the engineer in charge. After scrutiny, the engineer in charge shall record the bill and send the same to accounts department for payment duly recommended.
STAGE WISE PAYMENT SCHEDULE FOR CIVIL WORKS

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Unit and Stage of Construction</th>
<th>% of Cost of Unit (Refer Price Breakup Schedule)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Inlet Chamber</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Excavation</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Entire Completion of Civil Works</td>
<td>77</td>
</tr>
<tr>
<td></td>
<td>Successful Hydraulic Testing and Commissioning</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Consistent Performance of the Plant</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>Screen Chamber</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Excavation</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Concreting of Raft</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Concreting of Walls (1/2 height)</td>
<td>22</td>
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<td></td>
<td>Concreting of Walls (full height)</td>
<td>22</td>
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<td></td>
<td>Successful Hydraulic Testing and Commissioning</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Consistent Performance of the Plant</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>Grit Chamber and Parshall Flume</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Excavation</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Concreting of Raft</td>
<td>25</td>
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<td></td>
<td>Successful Hydraulic Testing and Commissioning</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Consistent Performance of the Plant</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>Distribution Box</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Excavation</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Entire Completion of Civil Works</td>
<td>77</td>
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<tr>
<td></td>
<td>Successful Hydraulic Testing and Commissioning</td>
<td>5</td>
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<tr>
<td></td>
<td>Consistent Performance of the Plant</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>Cyclic Activated Sludge / SBR Basin</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Excavation</td>
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<td></td>
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<tr>
<td></td>
<td>Concreting of Walls (full height)</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>Entire Completion of Civil Works</td>
<td>8</td>
</tr>
</tbody>
</table>

_________________________  ___________________________
Company Seal              Signature of the Bidder
<table>
<thead>
<tr>
<th>Sr.</th>
<th>Unit and Stage of Construction</th>
<th>% of Cost of Unit (Refer Table 1.0)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Successful Hydraulic Testing and Commissioning</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Consistent Performance of the Plant</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td><strong>Sludge Sump and Pump House</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Excavation</td>
<td>12</td>
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<td></td>
<td>Concreting of Raft</td>
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<tr>
<td></td>
<td>Consistent Performance of the Plant</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td><strong>Chlorination Tank</strong></td>
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<tr>
<td></td>
<td>Excavation</td>
<td>12</td>
</tr>
<tr>
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</tr>
<tr>
<td>8</td>
<td><strong>Centrifuge House</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Excavation</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>RCC Framed Structure</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>Entire Completion of Civil Works</td>
<td>50</td>
</tr>
<tr>
<td>9</td>
<td><strong>Administrative Building including Furniture and Laboratory Equipments</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Excavation</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>RCC Framed Structure</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>BBM and Plastering</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Entire Completion of Civil Works</td>
<td>30</td>
</tr>
<tr>
<td>10</td>
<td><strong>Blower and MCC cum Control Rooms, Staff Quarter.</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Excavation</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>RCC Framed Structure</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>Entire Completion of Civil Works</td>
<td>50</td>
</tr>
<tr>
<td>11</td>
<td><strong>Site Clearance, Disposal/ Plot Development – Landscaping etc.</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Entire Completion of Works</td>
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</tr>
</tbody>
</table>
STAGEWISE PAYMENT SCHEDULE FOR MECHANICAL / ELECTRICAL / INSTRUMENTATION / INTERCONNECTING PIPING / TRANSFORMER / AUTOMATION FOR BLOWER ROOM / MISCELLANEOUS OFFICE EQUIPMENT WORKS

<table>
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</tr>
<tr>
<td>3</td>
<td>Testing and successful commissioning including 3 months trial run</td>
<td>15</td>
</tr>
</tbody>
</table>

Being a lump sum contract, the payments through RA Bills will be made to the contractor on the basis of stage wise break-up of payment. A part of work will become eligible for payment only on completion of particular stage of payment. Intermediate payments on pro-rate basis or as per actual measurements shall not be made. The bidders are expected to study the unit wise and stage wise break-up of the payment and shall quote their total price accordingly. The successful bidder will submit the payment break up for approval of the competent authority. The payment break up approved by the competent authority shall be final and binding on the agency.

__________________________
Company Seal

__________________________
Signature of the Bidder
## PRICE SCHEDULE

**Name of Work:** Providing Sewerage Scheme for Urban Estate Hissar "Design, Construction, Supply, Erection and Commissioning of Cyclic Activated Sludge Process/SBR technology based 15MLD Sewage Treatment Plant including 3 months successful trial run, operation & maintenance for 12 months during defect liability period, and thereafter operation & maintenance for 4 years at Urban Estate Hissar.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Description</th>
<th>Rate to be quoted by the contractors for compete work / jobs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Providing external Sewerage Scheme for Zone – III, Hissar.</td>
<td></td>
</tr>
<tr>
<td>i)</td>
<td>Providing Sewerage Scheme for Urban Estate Hissar &quot;Design, Construction, Supply, Erection and Commissioning of 15 MLD capacity main pumping station including all Civil Mechanical Electrical, instruments, transformers, HT Panel etc including 3 months successful trial run at urban Estate, Hisar. ( FOR 15 MLD MPS )</td>
<td>Rs. …………………. ( In figures) Rs………………….. ( In words )</td>
</tr>
<tr>
<td>2.</td>
<td>Operation and Maintenance for 5 Years after successful 3 months trial run with operation and maintenance including operational staff consumable /material/ items including maintenance of machinery / equipments structures street light, land scaping etc as required for the complete job but excluding the cost of electricity bills.</td>
<td>Rs. …………………. ( In figures) Rs………………….. ( In words )</td>
</tr>
<tr>
<td>a)</td>
<td>Operation and Maintenance for 1st Year i.e, 12 months during the defect liability period after 3 months trial run.</td>
<td>Free of Cost</td>
</tr>
<tr>
<td>b)</td>
<td>Operation and Maintenance for 2nd Year .</td>
<td>Rs. …………………. ( In figures) Rs………………….. ( In words )</td>
</tr>
<tr>
<td>c)</td>
<td>Operation and Maintenance for 3rd Year .</td>
<td>Rs. …………………. ( In figures) Rs………………….. ( In words )</td>
</tr>
<tr>
<td>d)</td>
<td>Operation and Maintenance for 4th Year .</td>
<td>Rs. …………………. ( In figures) Rs………………….. ( In words )</td>
</tr>
<tr>
<td>e)</td>
<td>Operation and Maintenance for 5th Year .</td>
<td>Rs. …………………. ( In figures) Rs………………….. ( In words )</td>
</tr>
</tbody>
</table>

**Company Seal**

**Signature of the Bidder**
HARYANA URBAN DEVELOPMENT AUTHORITY
HUDA DIVISION No. 1 HISSAR
NOTICE INVITING TENDERS


2. Printed forms of tenders consisting of the detailed plans; complete specification, the schedule of quantities of the various classes of work to be done and the set of conditions of contract to be complied with by the person whose tender may be accepted, can be purchased from the Divisional Office during office hours everyday except on Sundays and Public Holiday on payment of Rs.7500 in cash.

2A. The site for the work is available.

3. Tenders, which should always be placed in sealed cover, with the name of the work written on the envelope will be received by the Executive Engineer HUDA Division Hissar upto 3.00 pm on _______ and will be opened by him in his office on the same day at 3.30 p.m.

4. The time allowed for carrying out the work will be 15 months.

5. The contractor should quote in figures as well as in words the rates, and amount tendered by them. The amount for each item should be worked out and the requisite totals given.

6. Issue of tender form will be stopped two days before the date fixed for the opening of the tenders.

7. Earnest money amounting to Rs. 26.00 lacs in form of DAC / Demand Draft must be submitted along with individual tender and is to be sealed / superscribed with the name of the work and addressed to the Executive Engineer HUDA Division Hissar. No.1 other form including hard cash shall be accepted.

E.M.D. in the approved form only is to be submitted in a separate sealed cover and attached to the tender documents cover. The tender shall be opened, only, if the E.M.D. is in form of Demand Draft/Deposit at Call Receipt (DAC) issued by a scheduled Bank. EMD in no other form shall be accepted. DD/DAC shall be payable at Hissar.

8. The contractor, whose tender is accepted will be required to furnish by way of security deposit for the due fulfillment of the contract at uniform rate 5% of agreement cost.
The security Deposit will be collected by deductions from running bills of the contractor at the rates mentioned above and the earnest money deposited in cash at the time of tenders, will be treated as a part of security deposit.

9. The acceptance of a tender, will rest with the Chief Engineer who does not bind himself to accept the lowest tender, and reserves to himself the authority to reject any or all of the tenders received without the assigning any reason. Tenders in which any of the prescribed conditions are not fulfilled or are incomplete in any respect are liable to be rejected.

10. Canvassing in connection with tenders is strictly prohibited and the tenders submitted by the contractors who resort to canvassing will be liable to rejection.

11. All rates shall be quoted in the proper form of the tender alone.

12. An item rate tender containing percentage below/above will be summarily rejected, however where a tenderer voluntarily offers a rebate for payment within a stipulated period this may be considered.

13. On acceptance of the tender, the name of the accredited representative(s) of the contractor who would be responsible for taking instruction from the Engineer-in-charge shall be communicated to the Engineer-in-charge.

14. Special care should be taken to write the rates in figure as well as in words, and the amount in figures only, in such a way that interpolation is not possible. The total amount should be written both in figure and in words. In case of figure, the words Rs. should be written before the figure of rupees and words Paise after the decimal figure e.g. Rs. 2.15 P and in case of words the word Rupees should precede and the word paise should be written at the end, unless the rate is in whole rupees and followed by the words only, it should invariably by upto two decimal places. While quoting the rate in schedule of quantities, the word only should be written closely following the amount and it should not be written in the next line.

15. HUDA does not bind himself to accept the lowest or any tender and reserves to himself the right of accepting the whole or any part of the tender and the tenderer shall be bound to perform the same at the rate quoted.

16. Sales tax/or any other tax on material and Service tax in respect to this contract shall be payable by the contractor and Government will not entertain any claim whatsoever in this respect.

17. The contractor must produce permanent account number (PAN) issued by the income tax authorities before the tender papers can be sold to him.

18. The contractor shall not be permitted to tender for works in the HUDA . Circle (responsible for award and execution of contracts) in which his near relative is posted as Divisional Accountant or as an officer in any capacity between the grades of
Superintending Engineer and Assistant Engineer (both inclusive). He shall also intimate the names of the person who are working with him in any capacity or are subsequently employed by him and who are near relative to any gazetted officer in the HUDA Haryana. Any breach of this conditions by the contractor would render him liable to be removed from the approved list of contractors of the Department.

19. The tender for the work shall remain open for acceptance for a period of 90 days from the date of opening of the tender. If any tenderer withdraws his tender before the said period or makes any modification in the terms and condition of the tender which are not acceptable to the department then the HUDA shall without prejudice to any other right or remedy is at liberty to forfeit the entire amount of the Earnest Money Deposit (EMD) in the first instance. If such withdrawal is repeated with any other division in this department then the tenderer will also be liable for blacklisting, after issue of proper Show Cause Notice.

20. The tender for the composite work includes the sanitary and water supply installations. Electrical Works and Horticulture work.

21. It will be obligatory on the part of the contractors to tender and sign the tender documents for all the component parts and that, after the work is awarded, he will have to enter into an agreement for each component with the Executive Engineer HUDA Division No.1 Hissar.

22. The contractor shall submit list of works which are in hand (in Progress) in the following form:

<table>
<thead>
<tr>
<th>S N o.</th>
<th>Name of work</th>
<th>Name and Particulars of Division where work is being executed</th>
<th>Amount of work</th>
<th>Stipulated date of completion</th>
<th>Actual time taken for completion</th>
<th>Position of works in progress</th>
<th>Remarks</th>
</tr>
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<tbody>
<tr>
<td>1</td>
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</tbody>
</table>

Commencement | Completion |
23. The contractor’s responsibility for the contract shall commence from the date of issue of order of acceptance of tender.

24. Unsealed tenders will be summarily rejected.

25. The contractor should read the specifications and study the working drawing carefully before submitting the tender.

26. The tenderers should acquaint with the work and working conditions of the site and locality and no claim will be entertained on this issue.

27. Tender should enclose duly attested copies of the following along with tenders:

   a. Contractor’s Latest Registration Certificate.
   b. Permanent Account Number
   c. Any other certificate etc. as mentioned in the Tender Notice.

Executive Engineer
HUDA Division No. 1
Hissar.
FORM F-1
HARYANA URBAN DEVELOPMENT AUTHORITY
DIVISION NO. 1, HISAR
SINGLE PERCENTAGE RATE TENDER

Name of Contractor Sh. /M/s ________________________________________________
_______________________________________________________________________
_______________________________________________________________________

Name of work : ( As described at page No. 1 )            Job No. ..................

TENDER FEE Rs. 7500/- DEPOSITED VIDE RECEIPT NO. ________ DATED__________

Signature
( Dy. Supdt. )

GENERAL RULES AND DIRECTIONS FOR THE GUIDANCE OF CONTRACTOR

1. All works proposed for execution by contract will be notified in a form of invitation to tender posted in public places and signed by the Engineer-in-charge.

This form will state the work to be carried out as well as the date for submitting and opening tenders and the time allowed for carrying out the work; also the amount of earnest money to be deposited with the tender and the amount of the security deposit to be deposited by the successful tenderer and the percentage to be deducted from bills. Copies of the specification, drawings and any other documents, required in connection with the work, signed for the purpose of identification by the Engineer-in-charge will also be open for inspection by the contractor(s) at the office of the Engineer-in-charge during office hours.

2. In event of the tender being submitted by a firm, it must be signed separately by each member thereof, or in the event of the absence of any partner, it must be signed on his behalf, by a person holding power of attorney authorizing him to do so.

3. Any person who submits a tender shall fill up the usual printed form stating the Lump Sum rate of at which he is willing to do the work including any item considered necessary.

No single tender shall include more than one work, but contractor who wishes to tender for two or more works, shall submit separate tenders for each work. Tenders shall have the name and number of the work to which they refer written outside the envelope, in which these are sealed.
4. The tender receiving Committee or its authorized assistant will open tenders in the presence of intending contractors or their authorized agents who may like to be present at that time, and will enter the rate of all tenders. In the event of a tender being accepted, a receipt for the earnest money forwarded there with shall be given to the contractor. In the event of tender being rejected, the earnest money forwarded with such unaccepted tender shall be returned to the contractor.

5. The Executive Engineer reserves the right to reject all or any of the tender without assigning any reason.

6. The Haryana Urban Development Authority may refuse or suspend payments on account of a work which is executed by firm or by contractor described in their tender as a firm, unless receipt are signed by all the partners, or one of the partners, or some other person produces written authority enabling him to give effectual receipt on behalf of the firm.

7. The receipt of an Divisional Accountant or Dy. Supdt. for any money paid by the contractor will be considered as a acknowledgement of payment to Executive Engineer and the contractor shall be responsible for ensuring that he procures a receipt, duly signed by an authorized person.

8. The memorandum of work tendered for an the memorandum of materials to be supplied by the Haryana Urban Development Authority and their issue rates, shall be filled in the completed in the office of the Executive Engineer before the tender is issued to an intending tenderer, without having been so filled in and completed he shall request the office to have this done before he completes & delivers the tender.

The sum of Rs. 26.00 Lacs  Deposited vide Haryana Urban Development Authority Receipt No. __________ dated ________ as earnest money, the full value of which is to be absolutely forfeited to the Haryana Urban Development Authority or its successor in office without prejudice to any other rights or remedies. Should I/ we fail to commence the work specified in the above memorandum the said sum of equal to 5% of the total cost shall be retained by the Haryana Urban Development Authority on account of the security deposit specified in, Clause 1 of the said conditions of contract. Should I/ we withdraw of modify the tender after the date of opening of tender, my/ our earnest money will stand forfeited to the Haryana Urban Development Authority.

Witness

Signature of the Contractor

Executive Engineer                             Address

Date ………………..

The above tender is hereby accepted by me on behalf of Haryana Urban Development Authority.

Dated:…………………

Executive Engineer,
HUDA, Division No. 1 Hissar.
CONDITIONS OF CONTRACT

Clause-1  Security deposit. This will be the same percentage as that in the tender at (d) of Pre-page: The person/persons whose tender may be accepted (hereinafter called contractor) shall deposit an amount equal to five percent of the estimated cost of the work with the Executive Engineer (Earnest money shall be accounted as per memorandum) within 10 days of the acceptance of the tender by way of security deposit in case of default, the earnest money already lying with Executive Engineer shall stand absolutely forfeited to” the Haryana Urban Development Authority or its successor in office and the contract shall stand terminated or in the alternative, at the discretion of the Engineer-in-charge, the contractor may be required to permit Haryana Urban Development Authority at the time of making any payment to him for work done under the contract to deduct such sum as well (with the earnest money deposited by him) amount to 5% of all moneys so payable, such deductions to be held by Haryana Urban Development Authority by way of security deposit. All compensation or other sums of money payable by the contractor to Haryana Urban Development Authority under the terms of this contract may be deducted from his security deposit or from any sums which may be due or may become due to the contractor by Haryana Urban Development Authority on any account whatsoever and in the event of his security deposit being deducted by reason of any deduction, the contractor shall within 10 days thereafter make good in cash as aforesaid any sum which may have been deducted from his security deposit or any part thereof.

Clause-2  Compensation of Delay : The time allowed for carrying out the work as entered in the tender shall be strictly observed by the contractor and shall be reckoned from the date on which the order to commence work is given to the contractor. The work shall through out the stipulated period of the contract be proceeded with all due diligence (time being deemed to be the essence of the contract on the part of the contractor) and the contractor shall pay as compensation an amount equal to one percent which the Executive Engineer-in-Charge may levy on the estimated cost of the whole work as shown by the tender for everyday that the work remains un-commenced or unfinished, after the proper dates. And further to ensure good progress during the execution of the work the contractor shall be bound in all such cases in which the time allowed for any work exceeds one month to, complete one fourth of the whole of the work before one fourth of the whole of time allowed under the contract has elapsed, one half of the work before one half of such time has elapsed and three-fourth of the work before three fourth such time has elapsed. In the event of the contractor failing to comply with this condition, he shall be liable to pay as compensation, an amount equal to one percent which the Executive-Engineer-in-Charge may levy on the said estimated cost of the whole work for everyday that the due quantity of work remains incomplete. Provided always that the entire amount of compensation to be paid” under the provisions of this clause shall not exceed ten percent of the estimated cost of work as shown in the tender. The Superintending Engineer HUDA Circle, Hisar may on representation from the contractor, reduce the amount of compensation and his decision, in writing shall be final.
Clause-3  Action when whole of security deposit is forfeited: In any case in which under any clause in the contract, the contractor shall have rendered himself liable to pay any compensation to the Executive Engineer on behalf of the Haryana Urban Development Authority shall have power to adopt any of the following courses, as he may deem best suited in the interest of Haryana Urban Development Authority:-

(a) To rescind the contract of which rescission notice in writing to the contractor under the hand of the Executive Engineer shall be conclusive evidence and in such case the security deposit of the contractor shall stand forfeited and belong absolutely to the Haryana Urban Development Authority.

(b) To employ labour paid by the Haryana Urban Development Authority to supply material to carry out the work or any part of the work debiting the contractor with the cost of the labour and the price of the materials (for the amount a certificate of the Executive Engineer shall be final and conclusive, against the contractor) and crediting him with the value of the work done in all respects in the same manner and at the same rate as if it had been carried out by the contractor under the terms of his contract. The certificate of Executive Engineer as to the value of the work done shall be final and conclusive against contractor.

(c) To measure up the work of the contractor, and to take such part there of as shall be unexecuted out of his hands and to gives it to another contractor to complete, in which case any expenses which may be incurred in excess of the sum which would have been paid to the original contractor of the whole work has been executed by him (for the amount the certificate in writing of the Executive Engineer shall be final and conclusive) shall be borne and paid by the original contractor and may be deducted from any money due to him by Haryana Urban Development Authority under the contract or otherwise or from his security deposit.

In the event of any of the above courses adopted by the Executive Engineer, the contractor shall have no claim for the compensation for any loss sustained by him by reason of his having purchased or procured any materials or entered into any engagement or made any advance on account or with a view to the execution of the work or the performance of the contract and in case the contract shall be rescinded under the provision aforesaid the contractor shall not be entitled to recover or be paid any sum for any work thereof, actually performed under this contract unless and until the Executive Engineer have certified, in writing, the performance of such work and the value payable in respect, thereof, and he shall only be entitled to be paid the value so certified.

Clause-4  Contractor remains liable to pay compensation if action not taken under clause 3: In any case in which any of the powers conferred upon the Executive Engineer by clause 3 hereof shall have become exercisable and the same shall not exercised the
non-exercise thereof shall not constitute a waiver of any of the condition thereof and such powers shall notwithstanding be exercisable in the event of any future case of default by the contractor for which by any clauses thereof he is declared liable to pay compensation amounting to the whole of his security deposit and the liability of contractor, for past and future compensation shall remain unaffected.

**Power to take possession or require removal or sell contractor's plant:** In the event of the Executive Engineer putting in force either of the power (a) or (c) vested in him under the proceeding clause he may, if he so desire to take possession of all or any tools, plant, materials and stores in or upon the works, or at the site thereof or belonging to the contractor or procured by him and intended to be used for execution of the work or any part thereof paying or allowing for the same on account at the contract rates, in case of these not being applicable at current market rates to be certified by the Executive Engineer where certificate thereof shall be final, otherwise the Executive Engineer may by notice, in writing, to the contractor or his clerk of the work, foreman or other authorized agent require him to remove such tools, plants, materials or stores from the premises within a time to be specified in such notice and in the event of the contractor failing to comply with any such requisition, the Executive Engineer may remove them at the contractor’s expense or sell them by auction or private sale, on account of the contractor and at his risk in all respect and the certificate of the Executive Engineer to the expenses for such removal and the amount of the proceeds and expenses, if any, shall be final and conclusive against the contractor.

**Clause- 5**

**Extension of time:** If the contractor desire an extension of the time for completion of the work on the ground of his having been unavoidably hindered in its execution or on any other ground, he shall apply, in writing, to the Executive Engineer within 30 days of the date of the hindrance but before the expiry of the contractual period on account of which he desires such extension as aforesaid and the competent authority shall, if in his opinion (which shall be final reasonable ground) be shown therefore authorize such extension of time if any so may in his opinion be necessary or proper.

**Clause-5(a)**

**Contractor to submit a return every month on any work claimed as extra:** The contractor shall deliver in the office of the Executive Engineer on or before 10th day of every month during the continuance of the work covered by this contract a return showing details of any work claimed for as extra and such return shall contain the value of such work as claimed by the contractor, which value shall be based upon the prices in the contract or in Schedule of rates in force in the District for the time being. The contractor shall include in such monthly return particulars of all claims of whatsoever kind. However arising which at the date thereof, he has or may claim to have against the Executive Engineer under or in respect of or in any manner, arising out of the execution of work and the contractor shall be deemed to have waived all claims not included in such return and will have no right to enforce any such claim not so included whatsoever be the circumstances.
Clause-6

Without prejudice to the right of Haryana Urban Development Authority, under any clause hereinafter contained on completion of the work, the contractor shall be furnished with the certificate by the Executive Engineer (hereinafter called the Engineer-in-charge) of such completion, but no such certificate shall be given nor work shall be considered to be completed until the contractor shall have removed from the premises on which the work shall be executed all scaffolding, surplus materials and rubbish and clean off dirt from all wood works, floor, other parts of any building in, upon or around which the work is to be executed, or part of which he had in possession for the purpose of the execution thereof and the measurements in the said certificate shall be binding and conclusive against the contractor. If the contractor shall fail to comply with the requirements of this clause as to removal of scaffolding surplus materials and rubbish and cleaning of dirt on or before the date fixed for the completion of the work, the Engineer-in-charge at the expense of the contractor shall remove such scaffolding, surplus materials and rubbish and dispose of the same as he may think fit and clean off such dirt as aforesaid and the contractor shall pay the amount of all expenses so incurred and shall have no claim in respect of any such scaffolding or such surplus materials as aforesaid except for any sum actually realized on account of sales, thereof.

Clause-7

Payments on intermediate certificates to be regarded as advances: No payment shall be made for works estimated to cost less than Rs. One thousand, till the whole of the works shall have been completed and the certificate of completion given. But in the case of work estimated to cost more than Rs. One thousand the contractor not submitting the bill thereof, be entitled to receive a monthly payment proportionate to the part thereof as approved and passed by Engineer-in-charge, whose certificate of such approval and passing of the sum so payable shall be final and conclusive against the contractor. But all such intermediate payment shall be regarded as payments by way of advances against the final payment only and not as payments for the works actually done and completed and shall not preclude the requiring of bad, unsound and imperfect or unskilled work to be removed and taken away and reconstructed, or re-erected or be considered as an admission of due performance of the contract or any part thereof in any respect or the accruing of any claim. Nor shall it conclude, determine or effect in any way the powers of the Engineer-in-charge under these terms and conditions or any of them as far the final settlement and adjustments of the accounts or otherwise or in any other way vary or effect the contract. The final bill shall be submitted by the contractor within one month of the date fixed for completion of the work, otherwise the Engineer-in-charge’s certificate of the measurements and the total amount payable for work, accordingly, shall be final and binding on all parties. The amount, payable, however, shall be determined after pre-audit of the bill by the accounts Departments authorities within fifteen days of the presentation of the bill by the Engineer-in-charge to Accounts Department, otherwise the amount already determined by the Engineer-in-charge shall become binding on both parties. Both the Engineer-in-charge and the Accounts Department shall inform
the contractors by registered post about the facts of the movement of the final bill and the amount thereof.

Clause-7 (a) The deduction referred to in Clause-1 herein before or such part thereof as may be due to contractor under this contract shall be payable to contractor after maintenance defect liability period of one year has lapsed after the payment of final bill & after giving bank guarantee of equivalent amount valid for the period of O&M period in favour of Executive Engineer, HUDA Division No. I, Hisar.

Clause-8 Bills to be submitted monthly: A bill shall be submitted by the contractor each month on or before the date fixed by the Engineer-in-charge for all work executed in the previous month and the Engineer-in-charge shall take the requisite measurement for the purpose of having the same verified and the claim, as far as admissible, adjusted if possible, before the expiry of ten days from the presentation of the bill. If the contractor do not submit the bill within the time fixed as aforesaid, the Engineer-in-charge may depute a subordinate to measure up the said work in the presence of the contractor whose counter signature to the measurement list will be sufficient and the Engineer-in-charge may prepare, a bill from such list which shall be binding on the contractor in all respect.

Clause-9 Bills to be on printed forms: The contractors shall submit all bills, in triplicate, on printed forms to be had on application from the office of the Engineer-in-charge and the charge in the bill shall always be entered at the rates specified in the tender or in the case of any extra works ordered in pursuance of these conditions and not mentioned or provided for in the tender at the rate hereinafter provided for such work.

Clause-10 If the specification of estimate of the work provides for the use of any special description of materials to be supplied from Engineer-in-charge’s store or if it is required that contractor shall use certain store to be provided by the Engineer-in-charge (such materials and stores and the prices to be charged thereof as hereinafter mentioned being so far as practicable for the convenience of the contractor, but not so in any way to control the meaning for effect of this contract specified in the schedule or memorandum hereto annexed) the contractor shall be supplied with such materials and stores required from time to time to be used by him for the purpose of the contract only and the value of the full quantity of the materials and stores so supplied at the rates specified in the said schedule of memorandum may be set off or deducted from any sums due or thereafter to become due, to the contractor under the contract or otherwise against or from the security deposit. Materials supplied to the contractor shall remain the property of the HUDA and shall be kept in safe custody of contractor but shall not on any account be removed from the site of the work without the written permission of the Engineer-in-charge & shall all times be opened for inspection by him. Any such materials unused and in perfectly good condition at the time of the completion of the contract shall be returned to the Engineer-in-charge’s store if by a notice, in writing, under his hand he shall so require, but the contractor shall not be entitled to return any such materials without such consent and shall have no claims for compensation on account of any such materials to be supplied to him as aforesaid being unused by him, or any wastage in or damage to any such materials.
Clause –11  Works to be executed in accordance with specifications drawing orders etc: The contractor shall execute the whole and every part of the work in most substantial and workmen like manner, both as regards to materials and otherwise in every respect in strict accordance with Haryana P.W.D. specification latest edition / specifications as may be specifically provided for. The contractor shall also confirm exactly, fully and faithfully to the designs, drawing and instructions in writing relating to the work (signed by the Engineer -in-charge) and lodged in the office and to which the contractor shall be entitled to have access at his office or at the site of the work. For the purpose of inspection during office hours, the contractors shall if he so requires, be entitled at his own expenses to make or cause to be made copies of the specifications and of all such designs and instruction as aforesaid.

Clause-11A  Removal of employee workman and foreman: The Engineer-in-charge shall have full powers at all time to object to the employment of any workman, Foreman or other employees on the works by the contractor and if the contractor shall receive notice in writing from the Engineer-in-charge requesting the removal of such workman from the work, the contractor shall comply with the request forth with.

No such workman, foreman or other employees after his removal from the works by orders of the Engineer-in-charge shall be re-employed or engaged on the works by the contractor at any time, except with the prior approval, in writing, from the Engineer-in-charge.

The contractor shall not be entitled to demand the reason from the Engineer-in-charge, requiring the removal of any such workman or other employees.

Clause –12  Alterations in specifications and designs: The Engineer-in-charge shall have power to make any alteration or omission or additions from the original specifications, drawings designs, and instructions that may appear to him to be necessary or advisable during the progress of the work and the contractor shall be bound to carry out the work in accordance with the instructions given to him, in writing, duly signed by the Engineer-in-charge and such alterations omissions, additions or substitutions shall not invalidate the contract & any altered, additional or substituted work which the contractor may be directed to do in the manner above specified as part of the work shall be carried out by the contractor on the same rates, terms & conditions on which he agreed to do the main work. The time for the completion of the works shall be extended in the proportion that the altered, additional or substituted works bears to the original contract work and certificate of the Engineer-in-charge shall be conclusive as to such proportion. If the altered, additional or substituted work includes any class of work for which no rate is specified in this contract, then such class of work shall be carried out at the rate entered in the Haryana schedule of rates, subject to the same percentage above or below for items and if such class or work is not entered in the Haryana PWD Schedule of rates, then the contractor shall within seven days of the date of his receipt of the order to carry out the work, inform the Engineer-in-charge of the rate, which it is his intention to charge for such class of work. If Engineer-in-
charge does not agree to his rate, he shall by notice, in writing, be at liberty to cancel his order to carry out such class of work and arrange to carry it out in such manner as he may consider advisable, provided always that the contractor shall commence the work or incur any expenditure in regard thereto before the rates shall have been determined herein before mentioned and in such case he shall be entitled to be paid in respect of the work carried out or expenditure incurred by him prior to the date of the determination of the rates as aforesaid according to such rate or rates as shall be fixed by the Engineer-in-charge. In the event of a dispute, the decision of the respective Superintending Engineer, HUDA shall be final.

Clause 13  
No compensation for alternation in or restriction of work to be carried out: If at any time, after the commencement of the work, the Haryana Urban Development Authority shall for any reason whatsoever not require the whole work thereof as specified in the tender to be carried out, the Engineer-in-charge shall give notice, in writing, of the fact to the contractors who shall have no claim to any payment or compensation, whatsoever on account of any profit or advantage which he might have derived from execution of the work in full which he did not drive in consequence of the full amount of the work not having been carried out, neither shall have any claim for compensation by reason of any alteration having been made in the original specification, drawing, designs and instructions which shall involve any curtailment of the work originally contemplated.

Clause 14  
Action and compensation payable in case of bad work: If it shall appear to the Engineer-in-charge or his subordinate in-charge of the work, that any work has been executed with unsound, imperfect or unskillful workmanship or with material of any inferior description or that any material or article provided by him for the execution of the work are unsound or of a quality inferior to the contract or otherwise not in accordance with the contract, the contractor shall on demand, in writing, from the Engineer-in-charge specifying the work, materials or articles complained or not withstanding that the same may have been inadvertently passed, certified and paid for forthwith rectify or removed and reconstruct the work so specified in whole or in part as the case may require or as the case may be, remove the materials or articles so specified and provide other proper and suitable materials or article at his own charge and cost. In the event of its failing to do so within a period to be specified by the Engineer-in-charge in his demand aforesaid then the contractor shall be liable to pay compensation at the rate of one percent on the amount of estimate of everyday not exceeding ten days, while his failure to do so shall continue and in case of any such failure the Engineer-in-charge may rectify or remove and re-execute the work or remove and replace with other materials or articles complained of, as the case may be, at the risk and expense of the contractor.

Clause 15  
Work to be open to inspections, contractor or his responsible agent to be present: All works under or in course of execution or executed in pursuance of the contract shall at all times be open to the inspection and supervision of the Engineer-in-charge and his subordinates and the contractor shall at all times, during the usual
working hours and at all other time with reasonable notice of the inspection of the Engineer-in-charge or his subordinates to visit the work shall have been given to the contractor either himself be present to receive orders and instruction, or have a responsible agent duly authorized, in writing, present for that purpose. Orders given to the contractor’s agent shall considered to have the same force as they had been given to the contractor himself.

Clause 16  
**Notice to be given before work is covered up:** The contractor shall give not less then five days notice in writing to the Engineer-in-charge or his subordinate-in-charge of the work before covering up or otherwise placing beyond the reach of measurement any work in order that same may be measured and correct dimensions thereof be taken before the same is so covered up or placed beyond the reach of measuring and shall not cover up or place beyond the reach of measurement without the consent, in writing, of the Engineer-in-charge or his subordinate-in-charge of the work. If any work shall be covered up or placed beyond the reach of measurement such notice having been given or consent obtained, the same shall be uncovered at the contractor’s expense, or in default thereof no payment or allowance shall be made for such work or the materials with which the same was executed.

Clause 17  
**Contractor liable for damage done and for imperfections for 3 months after certificate:** If the contractor or his work people or servants shall break, deface, injure or destroy any part of a building in which they may be working, on any building, Road, Fence, enclosure or grass, land, cultivated ground or the premises on which the work or any part of it is being executed, or if any damage happens to the work, while in progress from any cause whatever or any imperfection become apparent in it within three months after the final certificate or order of its completions, shall have been given by the Engineer-in-charge as aforesaid, the contractor shall make the same good at his own expenses and in default, the Engineer-in-charge may cause the same to be made good by other workmen and deduct the expense (of which the certificate of the Engineer-in-charge shall be final) from any sums that may be then, or at any time thereafter, may become due to the contractor or from his security deposit.

Clause 18  
**Contractor to supply plant ladders, scaffoldings etc:** The contractor shall supply at his own cost all material except such special material, in accordance with the contract be supplied from the Engineer-in-charge’s stores, plants, tools appliances, ladders, cordage, scaffolding and temporary works required for proper execution of the work, whether original, altered or substituted and whether included in the specifications or other documents forming part of the contract referred to in these conditions or not, or which may be necessary for the purpose of satisfying or complying with the requirements of the Engineer-in-charge, as to any matter as to which, under these conditions he is entitled to be satisfied or which he is entitled to require together with carriage thereof to and from the work. The contractor shall also supply without charge the requisite number of persons with the means and materials, necessary for the
purpose of setting out works and counting, weighing and assisting in the measurement of examination at any time and from time to time of the work or material. Failing to do so, the same may be provided by the Engineer-in-charge at the expenses of the contractor, and the expense may be deducted from any money due to the contractor under the contract or from any other contract of the agency or from his security deposit or the proceeds of sale thereof or a sufficient portions thereof. The contractor shall also provide all necessary fencing & lights required to protect the public from accident and shall be bound to bear the expenses of defence of every suit, actions or other proceedings at law that may be brought by any person for injury sustained owing to neglect of the above precautions and to pay any damages and cost which may be awarded in any such suit, action or proceedings to any such person or which may with the consent of the contractor be paid to compromise any claim by any such person.

Clause 19  
No female labour shall be employed within the limits of Cantonment.

Clause 19A  
No labour below the age of 12 years shall be employed on the work.

Clause 19B  
The contractor shall pay his labourer not less than the wages determined under minimum wages act for the District.

Clause 20  
**Work on Sunday:** No work shall be done on Sunday without the sanction, in writing, of Engineer-in-charge.

Clause 20A  
**Contractor liable for payment of compensation to injured workman or in case of death to his relations:** In every case in which by virtue of the provision of section 12, sub section (1) of the workmen’s compensation Act, 1923. Haryana Urban Development Authority is obliged to pay compensation to workman employed by the contractor, in execution of the works. Haryana Urban Development Authority will recover from the contractor the amount of the compensation so paid and without prejudice to the right of Haryana Urban Development Authority under section 12, sub section (2) of the said acts, Haryana Urban Development Authority shall be at liberty to recover such amount or any part thereof by deducting it from the security or from any sum due to the contractor, whether under this contract or otherwise.

Haryana Urban Development Authority shall not be bound to contest any claim made against it under section 12 sub-section (1) of the said act except on the written request of the contractor and upon his giving request to Haryana Urban Development Authority full security for all costs for which Haryana Urban Development Authority might become liable in consequence of contesting such claim.

Clause 21  
**Work not be sublet. Contract may be rescinded and security deposit forfeited:** The contract shall not be assigned or sublet without the written approval of the Engineer-in-charge. And if the contractor shall reassign or sublet his contract or attempt to do so or become insolvent or commence any insolvency proceedings or
make any composition with his creditors or attempts to do so or if any bribe, gratuity, gift, loan, reward or otherwise, shall either directly or indirectly be given, promised or offered by the contractor or any of his servants or agents to any public officer or person in the employment of Haryana Urban Development Authority, in any way relating to his office or employment or if any such officer or person shall become in any way directly or the indirectly interested in the contract, the Engineer-in-charge may thereupon by notice, in writing, rescind the contract and security deposit of the contractor shall stand forfeited and be absolutely at the disposal of Haryana Urban Development Authority. The same consequence shall ensure as if the contract had been rescinded under clause 3 thereof and in addition the contractor shall not be entitled to recover or be paid for any work thereof actually performed under the contract.

Clause 22  **Sum payable by way of compensation to be considered as reasonable compensation without reference to actual loss:** All sums payable by way of compensation under any of these conditions shall be considered as reasonable compensation without reference to the actual loss or damage sustained and whether or not any damage shall have been sustained.

Clause 22A  **Deduction of amounts due to Government on any account whatsoever to be recoverable from sums payable to a contractor:** Any excess payment made to the contractor inadvertently or otherwise under this contract or on any account whatsoever and any other sum found to be due to Haryana Urban Development Authority by the contractors in respect of this contract or any other contract or work order for any sum whatsoever shall be recoverable from the contractor from the payment due to him either in respect of this contract or any other work order or contract or any other account by any other department of the Haryana Government / Haryana Urban Development Authority.

Clause –23  **Changes in constitution of firm:** In the case of a tender by partners, any change in the constitution of the firm shall be forthwith notified by the contractor to the Engineer-in-charge for his information.

Clause 24  **Work to be under directions of Superintending Engineer:** All works to be executed, under the contract shall be executed under the directions of and subject to the approval of the Superintending Engineer, Haryana Urban Development Authority circle Hisar for the time being who shall be entitled to direct at what point or points and in what manner they are to be commenced or from time to time carried on.

Clause 25:  **Claims for payment of any extra ordinary nature to be referred to HUDA for decision:** No claims for payment of an extraordinary nature, such as claims for a bonus for extra labour employed in completing the work before the expiry of the contractual period at the request of the Engineer-In-Charge or claims for compensation where work has been temporarily brought to a standstill with no fault
of the contractor, shall be allowed unless and to the extent that the same shall have been sanctioned by the Haryana Urban Development Authority.

Clause 25(A): (i) If any dispute or difference of any kind whatsoever shall arise between the HUDA/or authorized representative of HUDA and the contractor in connection with or arising out of the contract, or the execution of the work that is (i) whether before its commencement or during the progress of the work or after its completion, (ii) and whether before or after the termination, abandonment or breach of the contract, it shall, in the first instance, be referred to, for being settled by the Executive Engineer-In-Charge of the work at that time and Engineer-In-Charge shall with in a period of sixty days after being requested, in writing, made by the contractor to do so, convey his decision to the contractor, and subject to arbitration as hereinafter provided, such decision in respect of every matter so referred, shall be final and binding upon the contractor. In case the work is already in progress, the contractor will proceed with the execution of the work on receipt of the decision by the Executive Engineer-In-Charge as aforesaid, with all due diligence whether HUDA/or authorized representative of HUDA or contractor requires arbitration as hereinafter provided for, or not. If the Executive Engineer, In-Charge of the work has conveyed his decision to the contractor and no claim to arbitration has been filed with him by the contractor within a period of sixty days from the receipt of letter communicating the decision, the said decision shall be final and binding upon the contractor and will not be a subject matter of arbitration at all. If the Executive Engineer, In-Charge of the work fails to convey his decision within a period of sixty days, after being requested, as aforesaid, the contractor may, within further sixty days of the expiry of first sixty days, after being requested, from the date on which request has been made to the Executive Engineer In-Charge request the Engineer-in-Chief / Chief Engineer, HUDA that the matters in dispute be relevant to arbitration, as hereinafter provided.

(ii) All dispute or difference in respect of which the decision is not final and conclusive shall at the request, in writing, of either party, made in a communication sent through Registered A.D. Post, be referred to the sole arbitration of any serving Superintending Engineer of HUDA, to be nominated by designation by the Engineer-in-Chief / Chief Engineer, HUDA at the relevant time. There will be no objection to any such appointment that the arbitrator so appointed is a Govt. servant/in service of HUDA or that he had to deal with the matters to which the contract relates in the course of his duties as a Govt. servant/in service of HUDA he has expressed his views on all or any of the matter in dispute. The Arbitrator to whom the matters is originally referred being transferred or vacating his office, his successor-in-office, as such shall be entitled to proceed with the reference from the stage at which it was left by his predecessor.

Or

In case the arbitrator nominated by the Engineer-in-Chief / Chief Engineer, HUDA is unable or unwilling to act as arbitrator such for any reason, whatsoever the
Engineer-in-Chief / Chief Engineer, HUDA shall be competent to appoint and nominate any other Superintending Engineer of HUDA as arbitrator in his place and the arbitrator so appointed shall be entitled to proceed with the reference.

(iii) It is also a term of this arbitration agreement that no person other than a person appointed by the Engineer-in-Chief / Chief Engineer, HUDA shall act as arbitrator and if for any reason that is not possible the matter shall not be referred to arbitration at all. In all cases where the aggregate amount awarded exceeds Rs. 25000/- the arbitrator must invariably give reasons for his award in respect of each claim and counter / claims separately.

(iv) The arbitrator shall award separately giving his award against each claim and dispute raised by either party including any counterclaim individually and that any lump-sum award shall not be legally enforceable.

(v) The following matters shall not lie within the perview of arbitration: -

a) Any dispute relating to the levy of compensation as liquidated damages, which has already been referred to the Superintending Engineer and is being heard or/ and has been finally decided by the Superintending Engineer, In-Charge of the work.

b) Any dispute in respect of substituted, altered, additional work/omitted work / defective work referred by the contractor for the decision of Superintending Engineer In-Charge of the work if it is being heard or has already been decided by the said Superintending Engineer.

c) Any dispute regarding the scope of the work or its execution or suspension or abandonment that has been referred by the contractor for the decision of the HUDA and has been so decided finally by the HUDA.

(vi) The independent claims of the party other than the one getting the arbitrator appointed, as also counter-claims of any party will be entertained by the arbitrator notwithstanding that the arbitrator had been appointed at the instance of the other party.

(vii) It is also a term of this arbitrator agreement that where the party invoking arbitrator is the contractor, no reference for arbitrator shall be maintainable unless the contractor, furnishes to the satisfaction of the Executive Engineer In charge of the work, a security deposit of a sum determined according to details given below and the sum so deposited shall, on the termination of the arbitration proceedings, be adjusted against the cost, if any, awarded by the arbitrator against the claimant party and the balance remaining after such adjustment or whole sum in the absence of any such cost being awarded will be refunded to him within one month from the date of the award.
<table>
<thead>
<tr>
<th>Amount of claims</th>
<th>Rate of security deposit</th>
</tr>
</thead>
<tbody>
<tr>
<td>i) For claims below Rs.10,000/-</td>
<td>2% of amount claimed.</td>
</tr>
<tr>
<td>ii) For claims of Rs.10,000/- and above &amp; below Rs.1,00,000/-</td>
<td>5% of amount claimed.</td>
</tr>
<tr>
<td>iii) For claims of Rs.1,00,000/- and above.</td>
<td>7½% of amount claimed.</td>
</tr>
</tbody>
</table>

The Stamp-fee due on the award shall be payable by the party as desired by the arbitrator and in the event of such party’s default the Stamp-fee shall be recoverable from any other sum due to such party under this or any other contract.

(viii) The venue of arbitration shall be such places as may be fixed by the arbitrator at his sole discretion. The work under the contract shall continue during the arbitration proceedings.

(ix) Neither party shall be entitled to bring a claim for arbitration if the appointment of such arbitrator has not been applied within 6 months:

a) Of the date of completion of the work as certified by Executive Engineer-In-Charge, or

b) Of the date of abandonment of the work, or

c) Of its non-commencement within 6 months from the date of allotment or written orders to commence the work as applicable, or

d) Of the completion of the work through any alternative agency or means after withdrawal of the work from the contractor in whole or in part and/or its recession, or

e) Of receiving an intimation from the Executive Engineer-In-Charge of the work that final payment due to or recovery from the contractor had been determined which he may acknowledge and/or receive.

Whichever of (a) to (e) above is the latest.

If the matter is not referred to arbitration within the period prescribed above, all the rights and claims of any party under the contract shall be deemed to have been forfeited and absolutely barred by time even for civil litigation notwithstanding.

(x) It is also a term of this arbitration agreement that no question relating to this contract shall be brought before any Civil Courts without first involving and completing the arbitration proceedings as above. If the scope of the arbitration specified herein covers issues that can be brought before the arbitrator i.e. any matter
that can be referred to arbitration shall not be brought before a Civil Court. The pendency of arbitration proceedings shall not disentitle the Engineer-In-Charge, HUDA to terminate the contract and make alternative arrangements for the completion of the work.

(xi) The arbitrator shall be deemed to have entered on the reference on the day he issues notices to the parties fixing the first date of hearing. The arbitrator may, from time to time, with the consent of the parties enlarge the initial time for making and publishing the award.

(xii) It is also a term of this arbitration agreement that subject to the stipulation herein mentioned, the arbitration proceedings shall be conducted in accordance with the provisions of the Arbitration Act, 1940 or any other law in force for the time being.

Clause 26

Fluctuation in railway freight

No alteration in contract rates shall be admissible in consequence of fluctuation in railway freight when such railway freight is on account of material which is required by a contractor in the manufacturing of an article to be supplied under this contract e.g. fluctuation in railway freight on coal required for burning bricks will not be taken into consideration, or for an article which forms part of a finished work for purpose of this clause. Similarly no alteration in rates will be allowed when a manufactured article is transported by rail from place A to place 'B' to form part of finished work.

Clause 27

Lump sum estimate: When the estimate on which a tender is made include lump- sump provision in respect of parts of the work, the contractor shall be entitled to payment in respect of the items of work involved or the part of the work in question at the same rates as are payable under this contract for such items or the part of the work in question is not in the opinion of the Engineer-in-charge, measurable, the Engineer-in-charge may at his discretion, pay the lump sum amount entered in the estimate and the certificate, in writing, of the Engineer-in-charge shall be final and conclusive against the contractor with regard to any sum payable to him under the provisions of this clause.

Clause 28

Action where no specification: In case of any class of work for which there is no specifications as is mentioned in Rule 1, such work shall be carried out in accordance with the district specifications and in the event of there being no district specification, then in such case, the work shall be carried out in all respect in accordance with the instructions and requirement of the Engineer-in-charge.

Clause 29

Definition on work: The expression “Work or Works” where used in these conditions shall unless specified either in subject or context repugnant to such construct or be constructed & taken to mean the works by virtue to the contract, contracted to be executed whether temporary or permanent and whether original, altered, substituted or additional.
Clause 30 The Item referred to at page-22 of the tender will be calculated on the gross amount (value of finished work including cost of materials whether purchased from the Haryana Urban Development Authority or direct) of (1) the item of work to which the rates in the tender apply.

Clause 31 Unless otherwise specified in the contract, the term “Engineer-in-charge” referred to in the tender and contract for the work means Executive Engineer, HUDA, Division I, Hisar.

Clause 32 The contractor shall be responsible for making his own arrangements for securing licences for the materials and their transportation required for the works and Engineer-in-charge shall not be held responsible in any way for making such arrangements.

Clause 33 The contractor undertakes that he is not related to any of the officers employed by the Haryana Urban Development Authority.

Clause 34 No pit shall be dug by the contractor near the site of the work for taking out earth for use on the work. In case of default, the pit so dug will be filled in by the department at the cost of the contractor plus 14% departmental charges.

Clause 35 All royalty and compensation for building stone, bajri and stone metal or any other material should be included in the rates to be quoted and is payable by the contractor.

Clause 36 The rates given are for the finished work inclusive of octroi charges, sales tax, all duties and all other taxes as applicable and including labour cess @ 1%.

Clause 37 It will be the responsibility of the contractor to ensure that trees at the site of work and in the vicinity or their fruit etc. are not damaged by his labour or agent. Cost of damage done, if any, will be assessed at the discretion of the Engineer-in-charge and deducted from the bill of the contractor.

Clause 38 The contractor shall provide at his own cost separate latrine, bathing enclosures and platform for use of the men and women labour and keep them clean to the satisfaction of the Engineer-in-charge. He should also arrange at his own expense for clean drinking water, housing, medical facilities necessary for the welfare of the labour employed at his work. In case of his failure the same shall be provided by the HUDA at contractor’s cost. Any dispute regarding this will be settled by the Engineer-in-charge whose decision will be final and binding. Contractor will also follow the fair wage clause attached.

Clause 39 Any material left on the site of work after one month from the date of completion of the work shall become the property of the HUDA and no payment shall be made for it.
Clause 40  The amount of the work can be increased or decreased according to the requirement of the department and no claim whatsoever on this account will be entertained.

Clause 41  HUDA reserve the option to take away any items of the work or part thereof at any time during the currency of the contract and re-allot it to another agency with due notice to the contractor without liability or compensation.

Clause 42  No claim on account of fluctuation in prices due to war or any other cause will be entertained.

Clause 43  The contractor shall be liable to make good all damages caused by breakage from the moment the stores are handed over to his charge.

Clause 44  No compensation whatsoever will be payable on account of any delay or default in the supply of material mentioned in the “list of material to be issued to the contractor” by the department and consequent delay in the execution of work.

Clause 45  The contractor will inform the C.M.O about the employment of labourer on the work for carrying out Malaria Surveillance.

Clause 46  The terms and conditions of the agreement have been explained to me / us and I / we clearly understand them.

Clause 47  All type of cautionary board, signals for safe and smooth execution of work, diversion of traffic etc. shall be provided by the contractor at his own cost and nothing extra is payable on this account.

Clause 48  With the issue of allotment letter in the name of lowest agency made by the Executive Engineer, the agreement shall stand concluded and all the clauses, terms and conditions mentioned above and in the tender form shall be applicable, even when the agreement for the work is not signed by the contractor / firm.
HARYANA URBAN DEVELOPMENT AUTHORITY
CONTRACTS LABOUR REGULATIONS

1. **Short titles**: These regulations may be called Haryana (1) Public Works Department Contractors Labour Regulations.

2. **Definitions** in these regulations unless otherwise expressed or indicated the following words and expression shall have the meaning given herein against them respectively that is to say.
   
   a) "Labour" means workers employed by the contractor directly or indirectly through sub contractor or other person or by an agent on his behalf.
   
   b) Fair wages means wages whether for time or piece work notified at the time of submitting tender of the work and where such wages have not been so notified the wages prescribed by the Haryana Public Works Department for the district in which the work is done.
   
   c) "Contractors" shall include every person whether a sub-contractor or headmen or agent employing labour on the work taken on contract.
   
   d) "Wages" shall have the same meaning as defined in the payment of wages Act, 1936 and include time and piece rate wages.

3. **Display of notice regarding wages etc.** The contractor shall before he commences his work on contract display and correctly maintain and continue to display and correctly maintain in a clean and legible condition in conspicuous place on the work notice in English and in the local Indian language spoken by the majority of the workers giving the fair wages notified or prescribed by the Haryana Public Works Department and the hours of work for which such wages are earned.

4. **Payment of wages (1)** Wages due to every worker shall be paid to him direct, (2) all wages shall be paid in current coin or currency or in both.

**FIXATION OF WAGES PERIODS :**

5. (i) The contractor shall fix wages period in respect of which the wages shall be payable.

(ii) No wage period shall exceed one month.
(iii) Wages of every workman employed on the contract shall be paid before expiry of ten days after the last day of wage period in respect of which the wage are payable.

(iv) When the employment of any worker is terminated by or on behalf of the contractor the wages earned by him shall be paid before the day of expiry of the month in which his employment is terminated.

(v) All the payment of wages shall be made on working day.

6. **Wages book and wages slip etc.**

[1] The contractor shall maintain a wage book of each worker in such form as may be convenient but this shall include the following particulars.

(a) Rate of daily or monthly wages or contract wages.

(b) Name of work on which employed.

(c) Nature of work on which employed.

(d) Total number of days worked during each wage period and total amount payable for the work during wage period.

(e) All deduction made from the wages with an indication in each case of the ground for which the deduction is made.

(f) Wages actually paid for each wage period.

[2] The contractor shall also maintain a wage slip for each worker employed on the work.

[3] The authority competent to accept the contract may grant an exemption from the maintenance of Wage Book and Slip to a contractor who in his opinion may not directly or indirectly employee more than 50 persons on the work.

7. [1] Fines and deductions which may be made from the wages of a worker shall be paid to him without any deduction of any kind except the following.

(a) Fines.

(b) Deductions for absence from duty i.e. from the place of places where by the term of his employment he is required to work. The amount of deduction shall be proportion to the period for which he was absent.
(c) Deduction for damage to or loss of goods expressly entrusted to the employed person for custody or for less or more for which he is required to account where such damage or loss is directly attributable to his neglect or default.

(d) Any other deduction which Haryana Urban Development Authority may from, time to time allow.

[2] No fine shall be imposed on a worker and no deducting for damage shall made be from his wages until the worker has been given an opportunity or showing causes against such fines or deductions.

[3] The total amount or fines which may be imposed in any one wage period on a worker shall not exceed an amount equal to five paisa in a rupee of the wage payable to him in respect of that wage period.

[4] No fine imposed on a worker shall be recovered from him installment or after expiry of 60 days from the date on which it was imposed.

8. **Register of fines act-8 [1]**: The contractor shall maintain a register of fines and of all deductions for damage or loss. Such register shall mention the reason for which fine was imposed or deductions for damage or loss, which was made.

   [2] The contractor shall maintain a list in English and local Indian Language clearly defining acts and omissions for which penalty or fine can be imposed. He shall display such list and maintain it in a clear and legible condition at conspicuous place on the work.

9. **Preservation of Books** - The wage book, the slip and the register of fine deductions required to be maintained under the regulation shall be preserved for 12 months after the date of last entry made in them.

10. **Powers of Labour Welfare Officer to make investigation or Enquiry** - The Labour Welfare Office or any other person authorized by the Haryana Urban Development Authority on their behalf shall have power to make enquiry with a view to ascertaining and enforcing due and proper observances of the wage clause & the provisions of these regulations. He shall investigate into any complaint regarding the default made by contractor - sub contractor in regard to such provision.

11. **Report of labour welfare officer**. The Labour Welfare Officer or any other person authorized as aforesaid shall submit a report of the result of his investigation or enquiry to the executive Engineer concerned indicating the extent if any to which the default has been committed and the amount of fine recoverable in respect of the acts of omission of the laborers with a note that necessary
deducting from the contractors bill be made and wages of the other
dues be paid to the laborers concerned.

12. **Appeal against the decision of Labour Welfare Officer –**

Any person aggrieved by the decision and recommendation of the
labour welfare officer or other person so authorized may appeal,
against such decision to the Labour commissioner but subject to such
appeal, to decision of the officer shall be final and binding upon the
contractor.

13. No party shall be allowed to be represented by a lawyer during any
investigation or enquiry appeal or any other proceedings under these
regulations.

14. **Inspection of Register –**

The contractor shall allow inspection of the wages book and wages
slip to any of his workers or to his agent at a convenient time and place
after due notice received or the labour welfare officer or any other
person authorized by the Haryana Urban Development Authority on his
behalf.

15. **Submission of return –**

The contractor shall maintain and submit periodical return as may be
specified from time to time.
16. **Amendment –**

The Haryana Urban Development Authority from time to time add or amend these regulations and or any question as to the application, interpretation or effect of these regulation the decision of the Labour Commissioner to Haryana Government or any other person authorized by the Haryana Urban Development Authority in that behalf shall be final.

17. The contractor shall be responsible to provide to the entire satisfaction of the Engineer-in-charge at his own expenses the following amenities for the labour employed by him.

a) Suitable temporary hutting accommodation.

b) Trench Latrine, bathing enclosure, platforms, separately for men and women with regular clear Drinking Water.

In the event of his failure to provide any or all the amenities, the same shall be provided by the Haryana Urban Development Authority and cost thereof shall be recovered from the contractor. Any dispute regarding above point shall be settled by the Engineer-in-charge and his decision shall be final.

EXECUTIVE ENGINEER,
HUDA DIVISION No. I, HISAR
FAIR WAGES CLAUSES

(a) The contractor shall pay not less than fair wage to labour engaged by him on the work.

Explanation:
Fair wage means was whether for time or piece work notified at the time of inviting tenders of the work and where such wages have not been so notified, the wage prescribed by the Public Works Deptt., Building and road branch, Haryana for the district, in which the work is done.

(b) The contractor shall, notwithstanding the provisions of any agreement to the country, caused to be paid fair wages to labours, indirectly engaged on the work including any labour engaged by his sub contractors in connection with the said work, as if the labourers had been directly employed by him.

(c) In respect of labour directly employed on the works for the performance of the contractor's part of this agreement the contract shall comply with or cause to be complied with the Public Works Deptt. Contractors' Labours Regulations made by Government from time to time in regard to payment of wages period, deductions from wages, recovery of wages not paid and deductions unauthorized made, maintenance of wage register, wage slip, publication of wages and other terms of employment inspection ad submission of periodical returns and all other matters of such like nature.

(d) The Executive Engineer or Sub Divisional Engineer concerned shall have the right to deduct, from the money due to the contractor, any some required or estimated to be required for making good the loss suffered by a worker or workers by reason of non-fulfillment of the conditions of the contract for benefit of the workers, non-payment of wages or deductions made from his or their wages which are not justified by the terms of the contract or for non-observance of the regulation is referred to in clause (c) above).

(e) Vis-à-vis the Haryana Urban Development Authority, the contractor, shall be primarily liable for all payments to be made under and for the observance of the regulations aforesaid, without prejudice to his right to claim indemnity from his sub contractors.

(f) The regulations aforesaid shall be deemed to be a part of this contract and any breach thereof shall be deemed to be a breach of this contract.

(g) Attendance card should invariably be issued by the contractors to their workers, which should be returned to the contractors concerned at the time of receiving payment of their wages.

(h) Before making payment to the contractors, the authorities concerned should obtain a certificate form the contractor that he has made payment to all workers connected with the execution of the work, for which the payment is being made.

(i) The normal working hours of workers employed by contractors for the execution of work allotted to them should be 8 hours per day with a break of 2 hours during summer, one hour during winter after continuous work of 4 hours at the most. The spread over should in no case exceed 10 hours, workers working beyond these hours, should be paid over time wages, at the double the ordinary rate of their wages, calculated by the hour.

EXECUTIVE ENGINEER,
HUDA DIVISION No. I, HISAR
SAFETY CODE

1. Suitable scaffolds should be provided for workmen in all works that cannot safely be done from the ground, or from solid construction except for such short period as can be done safely from ladders. When a ladder is used an extra Mazdoor shall be engaged for holding the ladder and if the ladder is used for carrying materials as well, suitable footholds and handholds shall be provided on the ladder and the ladder shall be given an inclination not steeper than ¼ to 1(1/4 horizontal and 1 vertical).

2. Scaffolding or staging more than 3.6 m (12 feet) above the ground or floor, swung or suspended from an overhead support or erected with stationery support shall have guard rail properly attached bolted, braced and otherwise secured at least 90 cm. (3 feet) high above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends, thereof with only such opening as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the building or structure.

3. Working platform, gang ways and stairways should be so constructed that they should not sag unduly or unequally, and if the height of the platform or the gangway or the stairway is more than 3.6 m. (12 feet) above ground level or floor level, they should be closely boarded, should have adequate width and should be suitably fastened as described in (ii) above.

4. Every opening in the floor of a building or in a working platform be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be 90 cm. (3 feet).

5. Safe means of access shall be provided to all working platforms and working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9m. (30 feet) in length while the width between side rails in rung ladder shall in no case be less than 28 cm (11.1/2”) for ladder upto including 3m. (10 feet) in length. For longer ladders this width should be increased at least ¼” for each additional 30 cm. (1 foot) in length. Uniform step spacing shall not exceed 30 cm. (12 inch). Adequate precautions shall be taken to prevent danger from electrical equipment. No materials on any of the sites of work shall be so stacked or placed as to cause danger or inconvenience to any person or the public. The contractor shall provide all necessary fencing and lights to protect the public from accident and shall be bound to bear the expenses of defence of every suit, action or other proceedings at law that may be brought by any persons for injury sustained owing to neglect of the above precautions and to pay any damages and cost which may be awarded in any such suit, action or proceedings to any such persons or which may, with the consent of the contractor be paid to compromise any claim by any such person.

6. Excavation and Trenching – All trenches, 1.2 m (four feet) or more in depth, shall at all time be supplied with at least one ladder for each 30 m (100 feet) in length or fraction thereof. Ladder shall be extended from bottom of the trench to at least 90 cm. (3 feet) above the surface of the ground. The side of the trenches which are 1.5 m (5 feet) or more in depth shall be stepped back to give suitable slope or securely held by timber bracing, so as to avoid the danger or sides to collapse. The excavated materials shall not be placed within 1.5 m (5 feet) of the edges of the trench or half of the depth of the trench whichever is more. Cutting shall be done from top to bottom. Under no circumstances undermining or undercutting shall be done.
7. **Demolition**— Before any demolition work is commenced and also during the process of the work:

   a. **All roads and open areas adjacent to the work site shall either be closed or suitably protected.**

   b. **No electric cable or apparatus** which is liable to be a source of danger over a cable or apparatus used by the operator shall remain electrically charged.

   c. **All practical steps shall be taken to prevent danger** to persons employed from risk of fire or explosion or flooding. No floor, roof or other part of the building shall be so overloaded with debris or materials as to render it unsafe.

8. **All necessary personal safety equipment** as considered adequate by the Engineer-in-Charge should be kept available for the use of the person employed on the site and maintain in a condition suitable for immediate use, and the contractor should take adequate steps to ensure proper use of equipment by those concerned:

   a. **Workers employed on mixing asphaltic materials, cement and lime mortars be provided with protective footwear and protective goggles.**

   b. **Those engaged in white washing and mixing or stacking of cement bags or any materials which is injurious to the eyes shall be provided with protective goggles.**

   c. **Those engaged in welding works shall be provided with welder’s protective eyesight lids.**

   d. **Stone breakers shall be provided with protective goggles and protective clothing and seated at sufficient safe intervals.**

   e. **When workers are employed in sewers and manholes, which are in active use, the contractor shall ensure that the following safety measures are adhered to:**

      i. **Entry for workers into the line shall not be allowed except under supervision of the J.E. or any other higher officer.**

      ii. **At least five to six manholes upstream and downstream should be kept open for atleast 2 to 3 hours before any man is allowed to enter into the manholes for working inside.**

      iii. **Before entry, presence of toxic gases should be tested by inserting wet lead acetate paper which change colour in the presence of such gases and gives indication of their presence.**

      iv. **Presence of oxygen should be verified by lowering a detector lamp into the manhole. In case no, oxygen is found inside the sewer line, workers should be sent only with oxygen kit.**

      v. **Safety belt with rope should be provided to the workers. While working inside the manholes such rope should be handled by two men standing outside to enable him to be pulled out during emergency.**

      vi. **The area should be barricaded or cordoned by suitable means to avoid mishaps of any kind. Proper warning signs should be displayed for the safety of the public whenever cleaning works are undertaken during night or day.**
(vii) No smoking or open flames be allowed near the blocked manhole being cleaned.

(viii) The malba obtained on account of cleaning of blocked manholes and sewer lines should be immediately removed to avoid accidents on account of slippery nature of the malba.

(ix) Workers should not be allowed to work inside the manholes continuously. He should be given rest intermittently. The Engineer-in-Charge may decide the time upto which a worker may be allowed to work continuously inside the manhole.

(x) Gas masks with oxygen cylinder should be kept at site for use in emergency.

(xi) Air blowers should be used for flow of fresh air through the manholes. Whenever called for, portable air blower are recommended for ventilating the manholes. The motors for these shall be vapour proof and of totally enclosed type. Non sparking gas engines also could be used but they should be placed at least 2 metres away from the opening and on the lower side protected from wind so that they will not be source of friction on any inflammable gas that might be present.

(xii) The workers engaged for cleaning the manholes/sewers should be properly trained before allowing to work in the manholes.

(xiii) The workers shall be provided with gumboots or non sparking shoes, bump helmets and gloves, non-sparking tools, safety lights and gas masks and portable air blowers (when necessary) They must be supplied with barrier crane for anointing the limbs before working inside sewer lines.

(xiv) Workmen descending a manhole shall try each ladder step or rung carefully before putting his full weight on it to guard against insecure fastening due to corrosion of the rung fixed to manhole wall.

(xv) If a man has received a physical injury he should be brought out by the sewer immediately and adequate medical aid should be provided to him.

(xvi) The extent to which these precautions are to be taken depend on individual situation but the decision of the Engineer-in-Charge regarding the steps in this regard to be taken in an individual case will be final.

(f) The contractor shall not employ men below the age of 18 years and women on the work of painting with products containing lead in any form. Wherever men above the age of 18 are employed on the work of lead painting, the following precautions should be taken:

(i) No paint containing lead or lead products shall be used except in the form of paste or readymade paint.

(ii) Suitable face masks should be supplied for use by the workers when paint applied in the form of spray on a surface having lead paint dry rubbed and scrapped.

(iii) Overalls shall be supplied by the contractors to the workmen and adequate facilities shall be provided to enable the working painters to wash during the cessation of work.

(iv) A) 1) White lead, sulphate of lead or product containing these pigments, shall not be used in painting operation except in the form of pastes or paint ready for use.
2) Measures shall be taken, wherever required in order to prevent danger arising from the application of a paint in the form of spray.

3) Measures shall be taken, wherever practicable, to prevent danger arising out of from dust caused by dry rubbing and scrapping.

B) (1) Adequate facilities shall be provided to enable working painters to wash during and on cessation of work.

(2) Overall shall be worn by working painters during the whole of working period.

(3) Suitable arrangements shall be made to prevent clothing put off during working hours being soiled by painting materials.

C) (1) Cases of lead poisoning and suspected lead poisoning shall be notified and shall be subsequently verified by medical men appointed by competent authority of the Department.

(2) The department may require, when necessary medical examination of workers.

D) Instructions with regard to special hygienic precautions to be taken in the painting trade shall be distributed to working painters.

9. When the work is done near any place where there is risk of drowning all necessary equipments should be provided and kept ready for use and all necessary steps taken for prompt rescue of any person in danger and adequate provision should be made for prompt first aid treatment of all injuries likely to be sustained during in course of the work.

10. Use of hoisting machines and tackle including their attachments, anchorage and supports shall conform to the following standards or conditions:

1) (a) These shall be of good mechanical construction, sound material and adequate strength and free from patent defects and shall be kept in good working order.

(b) Every rope used in hosting or lowering materials or as a means of suspension shall be of durable quality and adequate strength, and free from patent defects.

2) Every crane driver or hosting appliance operator shall be properly qualified and no person under the age of 21 years should be in charge of any hoisting machine including any scaffolding winch or give signals to operators.

3) In case of every hoisting machine and of every chain ring hook, shackle swivel and pulley block used in hosting or as means of suspension, the safe working load shall be ascertained by adequate means. Every hoisting machine and all gear referred to above shall be plainly marked with the safe working load. In case of hosting machine having a
variable safe working load, each safe working load and the conditions under which it is applicable shall be clearly indicated. No part of any machine or any gear referred to above in this paragraph shall be loaded beyond the safe working load except for the purpose of testing.

4) In case of departmental machines, the safe working load shall be notified by the Electrical-Engineer – in – Charge. As regards contractor’s machines, the contractors shall notify the safe working load of the machine to the Engineer –in– charge whenever he brings any machinery to site of work and get it verified by the Electrical Engineer concerned.

11. Motors, gearing, transmission, electric wiring and other dangerous parts of hoisting appliances should be provided with efficient safeguards. Hoisting appliances should be provided with such means as will reduce to the minimum the risk of accidental descent of the load. Adequate precautions should be taken to reduce to the minimum the risk of any part of a suspended load becoming accidentally displaced. When workers employed on electrical installations which are already energized, insulating mats, wearing apparel such as gloves, seeves and boots as may be necessary should be provided. The workers should not wear any rings, watches and carry keys or other materials which are the good conductors of electricity.

12. All scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in safe conditions and no scaffold, ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities should be provided at or near places of work.

13. These safety provisions should be brought to the notice of all concerned by display on a notice board at a prominent place at work spot. The person responsible for compliance of the safety code shall be named therein by the contractor.

14. To ensure effective enforcement of the rules and regulations relating to safety precautions the arrangements made by the contractor shall be open to inspection by the Labour Officer, Engineer – in – Charge of the department or their representatives.

15. Notwithstanding the above clauses from 1 to 14 there is nothing in these to exempt the contractor from the operations of any other Act or Rule in force in the State of Haryana.

EXECUTIVE ENGINEER,
HUDA DIVISION No. I, HISAR
MODEL RULES FOR THE PROTECTION OF HEALTH AND SANITARY ARRANGEMENTS FOR WORKERS EMPLOYED BY CONTRACTORS

1. APPLICATION:
These rules shall apply to all building, road and other construction works in charge of HUDA Department in which twenty or more workers are ordinarily employed or are proposed to be employed on any day during the period during which the contract work is in progress.

2. DEFINITION:
Work place means a place where twenty or more workers are ordinarily employed or are proposed to be employed in connection with construction work on any day during the period during which the contract work is in progress.

3. FIRST AID FACILITIES:
1. At every work place there shall be provided and maintained, so as to be easily accessible during working hours, first-aid boxes at the rate of not less than one box for 150 contract labourers part thereof ordinarily employed.

2. The first aid box shall be distinctly marked with a red cross on white good and shall contain the following equipment, namely:

a) For work places in which the number of contract labour employed does not exceed 50
Each first – aid box shall contain the following equipments:
   i) 6 small sterilized dressings.
   ii) 3 medium size sterilised dressings.
   iii) 3 large size sterilized dressings.
   iv) 3 large sterilized burn dressings.
   v) 1 (30 ml.) bottle containing a two percent alcoholic solution of iodine.
   vi) 1 (30 ml.) bottle containing salvolatile having the dose not mode of administration indicated on the lable.
   vii) 1 snake – bite lancet.
   viii) 1 (30 gms.) bottle of potassium permagnate crystals.
   ix) 1 pair of scissors
   x) 1 copy or the first – aid leaflet issued by the Director General, Factory Advice Service and Labour Institutes, Government of India.
   xi) 1 bottle containing 100 tablets (each of 5 grams) of aspirin.
   xii) Ointment for burns.
   xiii) A bottle of suitable surgical antiseptic solution.

b) For work places in which the number of contract labour exceed 50 Each first – aid box shall contain the following equipments:
   i) 12 small sterilised dressing.
   ii) 6 medium size sterilized dressings
iii) 6 large size sterilized dressings.
iv) 6 large size sterilized burn dressings
v) 6 (15 gms) packets of sterilized cotton wool.
vi) 1 (60 ml.) bottle containing a two percent alcoholic solution iodine.
vii) 1 (60 ml.) bottle containing salvolatile having the dose and mode of administration indicated on the label.
viii) 1 roll of adhesive plaster.
ix) 1 snake bite lancet.
x) 1 (30 gms.) bottle of potassium permanganate crystals.
xi) 1 pair of scissors.
xii) 1 copy of the first – aid leaflet issued by the Director General, Factory Advice Service and Labour Institutes, Government of India.
xiii) A bottle containing 100 tablets (each of 5 grams) of aspirin.
xiv) Ointment for burns.
xv) A bottle of suitable surgical antiseptic solution.

3) Adequate arrangements shall be made for immediate recoupment of the equipment when necessary.

4) Nothing except the prescribed contents shall be kept in the First – Aid box.

5) The First – Aid box shall be kept in charge of a responsible person who shall always be readily available during the working hours of the work place.

6) A person in charge of the First – Aid box shall be person trained in First – Aid treatment in work places where the number of contract labour employed is 150 or more.

7) In work places where the number of contract labour employed is 500 or more and hospital facilities are not available within easy distance of the works, First – Aid posts shall be established and run by trained compounder. The Compounder shall be on duty and shall be available at all hours when the workers are at work.

8) Where work places are situated in places which are not towns or cities, a suitable motor transport shall be kept readily available to convey injured person or persons suddenly fallen ill, to the nearest hospital.

4. DRINKING WATER.

a) In every work place, there shall be provided and maintained at suitable places, easily accessible to labour, a sufficient supply of cold water fit for drinking.

b) Where drinking water is obtained from an intermittent public water supply, each work place shall be provided with storage where such drinking water shall be stored.

c) Every water supply of storage shall be at a distance of not less than 50 feet from any latrine, drain or other source of pollution. Where water has to be drawn from an
existing well which is within such proximity of latrine, drain or any other source of pollution, the well shall be properly chlorinated before water is drawn from it for drinking. All such wells shall be entirely closed in and be provided with a trapdoor which shall be dust and water-proof.

d) A reliable pump shall be fitted to each covered well, the trap-door shall be kept locked and opened only for cleaning or inspection which shall be done at least once a month.

5. **WASHING FACILITIES:**

i) In every work place adequate and suitable facilities for washing shall be provided and maintained for the use of contract labour employed therein.

ii) Separate and adequate screening facilities shall be provided for the use of male and female workers.

iii) Such Facilities shall be conveniently accessible and shall be kept in clean and hygienic condition.

6. **LATRINES AND URINALS:**

i) Latrines shall be provided in every work place on the following scale, namely:

a) Where females are employed there shall be least one latrine for every 25 females.

b) Where males are employed, there shall be least one latrine for every 25 males.

Provided that where the number of males or females, exceeds 100, it shall be sufficient if there is one latrine for 25 males or females, as the case may be up to the first 100 and one for every 50 thereafter.

ii) Every latrine shall be under cover and so partitioned off as to secure privacy, and shall have a proper door and fastenings.

iii) Construction of latrines: The inside walls shall be constructed of masonry or some suitable heat-resisting, non-absorbent materials and shall be cement washed inside and outside at least once a year. Latrines shall not be of a standard lower than bore-hole system.

iv) (a) Where workers of both sexes are employed there shall be displayed outside each block or latrine and urinal a notice in the language understood by the majority of the workers “For Men only” or “For Women only” as the case may be.

(b) The notice shall also bear the figures of a man or a woman as the case may be.

(v) There shall be at least one urinal for male workers up to 50 and one for female workers up to fifty employed at a time. Provided that where the number of male or female workman, as the case may be, exceeds 500, it shall be sufficient if there is one urinal for every 50 males or females up to 500 and one for every 100 or part thereof, thereafter.

vi) a) The latrines and urinals shall be adequately lighted and shall be maintained in a clean and sanitary conditions at all times.

b) Latrines and urinals other than those connected with a flush sewerage system shall comply with the requirement of the Public Health Authorities.
vii) Water shall be provided by means of a tap or otherwise so as to be conveniently accessible in or near the latrines and urinals.

viii) Disposal of excreta: Unless otherwise arranged for by the local sanitary authority, arrangements for proper disposal of excreta by incineration at the work place shall be made by means of a suitable incinerator. Alternately, excreta may be disposed of by putting a layer of night soil at the bottom of a pucca tank prepared for the purpose and covering it with a 15cm. layer of waste or refuse and then covering it with layer of earth for a fortnight (when it will turn into manure.)

ix) The contractor shall, at his own expense, carry out all instructions issued to him by the Engineer in Charge to effect proper disposal of soil and other conservancy work in respect of the contractor’s workman or employees on the site. The contractor shall be responsible for payment of any charges which may be levied by Municipal or Cantonment Authority for execution of such work on his behalf.

7. **PROVISION OF SHELTER DURING REST:**

At every place there shall be provided, free of cost, four suitable sheds, two for meals and the other two for rest separately for the use of men and women labour. The height of each shelter shall not be less than 3 metres from the floor level to the lowest part of the roof. These shall be kept clean and the space provided shall be on the basis of 0.6 sq. m. per head.

Provided that the Engineer-in-Charge may permit, subject to his satisfaction, a portion of the building under construction or other alternative accommodation to be used for the purpose.

8. **CRECHES:**

(a) At every work place, at which 20 or more women workers are ordinarily employed, there shall be provided two rooms of reasonable dimensions for the use of their children under the age of six years. One room shall be used as a play room for the children and the others as their bed room. The rooms shall be constructed on a standard not lower than the following:

i) thatched roof

ii) mud floors and walls

iii) planks spread over the mud floor and covered with matting

b) The rooms shall be provided with suitable and sufficient openings for light and ventilation. There shall be adequate provision of sweeper to keep the places clean.

c) The contractor shall supply adequate number of toys and games in the play room and sufficient number of cots and beddings in the bed room.

d) The contractor shall provide one Dai to look after the children in the creche when the number of women workers does not exceed 50 and two Dais when the number of women workers exceed 50.

e) The use of the rooms earmarked as creches shall be restricted to children, their attendants and mothers of the Children.
9. **CANTEENS:**

1. **In every work place** where the work regarding the employment of contract labour is likely to continue for six months and wherein contract labour numbering one hundred or more are ordinarily employed, an adequate canteen shall be provided by the contractor for the use of such contract labour.

2. The canteen shall be maintained by the contractor in an efficient manner.

3. The canteen shall consist of at least a dining hall kitchen, storerooms, pantry and washing places separately for workers and utensils.

4. The canteen shall be sufficiently lighted at all times when any person has access to it.

5. The floor shall be made of smooth and impervious material and inside walls shall be limewashed or colour washed at least once in each year.

   Provided that the inside walls of the kitchen shall be lime washed every four months.

6. **The precincts of the canteen shall be maintained in a clean and sanitary condition.**

7. Waste water shall be carried away in suitable covered drains and should not be allowed to accumulate so as to cause a nuisance.

8. Suitable arrangements shall be made for the collection and disposal of garbages.

9. The dining hall shall accommodate at a time 30 per cent of the contract labour working at a time.

10. The floor area of the dining hall, excluding the area occupied by the service counter and any furniture except tables and chairs shall not be less than one square meter per dinner to be accommodated as prescribed in sub-rule 9.

11. (i) A portion of the dining hall, and service counter shall be partitioned off and reserved for women workers, in proportion to their number.

   (ii) Washing places for women shall be separate and screened to secure privacy.

12. Sufficient tables, stool, chairs or benches shall be available for the number of dinners to be accommodated as prescribed in sub-rule 9.

13. (a) (i) There shall be provided and maintained sufficient utensils, crockery, furniture and any other equipment necessary for the efficient running of the canteen.

   (ii) The furniture, utensils and other equipment shall be maintained in a clean and hygienic conditions.

   (b) (i) Suitable clean clothes for the employees serving in the canteen shall be provided and maintained.

   (ii) A service counter, if provided, shall have top of smooth and impervious material.

   (iii) Suitable facilities including an adequate supply of hot water shall be provided for the cleaning of utensils and equipment.
14. The foodstuffs and other items to be served in the canteen shall be in conformity with the normal habits of the contact labour.

15. The charges for foodstuffs, beverages and any other items served in the canteen shall be based on ‘No Profit, No Loss’ and shall be conspicuously displayed in the canteen.

16. In arriving at the price of foodstuffs and other articles served in the canteen, the following items shall not be taken into consideration as expenditure, namely:
   a) The rent of land and building;
   b) The depreciation and maintenance charges for the building and equipment provided for the canteen;
   c) The cost of purchase, repairs and replacement of equipments including furniture, crockery cutlery and utensils;
   d) The water charges and other charges incurred for lighting and ventilation;
   e) The interest and amount spent on the provision and maintenance and equipment provided for in the canteen.

17. The accounts pertaining to the canteen shall be audited once every 12 months by registered accountants and auditors.

10. **ANTI-MALARIAL PRECAUTIONS**:  
    (As per circular No. 85/6/97/SSW-PWD/326 H. 22/8/97)

    The contractor shall at his own expense, conform to all anti-malarial instructions given to him by the Engineer-in-charge including the filling up of any borrow pits which may have been dug by him.

11. The above rules shall be incorporated in the contracts and in notices inviting tenders and shall form an integral part of the contracts.

12. **Amendments**:

    Government may, from time to time, add to or amend these rules and issue such directions as it may consider necessary for the purpose of removing any difficulty which may arise in the administration thereof.
LIST OF MATERIAL TO BE ISSUED BY THE ENGINEER-IN-CHARGE OF THE WORKS TO THE CONTRACTOR

NOTES:

1. All the materials, will be issued at the place of issue given and all the cost of carriage from the place of issue to the site of work will be borne by the Contractor and this is included in the rate for the work carried out by the contractor.

2. In case my quantity of cement, steel, coal or any other controlled or uncontrolled commodity for use directly on the aforesaid work of manufacturers or materials required in connection therewith, which is not utilized for the purpose for which it is issued or otherwise disposed off by him or spoiled or lost or allowed to get destroyed or used in excess of the qualities actually required to be used as per specification therein stipulated or these from fixed by the Engineer-in-charge, the cost of such quantities of the materials shall without prejudice to other rights and remedies available to the Haryana Urban Development Authority be recoverable from the contractor on double the stock rate at which it is agreed to be supplied to the contractor or double the stock rate for the quantities issued free of cost.

3. EXCESS/SHORT CONSUMPTION OF MATERIAL RECOVERY FROM CONTRACTOR

   a) For excessive consumption of Material upto 5% (five percent).

      Recovery will be made from the contractor at issue rate plus 3% storage charges.

   b) Excessive consumption of material more than 5% (five percent)

      Recovery will be made from the contractor for the excessive consumption of materials of panel rate provided in the contract plus three percent storage charges.

   c) For short consumption of material upto 5% (five percent)

      The recovery of cost of material less consumed would be made form the contractor at issue rates.

   d) In case of less consumption by more than 5% (five percent)

      The rates of concerned items will be reduced where less materials might have been consumed and the same would be reduced proportionate to the materials used shorter that prescribed. However where it is not possible to determine the exact item on which less materials has been used, the cost of materials would be recovered from the contractor at issue rate and in addition the contractor will be open for disciplinary action by the Divisional Officer. In case where the items of work become non-schedule and non-agreement due to less consumption of materials, the Executive Engineer may sanction such non-schedule and non-agreement rate upto the power of his technical sanction of original work where amounts larger than those mentioned above are involved, the rates will be got approved from the competent authorities concerned who can approve such rates upto their powers to sanction estimates technically. It should also be left to the Executive Engineer to determine whether the structure is affected adversely by less consumption of
material and in cases where he feels that it is likely to be so, it is for him to rejected the work and decision in such matters of Executive Engineer shall be final.

4. 3% storage charges will be levied on all materials issued to the contractor from stock, the cost of which is recoverable.

5. The octroi, terminal tax, royalty and other taxes and charges on the materials issued shall be borne by the contractor.

6. The recovery of material issued by HUDA store shall be made in the usual manner from the running bills for the up to date quantity of such materials issued to the contractor not withstanding that lesser quantity of material might have been consumed on the work & the balance quantity may be lying in store at the site of work.

7. Material issued at HUDA store if not used at site will be returned in HUDA store immediately. In case the material is not returned or lesser material is returned recovery at panel rate will be made at the rates given in the contract plus storage charges.

8. The other material mentioned in the list will be supplied to the extent of the separate security deposit of suitable amount as per direction of Engineer-in-charge.

EXECUTIVE ENGINEER,
HUDA DIVISION No. I, HISAR

No materials will be issued from Haryana Urban Development Authority stores for works contract to be executed.
AFFIDAVIT

I _____________________________ S/o Sh.____________________________
resident of _______________________________________________ Section ______________
Distt.____________________ contractor / partner / share holders (strike out the which is not
applicable) (firm or contractor) do hereby solemnly declare as under:-

1. That the person / firms black listed by HUDA / Haryana Govt. / Govt. of India from
time to time never had any connection and interest in my business.

2. That the above said contractor / persons / firms do not have any substituting in my
business and

3. That the said persons / firms are not employee of my firm and are not in any way
connected with my business.

4. That the said person / firms has submitted his bid online in the respective envelopes.

DEPONENT

WITNESS

DATED:

I do hereby solemnly declare and affirm that the above declaration is true and correct to the
best of my knowledge and belief. No part of it is false and nothing has been concealed and I shall be
held responsible if found not abide by the above mentioned items for the tender or the tender
document of this work.

DEPONENT

WITNESS

DATED:
SECTION – 1: Project Objective and SCOPE OF WORK

1.0 PROJECT OBJECTIVE

Providing external Sewerage Scheme for Zone - III, Hisar. “Design, Construction, Supply, Erection, Testing & Commissioning of 15 MLD Capacity MPS & Cyclic Activated Sludge Process/SBR technology based 15MLD Sewage Treatment Plant including 3 months successful trial run, operation & maintenance for 12 months during defect liability period, and thereafter operation & maintenance for 4 years at Zone - III, Hisar. HUDA Division No. 1 Hisar intends to invite offer from the eligible bidders for the execution of this work on turnkey basis.

The offers shall be based on the bidder's own design and operating philosophy which is to be based on the cyclic activated sludge process/ sequential batch reaction process and should be within the overall frame work and guidelines specified by HUDA in the bid document and its specifications.

The bidder’s design for the following:

- Raw Water Sewage Pumping Station
- Sewage Treatment Plants
- Automation for above

Shall be such that the project -

- Requires minimum land space,
- Requires minimum energy for treatment of sewage,
- Generates treated effluent which meets the parameter on specified and can be recycled if required.

Planning of the entire system should be done in such a manner so as to optimize capital and operational costs of treatment of sewage and maintenance of allied works.

1.1 BRIEF SCOPE OF WORK

The scope of the work shall include but not be limited to the following:

- Design, construction, supply, erection, testing and commissioning of 15MLD capacity Raw Sewage Pumping Station and STP.
- Required site development including leveling and grading to improve the aesthetics and to facilitate the vehicular movement and also including clearing the site of trees / shrubs, debris, etc.
- Preparation and submission of process, hydraulic, electrical, mechanical and piping design, all civil, mechanical, electrical and piping drawings including architectural, construction and as built drawings for approval of the department.
- Works connected in respect obtaining power supply to proposed STP from State Electricity Department.
- Construction of civil engineering works for all the units plus all the ancillary structures as detailed in Civil Specifications.
- Supply, erection testing & commissioning of all the mechanical equipment as detailed in Mechanical Specifications.
• Supply, erection testing & commissioning of all the Electrical & Instrumentation equipment as detailed in Electrical Specifications.

• Supply, erection, testing & commissioning of all the piping & valves as specified in Civil Specifications.

• Trial Run of the constructed & hydraulically tested plant along with electrical & mechanical equipment for a period of Three (3) months, defect liability period of twelve months from the successful completion of trial run and operation & maintenance for **48 months** after trial run as per tender specifications including providing and installing all civil, material, labour, tools and plants all complete on turnkey basis.

• Supply of all documentation for the plant such as As-Built drawings, Operation & Maintenance manuals (3 sets) along with soft copy.

• Supply of all chemicals & materials required during Trial run, defect liability period of 12 months, thereafter and during 48 months of O & M Period.

• Water proof cement painting to all units with oil painting with corrosive treatment to railing and all MS, Cl and Gl works, every year during O & M period and defect liability period.

All the specifications are as per PWD / CPHEEO manual and IS standards

Any other items of work which have not been specifically mentioned in specifications but are necessary for construction of the plant as per engineering practice and safety norms and operation and guaranteed performance of the entire plant shall be deemed to be included within scope of work of this specifications and shall be provided by the contractor without any extra cost.

The time limit for completion shall be as under

Fifteen Months for Completion of work, Three Months Trial Run, 12 months defect liability period thereafter and 4 years Operation and Maintenance.

1.1.1 General

- Operation and Maintenance of units for 4 years after satisfactory commissioning of the complete plant, including maintaining a record of all required process parameters with respect to the plant operation and the regular preventive and breakdown maintenance of all components. However, depending on the performance, the operation and maintenance period can be extended for another 5 years.

- Providing “on the job” training to HUDA personnel.

- **Repairing & reconditioning of all the civil, electrical, mechanical units & equipments in the concluding year of operation & maintenance** with regular preventive and recommended maintenance.

- Cost of shifting of poles, cables, pipe lines etc. if required shall be borne by the contractor.

- All the connections such as electrical, water supply, sewage etc. should be arranged by the contractor. All other cost related to obtaining such approval is in the scope of work. It will be the total responsibility of contractor to obtain approval of entire electrical installation from electrical inspector. No expenses will be paid by Department on this account.
1.2 PROPOSED TREATMENT SCHEME

1.2.1 Receiving of Sewage
Raw Sewage will be received by deep gravity outfall sewer, which will discharge the raw sewage into a Receiving Chamber from where it will be taken into downstream screens. The function of the Receiving Chamber is to reduce the incoming velocity. Receiving Chamber shall be of adequate size to meet the requirements of workability inside it. The Receiving Chamber shall be water tight to prevent seepage of the sewage out of the Receiving Chamber.

1.2.2 Coarse Screening
Adequate nos. of coarse screens are to be provided up stream of Wet well for removal of floating and oversized material coming with the sewage. The coarse screens should be capable to screen out most of the medium & large floating and oversized material such as plastic rags, debris, weeds, paper, cloth, rags etc which could clog the waste water pump impellers. The coarse screen shall be inclined bar screen. It should be of sturdy design to take care of all sorts of materials envisaged in the gravity sewer. The bar screen shall be of stainless steel flats. The screenings shall be dropped on conveyor above the top of the screen channel. A conveyor system of suitable width shall be provided which shall be adjacent to the screens. The screening material as collected will drop automatically into a wheelbarrows for its disposal.

1.2.3 Raw Sewage Pumping Station
Screened sewage after coarse screening enters into wet well of the pumping station. Wet well is to be provided with two compartments so that grit/ sand coming along with sewage can be settle in the first compartment, necessary arrangement such as screw conveyor, desilting pump etc. for removal of grit/sand from well with motor and other accessories for periodical clearing should be provided with standby arrangement. The capacity of the wet well should be kept such that adequate detention time is available during average and peak flow conditions. The effective liquid volume shall be provided below the invert level of the incoming sewer after leaving provision for freeboard. The capacity of the wet well is to be so kept that with any combination of inflow and pumping, the operating cycle for any pump will not be less than 5 minutes. In addition to the above liquid depth, an additional depression shall be provided to ensure adequate submergence of the pump as per the manufacturer’s recommendations Pumping station should have a room adequate for installing electrical panels. Suitable arrangement should be provided for lifting of pumps.

Suitable combination of submersible pumps to be provided in the wet well to cater to the pumping requirements at average and peak flow conditions. Based on incoming flow conditions, adequate no. of pumps shall start / stop automatically to cater the pumping requirements. Automation shall be controlled through the PLC provided for operation of the plant.

The pumped flow from the pumping station shall be taken to the elevated head works Inlet chamber of the plant from where sewage will gravitate to fine screen channels.
1.2.4 **Fine Screening Channels**
Fine screens Channels to be provided for fine screening of sewage prior to grit removal. It shall be mechanically operated and must be suitable for sewage applications. The screens should be capable to screen out most of the floating and oversized material. The bar screen shall be of Stainless steel. A conveyor system of suitable width shall be provided which shall be adjacent to the screens. The screening material as collected will drop automatically into a wheel barrow for its disposal.

1.2.5 **De-gritting**
Screened Sewage will gravitate to Grit separator tank for removal of grit and small inorganic particle matter of specific gravity above 2.65. The design of Grit separator tank with respect to corresponding retention time and volume shall be such that no particle of any size shall be pass on the oil removal tank. The Grit separator tank shall be of RCC construction complete with mechanical internals. Proper arrangement shall be made to collect the separated grit for disposal. The degritted sewage shall flow through open channels from the grit separators and confluence into a single channel of suitable width.

1.2.6 **Oil Removal and Flow Measurement**
Oil Removal Tank shall be provided for removal of free floating oil & grease from the degritted sewage. It shall be in the form of RCC baffled tank with adequate detention time to allow free oil to float to the surface from where it will be removed using suitable mechanism to ensure 100% oil and grease removal.

Flow measurement in the common outlet channel after screening, grit removal shall be in the form of a particle flume housed in the RCC channel. The flume shall be constructed in RCC and finished in cement mortar. An ultrasonic level measurement device shall measure sewage depth in the flume and the flow computation shall be through the dedicated digital display with integrator near the flume.

1.2.7 **SBR / Cyclic Activated Sludge Process**
Screened, de-gritted sewage shall be fed into the Cyclic Activated Sludge Process / SBR Process Basins for biological treatment to remove BOD, COD, Suspended Solids, Nitrogen and Phosphorous. SBR / Cyclic Activated Sludge Process shall work on Cyclic / Batch mode in single step. It shall perform biological organic removal, Nitrification, De-nitrification and Biological Phosphorous removal. It shall be capable of simultaneous sludge stabilization. The oxygen required shall be supplied through diffused aeration system with auto control of oxygen level in tank. The system shall have a SVI < 120 for higher settling rates and should be designed in such a way that growth of filamentous bacteria is restricted. Complete operation of SBR / Cyclic Activated Sludge Process including decanting rate, sludge recirculation and wasting of excess sludge shall be controlled by PLC.

1.2.8 **Chlorination System**
Treated Sewage from SBR / Cyclic Activated Sludge Process units will be collected in a chlorination tank where disinfectant will be added for disinfection at suitable dosing rate. Baffle walls shall be provided in the tank to facilitate hydraulic mixing of treated sewage. Adequate retention time shall be considered for while designing the chlorination tank volume to ensure proper disinfection of treated sewage.
The treated sewage is to be collected in a treated water storage tank from where it will be reused / disposed off suitably by gravity.

1.2.9 **Sludge Handling System**

The sludge from the SBR / Cyclic Activated Sludge Process basins is withdrawn through sludge withdrawal system and collected in the sludge sump. Minimum of 4 hrs. hold-up volume shall be provided. The sludge shall be then pumped to Solid Bowl Centrifuge for dewatering of sludge. Centrifuge feed pumps shall be of positive displacement type screw pumps. Dewatering Polymer shall be dosed online prior to centrifuge feed. The dosing system shall include one solution preparation and one solution-dosing tank of minimum 12hrs. capacity equipped with slow speed mixers and metering type positive displacement pumps. The sludge in form of wet cake from centrifuges will be collected and disposed off. Necessary arrangement shall be done for disposal of the sludge within a lead of 10kms on a day to day basis.

Interconnection of various units shall be made through piping or RCC channels. Piping will be preferred over RCC channel wherever possible but the Engineer-in-Charge reserves the right to select any option.

**MISCELENEOUS**

The process considered shall be a well-established process for treatment of sewage. The Tenderers are to adopt the same nomenclature used for various treatment units in their design report as used in the tender documents. The Tenderer is required to fill up/complete the Datasheets. Technical Schedules as a part of the tender submission. Any bid without filled in Datasheet shall be considered as non responsive and shall be liable for rejection.

1.3 **COMPONENT OF WORK**

The different components to be covered by the contractor under the present scope of work are as follows:

The project shall have following major units:
1. Receiving Chamber.
2. Coarse Screen Channels with suitable mechanical & manual screens.
3. Raw Sewage Wet Well/ Sump and Pump House
4. Inlet Chamber
5. Fine Screen Channels with suitable mechanical & manual coarse screens.
7. Oil & grease removal arrangement.
8. Flow measurement arrangement.
9. Cyclic Activated Sludge Process / SBR Process Units
10. Chlorine Contact Tank
11. Chlorine House
12. Sludge sump and pump housing
13. Mechanical Sludge dewatering system
14. Air Blower unit with proper houses.
15. Effluent pump house.
16. Interconnecting Piping
17. Automation of the complete STP to facilitate its automatic operation using PLC, SCADA and Computer from the control room.
1.3.1 **Design Basis:**
Sewage Treatment Plant Capacity shall be:
- **Average Flow**: 15MLD
- **Peak Factor**: 2.25 of average flow
- **Peak Flow**: 33.75MLD

1.3.2 **Raw Sewage Quality:**
An abstract of Raw Sewage Characteristics is indicated in the following table:

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Parameters</th>
<th>Values</th>
<th>UOM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Biochemical Oxygen Demand (BOD₅)</td>
<td>250</td>
<td>mg/l</td>
</tr>
<tr>
<td>2</td>
<td>Chemical Oxygen Demand</td>
<td>500</td>
<td>mg/l</td>
</tr>
<tr>
<td>3</td>
<td>Total Suspended Solids</td>
<td>400</td>
<td>mg/l</td>
</tr>
<tr>
<td>4</td>
<td>Total Kjeldahl Nitrogen (as N)</td>
<td>45</td>
<td>mg/l</td>
</tr>
<tr>
<td>5</td>
<td>Ammonia Nitrogen (as N)</td>
<td>15</td>
<td>mg/l</td>
</tr>
<tr>
<td>6</td>
<td>Total Phosphorus (as PO₄)</td>
<td>5</td>
<td>mg/l</td>
</tr>
<tr>
<td>7</td>
<td>Sulfates</td>
<td>200</td>
<td>mg/l</td>
</tr>
<tr>
<td>8</td>
<td>Fecal Coliforms</td>
<td>10⁷ MPN/100ml</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Total Coliforms</td>
<td>10⁸ MPN/100ml</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Chlorides</td>
<td>200</td>
<td>mg/l</td>
</tr>
<tr>
<td>11</td>
<td>PH</td>
<td>7.0 to 8.0</td>
<td>mg/l</td>
</tr>
<tr>
<td>12</td>
<td>Oil &amp; Grease</td>
<td>20</td>
<td>mg/l</td>
</tr>
</tbody>
</table>

The contractor shall carry out the sampling tests of raw sewage by themselves to ascertain the raw sewage quality for treatment process. Contractor is also required to verify the operating data of existing plants.

1.3.3 **Treated Sewage Quality:**
The contractor shall design the process in such a way that the treated effluent quality attains the following maximum limits:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Parameters / Pollutants</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>i)</td>
<td>Biochemical Oxygen Demand (as BOD₅)</td>
<td>10 or less mg/l</td>
</tr>
<tr>
<td>ii)</td>
<td>Total Suspended Solids</td>
<td>10 or less mg/l</td>
</tr>
<tr>
<td>iii)</td>
<td>COD</td>
<td>Less than or equal to 100 mg/l</td>
</tr>
<tr>
<td>v)</td>
<td>pH</td>
<td>7 – 9</td>
</tr>
<tr>
<td>vi)</td>
<td>Oil &amp; Grease</td>
<td>Less than or equal to 5 mg/l</td>
</tr>
<tr>
<td>vii)</td>
<td>Ammonical Nitrogen</td>
<td>Less than or equal to 2 mg/l</td>
</tr>
<tr>
<td>viii)</td>
<td>Nitrate Nitrogen</td>
<td>Less than or equal to 10 mg/l</td>
</tr>
<tr>
<td>ix)</td>
<td>Total Phosphorous</td>
<td>Less than or equal to 2 mg/l</td>
</tr>
</tbody>
</table>
The above parameters are indicative only. Design parameters suggested by technology provider based on process requirements and inlet characteristics should be adopted. However, the adopted parameter must be within the standards and guidelines as laid in the Manual of Sewerage and Sewage Treatment by the Ministry of Urban Development Government of India.

1.3.4 Technical Specifications - STP:
1. Receiving Chamber
The deep gravity outfall sewers will discharge the raw sewage into a Receiving chamber. There shall be a proportional weir provided on upstream of the receiving chamber to ensure constant incoming velocities into the receiving chamber. The Receiving Chamber shall be designed for peak flow. Sluice gates shall be provided in the receiving chamber to regulate the flow of sewage. The maintenance staff should be able to operate the sluice gates, manually by standing on the chamber. There shall be a provision of one by pass channel for the chamber along with the gates for conveying at maintenance work on the chamber. The receiving chamber shall be open to sky and shall be water tight to prevent seepage of the sewage out of the inlet chamber. The entire construction is in M30 grade concrete and as per IS 3370. RCC access platform minimum 1m wide with G.I railing as per specifications shall be provided on one side of the chamber:

- Number of Units : 1 (one)
- Detention period : 60 sec.
- Min Free board : As per the site condition.
- Minimum volume of the Receiving chamber shall be 48 m$^3$.

The component / unit shall be designed for following.

- Average flow ---- 15MLD
- Peak factor ---- 2.25
- Peak flow ---- 33.75 MLD.

All other accessories, whether specified or not but required for completion of contract shall be in contractors scope.
2. **Coarse and Fine Screen Channels**

Two screens of 20 mm two mechanical & one manual each of 50% capacity are proposed in the screen chamber.

Both Mechanical and manual bar screens shall be made of 10 mm thick Stainless Steel (SS 304) flats respectively. Conveyor Belt and chute arrangement shall be provided to take the screenings to the screenings dropped from chute will be collected in a wheel borrow (to be supplied by contractor) of approx. 0.5 m³ capacity. Manually operated aluminum gates are to be provided at the upstream and downstream ends to regulate the flow.

All the screenings and unwanted materials shall be dumped in a pit to be provided in one corner of the plant premises on a regular basis.

RCC Platforms of minimum 1m width shall be provided at the upper level to enable operation of the unit. G.I Railings shall be provided around the entire periphery of the well as well as for the platform. RCC staircase 1200 mm wide shall be provided for access from the ground level to the top of the unit & to the operating platforms.

<table>
<thead>
<tr>
<th>Number of Units</th>
<th>(2) Mechanical + 1 Manual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approach Velocity at Average Flow (m/sec.)</td>
<td>0.3</td>
</tr>
<tr>
<td>Velocity through Screen at Average Flow (m/sec.)</td>
<td>0.6 maximum</td>
</tr>
<tr>
<td>Velocity through Screen at Peak Flow (m/sec.)</td>
<td>1.2 maximum</td>
</tr>
<tr>
<td>Free board</td>
<td>As per site conditions</td>
</tr>
<tr>
<td>Wheeled Trolley</td>
<td>2 Nos.</td>
</tr>
</tbody>
</table>

Minimum size of each screen channel shall be 4.0m long x 1m wide x 1m SWD.
With free board 0.5 m.
The component / unit shall be designed for following
Average flow ---- 15MLD
Peak factor ---- 2.25
Peak flow ---- 33.75 MLD.

All other accessories, whether specified or not, but required for completeness of contract shall be in contractor’s scope.

3. **Raw Sewage Pumping Station**

3.1 **Sump and Pumps**

Sewage enters into wet well of the pumping station after screening. The wet well shall be circular in shape and shall be designed for peak flow. The capacity of the wet well should be kept such that the detention time in the wet well shall be 30 minutes of average flow.

Following criteria’s shall be considered to size the sump:

1. That the pump of the minimum duty/ capacity would run for at least 5 minutes considering no inflow or
2. The capacity of the sump is to be so kept that with any combination of inflow and pumping the operating cycle for any pump will not be less than 5 minutes and
3. The arrangement of the submersible pumps as per pump manufacturer’s data i.e. spacing between pumps, minimum space between pump and wall etc. to be followed.
4. The side water depth (live liquid depth) shall be minimum 2.5 meter. In addition to the above liquid depth, an additional depression shall be provided to ensure adequate submergence of the pump as per the manufacturers recommendations Pumping station
should have a room adequate for installing electrical panels. Suitable arrangement should be provided for lifting of pumps.

5. The effective liquid volume shall be provided below the invert level of the screen chamber after leaving a provision for a minimum of 0.3m.

Wet well should be consist of two compartment i.e. baffle valve in order to prevent sand /grit deposit near the pump necessary by pass arrangement shall be provided to be used during the shut down of the plant

The wet well shall be equipped with a screw conveyor to remove deposit of any grit in the wet well. The screw shall be located in the wet well with a partition wall down stream so that the grit is arrested & can be lifted easily by the screw. The screw shall be designed for continuous duty and shall be made of SS304 construction. The screw shall lift the grit to a platform at an elevation 500mm above maximum water level in the sump and discharge the grit into the bucket of a bucket elevator with help of a chute. The bucket shall be then lifted with the help of a electrically operated lifting arrangement to the floor level near the sump from where the grit shall be disposed off suitably. The organic wash pumps shall be provided to wash out organics back into the wet well.

IS: 3370 and IS: 4111 (part 4) shall be followed for the design and construction of wet well. Pumping machinery shall be designed for 15MLD average flow and a peak factor of 2.25. There shall be three pumps each of 15MLD and two pumps each of 7.50 MLD flow to meet standby requirements as per CPHEEO norms. The pumps shall be Submersible raw sewage pumps with centrifugal, non-clog type design. The speed of pump shall be 1000 rpm. The impeller should be of a non-clog design with smooth passage and solid handling capability of 100 mm size.

The pumps shall have cutting edges facing the impellor to share the floating and suspended clogging materials like fibers, plastics, etc. The pumps will have automatic coupling arrangement at discharge end for removal and a guide pipe and chain in SS 304 will be provided for removal and lowering of pumps. Pump shall run smooth without undue noise and vibration. Noise level shall be limited to 85db at 1.86m. Vibration shall be limited as per BS 4675 Part I.

Bearing shall be easily accessible for inspection and maintenance. The bearings shall be having a minimum life of 25000 hours of working. The motor shall be squirrel cage type, suitable for three phase supply continuous duty with class ‘F’ insulation. Motor shall have integral cable parts and the cable entries shall be sealed. The cables shall be leak tight with respect to liquids and firmly attached to the terminal block. The Motor shall be designed for non-overloading characteristic of quantity. The Motor HP shall be at least 10% more than required at duty point.

The critical speed of the rotor shall be at least 30% above the operating speed. Complete rotor shall be balanced dynamically. The moisture sensor of the tripping unit shall be located inside the oil chamber.
Capacity in wet well : To accommodate 33.75 MLD. peak flow.
Minimum Retention Time : 5 minutes minimum at peak flow
Minimum Effective Liquid Volume of sump : 237.5m³
No. of pumps : Min 5nos including standby of suitable capacity as per CPHEEO norms including stand by
Type of pumps : Vertical Submersible type non-clog design
Solid passage size through pumps : 100 mm max.
Insulation : Class F
Protection : IP-68
Liquid : Raw Sewage
Specific gravity : 1.05
Temperature : Min. 20° C
Efficiency : more than 70%
Installation : Fixed.
Casing : Cast Iron IS 210 Gr. FG 260
Impeller : Stainless steel SS 304 or higher grade.
Shaft : AISI 410 (Stainless steel)
Cable gland : Cast Iron IS 210 Gr. FG 260
Motor Body : Cast Iron IS 210 Gr. FG 260
Seal cover : Cast Iron IS 210 Gr. FG 260
Automatic Coupling : Cast Iron
Duck foot bend : Cast Iron
Guide Pipe : SS-304 (Stainless steel)
Lifting chain : SS-304 (Stainless steel)
Fasteners : MS with GI coating

Wet well Specific Requirement and Accessories:

i. Number of Units : (1) One designed for peak flow
ii. Pumping Station Material of Construction
   Wet well / Sump : RCC M30

There shall be an Integral Electrical cum Control Panel room for the pumps and coarse Screens located near the sump. The room shall be of minimum area 40sq.m and height 4.5m to house the Electrical cum Control Panel, space for spare parts and a maintenance area, etc. and be complete with the following accessories:

i. Hoist - comprising of I- Girder and a 1½ ton or more chain pulley (the chain pulley block capacity to be 1½ Ton or 3 times the maximum single unit/ weight that may be required to be removed for maintenance) with horizontal travel on the I-beam.
ii. The room shall be so covered from sides to protect it from natural elements. Ventilation in the sheds shall be as per NBC norms specified in the Civil Construction manual.
iii. The shed shall be suitably designed to avail of natural lighting
iv. Adequate number of fire extinguishers is to be provided as per Electricity Authority norms.
   v. Internal Illumination at levels suitable for proper lighting as per relevant I.S. 
   vi. Sufficient no. of fan/ exhaust fan should be provide.
Testing of Pumps at Manufacturers Premises:

a) Hydrostatic Testing: All pressure parts of pumps prior to assembly, shall be subjected to hydrostatic tests to the satisfaction of Engineer-in-Charge at 1.5 times the maximum pressure obtained with the delivery valve closed and suction pressure at maximum, or twice the working pressure whichever is higher for a duration of 10 minutes.

b) Balancing Test: Impeller and pump rotating assembly shall be dynamically balanced.

c) Performance Test: Each pump shall be tested for full operating range individually to BS: 5316: Part 2 / relevant specification. Test shall be carried out for performance at rated speed with minimum NPSH as available at site.

d) Pump performance shall be within the tolerance limits specified in BS: 5316: Part 2/ relevant specification.

All other accessories, whether specified or not, but required for completeness of contract shall be in contractor’s scope.

3.2 Pumped Waste Water Conveyance

The pumped flow from the pumping station to the elevated head works inlet chamber of the plant shall be taken through a DI pipeline. The rising main shall be designed for 15MLD average flow with a peak factor of 2.25.

(a) The pipeline shall be adequately sized to have a minimum velocity of at least 1.2 m/sec. at minimum flow conditions and not more than 2.5 m/sec at pumped peak flow.

(b) The pump head shall be adequately sized to give a residual discharge head as per CPHEEO manual.

All other accessories, whether specified or not, but required for completion of contract shall be in contractor’s scope.

4 Inlet Chamber

Inlet Chamber will receive raw sewage from the raw sewage pumping station. Inlet chamber shall be designed for average flow of 15MLD with a peak factor of 2.25. The entire construction is in M30 grade concrete and as per IS 3370. RCC access platform minimum 2 wide with railing as per specifications shall be provided on one side of the chamber: RCC staircase 1.2 m wide shall be provided for access from ground level to the top of the unit & to the operating platforms.

<table>
<thead>
<tr>
<th>Total Average flow</th>
<th>15MLD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak factor</td>
<td>2.25</td>
</tr>
<tr>
<td>Design Flow</td>
<td>33.75MLD</td>
</tr>
<tr>
<td>Number of Units</td>
<td>(1) One</td>
</tr>
<tr>
<td>Detention period</td>
<td>60 sec.</td>
</tr>
<tr>
<td>Min Free board</td>
<td>0.5m</td>
</tr>
</tbody>
</table>
5 Fine Screen Channels
One mechanical working with one manual standby screens are proposed in the screen chamber. The screen channels shall be designed for peak flow.

The clear opening for mechanical screen shall be 6mm and shall be 10mm for manual screens. The mechanical bar screens shall be of 2 mm thick & manual bar screen shall be of 6 mm. Stainless Steel (SS316) flats. Conveyor Belt and FRP of 1mm then chute arrangement shall be provided to take the screenings dropped from FRP chute 1mm thin will be collected in a wheel barrow (to be supplied by contractor) of approx. 0.3 m\(^3\) capacity. This trolley will be housed in a roofed enclosure of masonry with proper access, screen washing arrangement and drain. Manually operated stainless steel gates are provided at the upstream and down stream ends to regulate the flow.

RCC Platforms shall be provided at the upper level to enable operation of the unit. Railings shall be provided around the entire periphery of the as well as for the platform. The entire structure is to be M 30 concrete and as per IS 3370 including the platform for the gates. RCC staircase size 1200 mm wide shall be provided for access from the ground level to the top of the unit & to the operating platforms.

The component / unit shall be designed for following

<table>
<thead>
<tr>
<th>Total Average flow</th>
<th>15MLD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak factor</td>
<td>2.25</td>
</tr>
<tr>
<td>Design Flow</td>
<td>33.75MLD</td>
</tr>
<tr>
<td>Number of Units</td>
<td>1 Nos. Mechanical Working + 1 No. Manual Standby each of 100% of peak flow Capacity.</td>
</tr>
</tbody>
</table>

- Approach Velocity at Average Flow (m/sec.) : 0.3
- Velocity through Screen at Average Flow (m/sec.) : 0.6 maximum
- Velocity through Screen at Peak Flow (m/sec.) : 1.2 maximum
- Free board : As per site conditions
- Wheel barrow : 2 Nos.

Minimum size of each screen channel shall be 4.0m long x 1m wide x 1m SWD. With free board 0.5 m.

All other accessories, whether specified or not, but required for completion of the contract shall be in contractor’s scope.

6 Grit Removal Unit
One mechanical grit chambers is proposed after fine screen units, with a bypass arrangement. The mechanical grit chambers shall be Square Mechanical Detritus Tank designed for average flow of 15MLD with a peak factor of 2.25.

Detritus tank chamber shall have the following:
- One tapered inlet channel running along one side with deflectors for entry of sewage into the grit chamber. The minimum SWD of the units shall be adopted on the basis of design requirement of the unit.
- One tapered outlet channel for collecting the degritted sewage, which will overflow over a weir into the outlet channel. Outlet channel of adequate size and shape to ensure that no settling takes place.
- One sloping grit classifying channel into which the collected grit will classified.
• The grit from classifier will be collected in a wheel barrow (to be supplied contractor) of approx. 0.3 m³ capacity. This barrow will be housed in a roofed enclosure of screen masonry with proper access, grit washing arrangement and drain.
• A grit scraping mechanism.
• Adjustable influent deflector.
• Reciprocating rake mechanism to remove the grit.
• Two-mechanism support beams with railing & chequered plates over half diameter of the chamber.
• Organic matter return pump

To enable easy operation of the gates, RCC platforms with G.I pipe railing shall be provided at the upper level. Also access is provided from this level to the mechanism support beam of the grit chamber. The entire construction shall be M 30 grade concrete and as per IS 3370. The component / unit shall be designed for following

| Total average Flow | 15MLD |
| Peak Factor        | 2.25  |
| Design peak Flow   | 33.75MLD |
| No of units        | 1 Nos. Working No grit/sand particle of any Size should pass on to the oil removal tank. |
| Type               | Mechanical |
| Free Board         | 0.5 m  |
| Side Water Depth   | 0.9 m  |
| Wheel barrow (Red Colour) | 2 nos. |

Minimum size of each mechanical grit chamber shall be 7.0 m x 7.0m x 0.9 SWD. With free board 0.3 m. All other accessories, whether specified or not, but required for completion of contract shall form the part of contractor’s scope.

7 Oil Removal Tank
One Oil Removal Tank shall be provided for removal of free floating oil & grease with sufficient detention time.

The component / unit shall be designed for following

| Total average Flow | 15MLD |
| Peak Factor        | 2.25  |
| Peak flow          | 33.75MLD |
| Min Free board     | 0.5m  |

All other accessories, whether specified or not, but required for completion of contract shall be in contractor’s scope.

8 Flow Measurement
Flow measurement in the common outlet channel after screening and grit removal shall be in the form of a Parshall flume housed in the RCC channel which shall be designed in accordance to CPHEEO manual. There shall be a straight length of at least 10 times the throat width of the channel housing the flume in both upstream and downstream of the flume. The flume shall be constructed in RCC and finished in cement mortar. An ultrasonic level measurement device shall be provided and the flow computation shall be through the
dedicated digital display with integrator near the flume. Venture flume shall be provided with calibration.

**Design Capacity**: 33.75MLD.

**No. of Units**: (1) One at downstream side of Degritting Tank

**Type**: Ultrasonic mounted on concrete channel having digital type Indicator, Integrator and Recorder with digital display fixed in the control room.

All other accessories, whether specified or not, but required for completion of contract shall be in contractor’s scope.

### 9 Cyclic Activated Sludge Process / SBR Process with Diffusers and Air Blowers

#### 9.1 Process Design

- The biological treatment section comprising SBR/ cyclic activated sludge process has to be installed and equipped for the total average flow of 15MLD and peak factor of 2.25 (33.75MLD. – Peak flow).

- The complete biological system has to be designed for handling peak flow capacity.

- Two nos. (minimum) rectangular tanks with minimum volume of 4410 m³ or minimum 20 hours detention period for each shall be provided. In addition, 0.5m free board shall be provided to each tank. Maximum liquid depth of tank shall be restricted to 6.0m.

- Cyclic Activated Sludge Process / SBR Process basins will be constructed in M30 grade concrete and as per IS 3370. RCC staircase 1.2m wide is to be provided for access from the ground level to the operating platforms. All platforms and walkways shall be provided hand railings as per tender specifications. 1.2 m Plinth protection along periphery shall be provided as per technical specifications.

- The design criteria and modelling parameters for SBR shall be maintained as per Met Calf & Eddy norms and design criteria for other units shall be maintained as per CPHEEO.

- F/M ratio and MLSS shall be maintained as per CPHEEO norms.

- SBR/ Cyclic activated sludge cycle times shall be selected adequately by the bidder considering min. 12 hrs/day of aeration and not exceeding decanting of 2.6 m liquid depth at any time.

- The excess sludge produced shall be fully digested. Sludge production (including perciipients) rate shall be about 0.6 – 0.8 kg / kg of BOD removed. The nitrification assumed shall be 90-96% and maximum power recovery from denitrification shall be not more than 50% of the power used for nitrification.

- In the SBR / cyclic activated sludge basins, NO filling during settling or decanting will be acceptable.

- The component / unit shall be designed for peak flow of 33.75MLD.

- All other accessories, whether specified or not, but required for completion of contract shall be in contractor’s scope.

#### 9.2 Decanting Mechanism

- The decanting mechanism shall of Stainless Steel (SS-304) and all the other accessories such as gear box etc. shall be provided on the operating platform. The hydraulic discharge capacity of the decanting mechanism shall be proportional to the selected basin area.

- There should be Maximum 1 decanting mechanism per basin.
Flexible rubber hose kind of decanting mechanism sealing or decanting mechanism based on telescopic arrangement is not acceptable.

Each Decanter mechanism shall be inclusive of local control boxes with manual operation selection and function buttons, communication to main PLC by DH485 or Ethernet. The component / unit shall be designed for average Flow.

All other accessories, whether specified or not, but required for completeness of contract shall be in contractor’s scope.

9.3 Specification for Aeration System

The Aeration facility shall be planned for present units will be installed for 15MLD average flow with peak factor of 2.25 (33.75MLD peak flow)

Minimum installed aeration equipment design capacity per day per basin for 15MLD average flow with peak factor shall be (33.75MLD.) marked on the basis of 12 hrs aeration per day per basin. Minimum oxygen transfer capacity provided for 15MLD with peak factor of 2.25 (33.75 ML) average flow shall be marked on 12 hrs. per day aeration basis.

Only fine bubble membrane diffusers shall be used for aeration with minimum membrane diffuser to floor coverage area of 5%. Diffusers shall be submerged fine bubble / fine pore, high transfer efficiency, low maintenance, non-buoyant type. Diffusers shall be tubular (membrane) type.

Material of construction for (entire under water system including accessories) shall be of non corrosive. Any support for under water system shall be of adjustable type and made of SS 304.

The air blower arrangement shall be capable of handling Total Water Level and Bottom Water Level operation conditions, controlled by process sensors such as DO, temperature and level.

Specification for aeration system : Given below is the general specification used for blowers by different boards.

Each SBR reactor basin shall be provided with dedicated set of blowers capable of meeting 100% of the peak oxygen demand of the one reactor basin plus 10% safety margin. Total No. of blowers shall be provided accordingly No sharing of working blowers between SBR reactor basins shall be permitted.

In addition to the dedicated set of blowers meeting 100% of the peak oxygen demand plus 10% safety margin, there shall be at least 50% additional stand by blowers.

All the blowers including standby shall be provided with individual VFD’s.

The blowers capacity should be controlled by a dedicated VFD interlocked with the DO meter in the bioreactor to provide the optimal oxygen demand.

Interlinking of VFD’s or providing a common VFD controlling more than one blower shall not be permitted. Each blower shall be controlled by one VFD.

The blowers shall be positive displacement (roots) type, and head for blowers shall be decided on the basis of Standard Oxygenation Rate of diffusers and maximum liquid depth in tank duly considering the losses governing point of delivery (diffusers) and the blowers. The number of standby blower shall be minimum 50% (fifty percent) of the number of working blowers. Blowers shall be complete with motor and accessories like base frame, anti vibratory pad, silencer, non return valve, air filter etc. as per requirements. Vibration due to operation of blowers should not damage the structures. Further, blowers shall have acoustic enclosure to ensure that the noise level at 3 m
from blowers is below 80db. The blower room shall have sufficient ventilation, lighting and working space. The room will be equipped with sufficient capacity EOT (Min 2 T or 1.5 times the weight of blower, whichever is more) to facilitate removal of blower/motor etc. for repairs. The room will also have rolling shutter.

- The aeration system shall be operated through PLC with help of variable frequency drive drives and shall be capable to operate at different speeds as per requirement of the system.

- The main air header/rising main shall be in MS as per relevant IS. The header / rising main shall be adequately supported at suitable intervals. The header shall have auto valves to facilitate switch over aeration cycle from one basin to other by PLC operation. The header shall supply air to basin at various locations through air supply pipes. Air supply pipe above water level shall be in MS and below water level it shall be in PVC as per relevant standards. All under water lateral pipes shall be of PVC.

- All other accessories, whether specified or not, but required for completeness shall form part of contractors scope.

Blower Details:-

<table>
<thead>
<tr>
<th>MOC</th>
<th>CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Twin lobe roots type</td>
</tr>
<tr>
<td>Duty</td>
<td>Continuous</td>
</tr>
<tr>
<td>Capacity of discharge</td>
<td>4000 m3/hrs @ 0.6 kg/sq.cm</td>
</tr>
<tr>
<td>No. of units</td>
<td>3 nos. (2W + 1S)</td>
</tr>
</tbody>
</table>

- All other accessories, whether specified or not, but required for completeness shall form part of contractors scope.

9.4 Return Sludge and Excess Sludge Pumps

- Dedicated Return sludge and excess sludge pumps shall be provided for each basin. The pump shall be of submersible centrifugal type suitable for handling biological sludge of 1 – 2% solids consistency. Capacity and heads shall be decided based on SBR / Cyclic Activated Sludge Process requirements. Each SBR / Cyclic Activated Sludge Process basin shall be provided with suitable lifting arrangements such as chain pulley block to facilitate lifting of pump, as required for maintenance.

- All other accessories, whether specified or not, but required for completeness shall form part of contractors scope.

a. Return Sludge Pumps:

<table>
<thead>
<tr>
<th>Pumps Capacity and Head</th>
<th>As per requirements ( shall not be less than 160m³/hr@5MWC.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Submersible / Vertical Centrifugal</td>
</tr>
<tr>
<td>Liquid</td>
<td>Bio-sludge of 1 – 2% solids consistency</td>
</tr>
<tr>
<td>Specific gravity</td>
<td>1.05</td>
</tr>
<tr>
<td>Solid size</td>
<td>100mm (Maximum)</td>
</tr>
<tr>
<td>Temperature</td>
<td>Min. 20° C</td>
</tr>
<tr>
<td>Efficiency</td>
<td>more than 70%</td>
</tr>
<tr>
<td>Installation</td>
<td>Fixed.</td>
</tr>
<tr>
<td>Quantity</td>
<td>1 no. per basin</td>
</tr>
</tbody>
</table>
b. Excess Sludge Pumps

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pumps Capacity and Head</td>
<td>As per requirements (shall not be less than 30 m$^3$/hr @ 7 MWC.)</td>
</tr>
<tr>
<td>Type</td>
<td>Submersible / Vertical Centrifugal</td>
</tr>
<tr>
<td>Liquid</td>
<td>Bio-sludge of 1 – 2% solids consistency</td>
</tr>
<tr>
<td>Specific gravity</td>
<td>1.05</td>
</tr>
<tr>
<td>Solid size</td>
<td>100 mm (Maximum)</td>
</tr>
<tr>
<td>Temperature</td>
<td>Min. 20$^\circ$ C</td>
</tr>
<tr>
<td>Efficiency</td>
<td>more than 70%</td>
</tr>
<tr>
<td>Installation</td>
<td>Fixed</td>
</tr>
<tr>
<td>Quantity</td>
<td>1 no. per basin</td>
</tr>
</tbody>
</table>

- All other accessories, whether specified or not, but required for completion of contract shall form part of contractors scope.

9.5 Automation and Control

- PLC based automation system with application software based on Rockwell to control all pumps, valves, blowers, VFD, decanting mechanism, limit switches and probes as per bidder’s design including I/Os with 20 % spares, power supplies, UPS, etc. complete.
- HMI Panel to comprise of up-to-date standard PC with monitor, printer, mouse, internet connection, RS-view, RS-links (gateway version), entire process and operator software with dynamic flow charts, pictures, screens, alarms, historical trends, reports etc.
- SCADA based Automation system to monitor continuously in each tank the followings:
  a. Filling volume
  b. Filling quantity
  c. Discharge quantity
  d. DO-level
  e. Temperature
  f. Oxygen Uptake Rate
  g. Blower speeds
  h. Decanting mechanism
  i. Equipment operation hours

10.1 Sludge Sump and Pump House

Sludge sump shall be provided to collect the excess sludge from Cyclic Activated Sludge Process/SBR Process Basins. There shall be one common sludge sump for all basins. There shall be auto gate valves on discharge sludge pipe of each Cyclic Activated Sludge Process / SBR Process basin. Diameter of valve shall be same as that of sludge pipe. Sludge tank shall be constructed in M 30 grade concrete and as per IS3370.

Above the sludge sump there shall be a pump house. This shall be RCC frame brick masonry structure. Minimum height of the pump house shall be 4 m from the plinth level. It shall be provided with rolling shutter and doors and windows as per technical specifications. EOT of minimum 1.5 T capacity shall be provided in the pump house to lift the pump assembly.
Entire pump from inside and from outside shall be painted with approved colour and make as directed by engineer-in-charge. Sludge sump shall be painted inside with bituminous paint.

<table>
<thead>
<tr>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Units</td>
<td>1 (One) nos.</td>
</tr>
<tr>
<td>Free Board</td>
<td>0.5 m</td>
</tr>
<tr>
<td>Minimum SWD</td>
<td>3.0 m</td>
</tr>
<tr>
<td>Detention time</td>
<td>4 hrs.</td>
</tr>
</tbody>
</table>

Minimum volume of the sludge sump shall be $42m^3$.

All other accessories, whether specified or not, but required for completion of contract shall be in contractors scope.

### 10.2 Sludge Transfer Pumps and Mixing Blowers

Sludge Transfer Pumps shall be provided in Sludge Pump House to feed secondary Sludge to Mechanical Dewatering Device. The pump shall be of screw type suitable for handling biological sludge of 1 – 2% solids consistency.

Pumps Capacity and Head shall not be less than:
- 12 m³/hr @ 15mwc

<table>
<thead>
<tr>
<th>Type</th>
<th>Screw Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid</td>
<td>Bio-sludge of 1 – 2% solids consistency</td>
</tr>
<tr>
<td>Specific gravity</td>
<td>1.05</td>
</tr>
<tr>
<td>Solid size</td>
<td>100mm (Maximum)</td>
</tr>
<tr>
<td>Temperature</td>
<td>Min. 20° C</td>
</tr>
<tr>
<td>Efficiency</td>
<td>more than 30%</td>
</tr>
<tr>
<td>Installation</td>
<td>Fixed.</td>
</tr>
<tr>
<td>Quantity</td>
<td>2 no. (1W+1S)</td>
</tr>
</tbody>
</table>

All other accessories, whether specified or not, but required for completion shall form part of contractors scope.

The blowers shall be positive displacement (roots) type, and head for blowers shall be decided on the basis of maximum liquid depth in tank duly considering the losses governing point of delivery and the blowers. The number of standby blower shall be 100% (hundred percent) of the number of working blowers. Blowers shall be complete with motor and accessories like base frame, anti vibratory pad, silencer, non return valve, air filter etc. as per requirements. Vibration due to operation of blowers shall not damage the structures.

BLOWER CAPACITY AND HEAD:
- 100m³/hr @ 0.4bar

<table>
<thead>
<tr>
<th>Type</th>
<th>Twin Lobe, Root</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installation</td>
<td>Fixed.</td>
</tr>
<tr>
<td>Quantity</td>
<td>2 no. (1W + 1S)</td>
</tr>
</tbody>
</table>

All other accessories, whether specified or not, but required for completion of contract shall be in contractors scope.
11 Mechanical Dewatering Unit:

11.1 Centrifuge:
The mechanical dewatering units shall be solid bowl centrifuge designed so as to give a 100% trouble free operation at all times and the sludge dewatering plant should operate for designed flow and capacity conditions and be sized as per the following guidelines.

i. The de-watering system should be so located that the de-watered sludge can be loaded into trolleys / drums / bins directly - preferably the de-watering unit shall be so located that the de-watered sludge falls into the containers/ bins without requirement of another material handling unit.

ii. The de-watered sludge should be truck-able & be suitable for disposal by open body truck and should have a minimum solid concentration of 20% or more (measured as dry solids w/w basis)

iii. The Dewatering Unit should have a 90-95% solid recovery.

iv. The Centrifuge Centrate should not contain more than 1000 mg/l solids.

vi. The Centrifuge should be capable of being operated at lower solid feed concentration in case of maintenance.

There shall be one Centrifuge shed in framed structure construction, the first floor will house centrifuges. The configuration shall be such that the wet cake discharge will be discharged through single central chute to the parked trailer/lorry below. Agency has to dispose this sludge within the lead of 10kms or as per direction of engineers in charge.

Liquid discharge from the centrifuge has to be routed to the raw sewage chamber with necessary permanent arrangement.

The centrifuge shall be solid bowl centrifuge of co-current/countercurrent design, as decided by the bidder. The centrifuge shall have sufficient clarifying length and differential RPM so that separation of solids is effective. The centrifuge shall have central lubrication system. The centrifuge shall have adjustable weir plate, so that its pond depth can be raised. The centrifuge and its accessories shall be mounted on a common base frame so that entire assembly can be installed on an elevated structure.

Suitable drive with V-belt arrangement and turbo-coupling shall be provided along with overload protection device. Centrifuge shall be with SS304 wetted parts.

Differential speed and bowl speed should be adjusted by changing the pulleys; differential speed may be adjustable by use of epicyclical-gear. The bowl shall be protected with flexible connections so that vibrations are not transmitted to other equipment. The base frame shall be in epoxy painted steel construction and provided with anti-vibration pads. All steps necessary to prevent transmission of structure borne noise shall be taken. The drive motor shall be of 1450 rpm. The noise level shall be 85 dB (A) measured at 1m distance under dry run. The vibration level shall be below 50 micron measured at pillow blocks under dry run condition. Adequate sound proof shall be carried out the housing the centrifuges to ensure that the noise level at 5 m distance from the enclosure is less than 75 dB (A).

A hoist shall be provided above centrifuge for maintenance purpose. The hoist shall be such that it shall be possible to erect or de-erect the centrifuge while one centrifuge is in operation.
Number of Centrifuges : 2 Nos. Working (1W + 1 SB)
Type : Horizontal
Capacity of each unit : As per requirement minimum 12.0 m3/hr.
Operating Hours : 16 hrs. per day and 7 days per week
Mixing arrangement of Polyelectrolyte and sludge: online-mixing

All other accessories, whether specified or not, but required for completion of contract shall be in contractors scope.

11.2 Polyelectrolyte Dosing:
The polyelectrolyte will be dosed online at the centrifuge inlet. Minimum dosage of polyelectrolyte shall be 1.2 kg/T of dry solids in sludge at 0.1% solution strength. There shall be two poly-dosing tanks each suitable for minimum 12 hrs. of operation. Each-tank shall be equipped with slow speed mixer (100 RPM) to prepare polyelectrolyte solution. The solution will be fed using positive displacement metering type dosing pumps. There shall be dedicated dosing pumps to each centrifuge with one common standby. The pumps shall be interlocked with centrifuge so that it can only be running in auto when centrifuge is on and should shut down when centrifuge stops. The dosing system shall be housed in centrifuge house itself. All the connected piping should be in stainless steel SS 304.

12 Chlorination Tank:
For Chlorination of final treated sewage a provision shall be made so that no harm is caused to the receiving water body such as river or estuary. Decanted treated water from Cyclic Activated Sludge Process / SBR Process shall be taken to chlorine contact tank by RCC channel/pipe.

Tank shall be provided for dosing of chlorine from the chlorination system to the sewage from Cyclic Activated Sludge Process / SBR Process. The tank shall be constructed in M 30 grade concrete and as per IS 3370. Complete inner surface of the tank including bottom, side walls, baffle walls etc. shall be provided with glazed tiling of Aqua Blue colour. RCC platform 1m as per specifications shall be provided. RCC staircase 900 mm wide shall be provided for access from the ground level to the top of the unit and to the operating platforms.

Baffle walls shall be provided to achieve proper disinfection. The baffle walls shall be constructed in M 30 grade concrete and 20 cm thick plaster in CM 1:3 on either side.

The inlet and outlet pipe shall be designed for peak flow or decant flow, whichever is more.

Design Flow : Decant flow.
No. of Units : (1) One no.
Detention Time : 20 minutes
Freeboa : 0.5m

Minimum volume of the Chlorine Contact Tank shall 441m3.

13 Chlorination System:
Flow : Decant flow.
Number of Units : 2 (1W + 1S)
Type : Vacuum Type
Chlorine Dosing : 3 ppm max.
Capacity of Chlorinator : Minimum 3 kg/hr
Chlorination system covering 5 Nos. chlorine cylinders duly filled-up & certify by the Explosive Department, water feed pumps, piping, booster pumps, ejector, lifting device with weighing scale, leak detection and leak absorption system, safety equipments like canisters, gasmasks etc. and other ancillary shall be provided in the chlorine house. Chlorine house of minimum 40-sqm plinth area shall be provided. It shall have sufficient ventilation as per the latest norms for safety purpose with necessary lifting arrangement and EOT of minimum 1.5times of the filled cylinders etc. complete.

All other accessories, whether specified or not, but required for completion of contract shall be in contractors scope.

14 Centrifuge Shed

Centrifuge Shed of sufficient size to accommodate two centrifuge units shall be constructed with sufficient floor height above Ground Level to park sludge collection vehicle directly under the sludge discharge line of centrifuge. The room shall have a RCC roof at a height suitable for installing an electrically operated two way movement gantry system. Minimum area of the Shed shall be 50 m². It should be framed RCC structure with the top roof also in RCC.

15 Sludge Storage Platform

A Platform of minimum 70 m² area shall be made at a suitable location within the plant area for storage of sludge from centrifuge. Flooring of the platform shall be 7.5 mm thick PCC (1:2:4) laid over 100 mm thick stone ballast /brick ballast. Level of platform shall be at least 20 cm above the level of approach road.

16 Administrative Block / Operations Building

MCC/ Blower Room shall be G+1 structure with minimum 160 m² area on each floor. A Blower Room of minimum 130 m² area with 5 m clear height shall be constructed to accommodate Blowers for SBR System. The blower room shall be RCC construction and shall be provided with adequate ventilation. Suitable arrangement should be provided for lifting of blowers by EOT. The capacity of EOT shall be 1.5 times of the weight of maximum single unit that may be required to be removed for maintenance. The Blower Room shall be at the Ground floor of the Building. Remaining 30 m² shall be utilized for staircase and toilet block.

The MCC Room shall be located on the first floor above the Blower & shall be of minimum 50 m² area which shall accommodate MCC & PCC panel. The PLC panel shall located besides MCC Room with minimum 20 m² area. The lab room of 20 m² size shall be located on the same floor. A admin Block of around 40 m² shall be located on the first floor besides the PLC/Lab room. The PLC Room shall be provided with Split Type air conditioners of suitable capacity.

There shall be two working platforms for keeping various glassware and test equipment. Stainless steel Sinks shall be provided for washing of glassware and other equipment.
The internal lighting, internal water supply & sanitation and joinery shall be done. However, external water supply is not in the scope of this bid. It shall be provided by HUDA. The drinking water to the working staff of S.T.P. after commissioning shall be provided by HUDA. However the water supply for construction work shall be provided if available with HUDA and will be charged @ ½ % of the construction cost of Civil Works. The detail of Lab Equipments & furniture to be provided by the agency shall be as per Annexure –A.

**Flooring:**
- Blower Room – Ironite Flooring
- First Floor – Marble Flooring
- Toilet & Stairs – Marble Flooring

**17. Interconnecting Piping and Valves**
All piping including valves, specials and other appurtenances, auxiliaries and accessories required as per process design and scope of work. All the piping, valves, specials shall be designed for peak flow.

In case of pumping mains, thrust blocks shall be provided wherever required. In case of buried pipes warning tapes shall be provided of appropriate colours.

The sizes and material for major interconnecting piping shall be as follows:

<table>
<thead>
<tr>
<th>Sr.</th>
<th>From</th>
<th>To</th>
<th>Minimum Dia. (mm)</th>
<th>Material and class</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Rising Main</td>
<td>Stilling Chamber</td>
<td>550</td>
<td>DI – K9</td>
</tr>
<tr>
<td>2.</td>
<td>Air Blower discharge Header</td>
<td>Cyclic Activated Sludge /SBR Process</td>
<td>350</td>
<td>MS</td>
</tr>
<tr>
<td>3.</td>
<td>Cyclic Activated Sludge /SBR Process</td>
<td>Chlorination Tank</td>
<td>600</td>
<td>RCC NP3</td>
</tr>
<tr>
<td>4.</td>
<td>Bypass Line from Wet well</td>
<td>Discharge Point Battery Limit</td>
<td>600</td>
<td>DI – K9</td>
</tr>
<tr>
<td>5.</td>
<td>Chlorination Tank</td>
<td>Discharge Point Battery Limit</td>
<td>600</td>
<td>DI – K9</td>
</tr>
<tr>
<td>6.</td>
<td>Air Grid piping</td>
<td>Cyclic Activated Sludge /SBR Process</td>
<td>50</td>
<td>PVC of relevant standard of pressure rating 6kg/sq.cm.</td>
</tr>
<tr>
<td>7.</td>
<td>All sludge pipes</td>
<td>Cyclic Activated Sludge /SBR Process</td>
<td>80</td>
<td>DI</td>
</tr>
<tr>
<td>8.</td>
<td>All sludge pipes</td>
<td>Sludge Handling System</td>
<td>80</td>
<td>DI</td>
</tr>
</tbody>
</table>

The above quantities are tentative however, the agency will provide quantities as per approved design / Layout / Site requirement.
18. **Landscaping**

Simple landscape work for 4.0 Acre land including filling of earth if required, plant, trees of Environmental value and suitably modifying the appearance of STP site and it should add scenic value of STP site to obtain maximum visual impact. Contractor has to develop proper landscaping plan and get it approved from the Engineer in Charge.

18 **Electrical & Instrumentation Works**

The contractor shall draw power from existing supply with suitable capacity cable of reputed make for connection to various equipments through different control panels, including necessary modifications at the transformer substation. The contractor shall produce required certificate for enhancement of power to the Electricity Department, as required and obtain suitable approvals from the competent authority for the same. The electrical system proposed for the STP shall include the following components;

- Main distribution panel board
- Motor control Centre
- Motor Starters,
- Safety Earthing,
- Cables and Cabling System,
- Frequency drain for blowers,
- Internal Lighting,
- Plot and area lighting,
- Any other item / accessories required for successful completion of the project.

The scope also includes lighting and earthing. The contractor shall work out the details based on his equipment's power consumption. The execution should take care of I.E. rules, Electricity Board's requirement and other local authorities and site condition.

The sub-panels are to be provided and located near the respective load centres, motors and panels for operation of various are to be supplied as part of the equipment, the same have not been considered as part of scope of work for electrical work. However, these should meet the requirements as specified under electrical works.

Contractor shall essentially provide adequate automation required for auto operation of complete primary treatment units, Cyclic Activated Sludge / SBR Process, and Mechanical Sludge dewatering system and associated dosing system as per Instrumentation specifications detailed in Volume – I and II.

All other accessories, whether specified or not, but required for completion of contract shall be in contractors scope.
19  Plant Utilities

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Item of work</th>
<th>Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Personal Computer</td>
<td>2 Nos. Personal Computers of Make HCL, Dell, Compaq with latest configurations as approved by the Engineer in Charge including all accessories.</td>
</tr>
<tr>
<td>2</td>
<td>Printer</td>
<td>02 Nos: HP or equivalent make as approved by the Engineer in Charge. 01 No: Laser Printer A3 Size, with latest version: configurations with an approved make.</td>
</tr>
<tr>
<td>3</td>
<td>Telecommunication Facility</td>
<td>Min 01 Telephone line, with a Broad Band connection Charger will be borne by the contractor up to the O &amp; M period.</td>
</tr>
<tr>
<td>4</td>
<td>Plant Model</td>
<td>01 no: On Wall Mounted process model: Electronic Plant Display model, with flow diagram and working. (Minimum size 3 m x 1.5 m) 01 No 3 Dimensional, Scaled Model with flow direction display with the lighting.</td>
</tr>
<tr>
<td>5</td>
<td>Air conditioner</td>
<td>Adequate no. of split Air conditioners shall be provided for Control Room as directed by engineer in charge.</td>
</tr>
<tr>
<td>6</td>
<td>Sign board on top of admin building</td>
<td>One no sign board of min size 20 ft x 5ft shall provided which includes name and capacity of treatment plant, name of employer etc as directed by engineer – in – charge with suitable lighting arrangement.</td>
</tr>
</tbody>
</table>

A toilet block shall be provided for the labourers comprising of following facilities:
- Bathrooms, 2 nos.
- WC, 2 nos.
- Urinals, 4 nos.

Portable fire extinguishers with ISI mark of approved make shall be provided at the MCC room, blower room, chlorine house and centrifuge house.

Each building shall be provided with following portable fire extinguishers
1. Dry chemical powder type fire extinguishers of 3.2 kg capacity – 6 cylinders
2. Buckets filled with dry clean sand - 6 Nos.

20. Storm Water Drainage
Storm water drains adjacent to the proposed approach road shall be sized for rainfall intensity of 25 mm / hr, allowing for 100% runoff. Drains roads / pathways shall be in RCC NP2 pipe of min 200 mm dia with necessary chambers at appropriate locations. These chambers shall be covered with CI gratings.

The storm water drainage system shall be designed and connected to the run – off from the plot and structures, and discharged into the city network nearby storm drain or nallah.
21. **Internal Roads, Pathways.**
All internal roads shall be concrete roads of M 20 with proper subgrade; the width of the road would vary from 3 m to 4 m as approved by the Engineer – in – Charge. The total area of the Internal roads may be up to 3000 sqm.

22. **Staff Quarter & Security Cabin**
2 Nos. Staff Quarter each of 41 sqm covered area and 1 No. Security Cabin of 10 sqm covered area at the Entry Gate as per Drawing & Specifications approved by Engineer in Charge.

23. **Street Light / Illuminations**
60 No. CFL street light 250 walts Philips / Bajaj Make with Tubular Pole @ 20 m centre to centre shall be provided. The design shall be approved by the Engineer in Charge. Street lights will be installed / provided along the Internal Roads, Boundary Walls, Entry Gate and Campus Area shall be provided as decided by Engineer – in – Charge. The specification of street lights shall be as per details given in specifications for electrical works with in the campus and proper illuminations.

24. **Railing around the structures**

   The railing shall consist of two horizontal rows of GI pipe of 32 mm dia with vertical post ( support of 40 mm dia GI pipe at 1.5 mtr centre to centre ). The GI pipe will be B class Jindal / Tata Make. The overall height of the railing shall be 0.9 meter clear from the floor level.

25. **Bearing Capacity**

   The safe bearing capacity will be got tested by the contractor & he will get the same approved from the Department.

1.3.5 **Technical Specifications – Civil works:**

a) **Survey Work:**

   The contractor shall carry out detailed survey work and submit both soft and hard copies of contour drawings with spot levels with 5 m x 5 m grid to HUDA. Necessary information such as reference to the location as proposed for the treatment plant by him with respect to site boundary, pumping stations and also existing plant.

b) **Geotechnical Investigation:**

   The contractor shall carry our Geotechnical Investigation work at the proposed location of treatment plant. The no. of bore holes to be taken, depth of boring etc. shall be decided in consultation with the Engineer-in-Charge. The contractor has to provide the hard and soft copies of the test reports and accordingly submit foundation designs for approval of the department.

c) **Process / Hydraulics Design:**

   (i) The contractor shall provide his own design system and equipments based on Cyclic Activated Sludge Process/ Sequential batch Reaction process to treat the raw sewage upto the effluent quality as said in Clause 1.3.3 or even better.
(ii) Bidder shall design the plant in such a way that in case of non-availability of sufficient sewage at the time of commissioning, plant can be commissioned with a minimum quantity of sewage available.

**Treatment Objective:**
Considering the raw sewage quality and the required treated effluent quality, the contractor shall furnish a process train to achieve the following objectives –

i. To achieve guaranteed treated effluent quality or even better.

ii. To ensure that the offered treatment process is the most appropriate and state of the art in terms of both efficacy of treatment and cost (the contractor shall have to produce the performance records with the same treatment systems applied elsewhere.)

iii. To ensure that the process is cost effective from both capital and running costs consideration.

iv. To ensure that the sludge produced is dewatered to a “spade able” or “open body truck able” consistency – so that it can be easily disposed off.

v. The process preferably should be free from utilization of chemical/any organic chemicals except for sludge removal process. No toxic chemical shall be used by the contractor. He will submit the toxicity test report from any govt. recognized laboratory at his own cost before using such chemical.

vi. Oils/lubes/fuels/media/chemicals etc. to be used will be defined by contractor.

e) **Structural Design:**
The contractor shall have to do the structural design considering the survey details and geotechnical investigation details like safe bearing capacity, seismic forces, depth of water table and hydraulic flow diagram. The design of plant units and buildings – shall be submitted by the contractor in soft and hard copies, with General Arrangements and detail RCC drawings. The design of units shall be finalized in consultation with the Engineer – in – Charge. Approval should be obtained from Engineer – in – Charge. The design of units shall be as per relevant BIS or other Indian/international standards in absence of BIS or sound engineering practice e.

All the design & specifications required for the plant should be approved by the technology provider before submitting to the department.

f) **Construction Works:**
The contractor shall construct the civil units of the plant (including intermediate process pumping stations wherever required) to accommodate the mechanical units to fulfill the requirement of process design. There shall be adequate working space, accessibility considerations like RCC stair, walkway with proper width, hand railing of steel work, adequate height for pumping station etc. For buildings, there shall be additional items like ventilation and lighting requirements, flooring and finishing. As per the direction of Engineer-in-charge. The civil units shall be constructed such that there is proper accessibility for repair or replacement of mechanical equipments. Any concreting shall be done only after approval of Engineer – in – charge. All construction work shall be carried out as per the provision of PWD specifications unless otherwise mentioned in the document.
g) **Equivalency of Standards and Codes**
Wherever reference is made in the Contract to specific standards and codes to be met by the goods and materials to be furnished, and work performed or tested, the provisions of the latest current edition or revision of the relevant standards and codes in effect shall apply, unless otherwise stated in the Contract. Where such standards and codes are national or related to a particular country or region, other authoritative standards which ensure an equal or higher quality than the standards and codes specified will be acceptable subject to the Engineer's prior review and written approval. Differences between the standards specified and the proposed alternative standards must be fully described in writing by the contractor and submitted to the Engineer at least 28 days prior to the date when the Contractor desires the Engineer's approval. In the event the Engineer determines that such proposed deviations do not ensure equal or higher quality, the Contractor shall comply with the standards specified in the Bid Documents.

h) **Board**
The Contractor at his own cost, shall provide sign boards at approved locations, in English at the site of the Works of approved size and design which provides (i) the name of the Project, (ii) the name and addresses of the Employer, the Contractor and the Consultant; (iii) the name and short description of Project, (iv) the amount of the Contract Price; and (v) the starting and completion dates. Contractor shall take care of signboard and re-do it in case of loss, damage, theft etc., as desired by the Engineer-in-Charge.

i) **Assurance Programme/Sample Tests**
Contractor shall be responsible to develop a quality control program and do all necessary materials, apparatus, instruments, equipment, facilities and qualified staff for sampling, testing and quality control of the materials and the under the Contractor. Without limiting the generality of the foregoing, the contractor shall either (i) establish a testing laboratory at the site of Works which be adequately equipped and staffed to carry out all sampling and testing in accordance with the requirement set out in the tender document specifications provide all field equipment and apparatus as necessary to conduct all in-situ tests and/or any Tests on Completion, or (ii) arrange for routine sampling, testing and reporting, as required, through a certified independent laboratory acceptable to the Engineer-in-Charge. The Contractor shall obtain the approval of the Engineer-in-Charge for the quality control programme developed by him and incorporate any modifications suggested by the Engineer-in-Charge at no extra cost.

All costs of such sampling, testing and reporting of test results will be borne by the Contractor, and the Contractor shall include sufficient provisions in his; tendered rates to allow for independent sampling and laboratory testing under the direction of the Engineer-in-Charge. The Contractor shall furnish certified copies of all test reports to the Engineer-in-Charge within 3 days of completion of the specified tests.

The Contractor shall, within 14 days after the date of the issue of Letter of Acceptance, submit to the Engineer-in-Charge for his consent a detailed description of the arrangements for conducting the quality control programme during execution of the Work, including details of his testing laboratory, equipment, staff and general procedures. If following submission, or at any time during the progress of Works, it
appears to the Engineer-in-Charge that the Contractor’s quality control programme is not adequate to ensure the quality of the Works, the Contractor shall produce a revised programme, as desired by the Engineer-in-Charge, which will be adequate to ensure satisfactory quality control, in case of the contractor will fail to ensure quality control program action as deemed fit will be taken against the contractor. HUDA shall carry out supervision and quality control and monitoring the progress of works.

j) **Protection of Utilities**
The Contractor is required to carefully examine the location of the Works and their alignments and to make special enquiries with all authorities concerning utility lines such as water supply, sewers, gas pipe, telephone (underground and/or overhead) lines, electric cable (underground and/or overhead) etc., and determine and verify to his own satisfaction the character, sizes, position and lengths of such utilities from authentic records. The Contractor shall be wholly responsible for the protection and/or facilitating relocation of such utilities as may be required and shall not make any claim for extra work or extra time that may be required to protect or facilitate relocating such utilities. If any major shifting realignment of water supply, sewers, gas pipes, electric and telephone lines is necessary due to their interference with the proposed Works, the same may done by the contractor. The cost of such relocations will be borne by the contractor.

k) **Erection**
Bidders to note that various items to be procured / executed under this contract subject to inspection by HUDA or their authorised representatives at manufacturer’s premises. Cost of inspection shall be borne by contractor

1.3.6 **Mechanical Equipments for STP:**
The contractor shall have to design, supply, erect and commission the mechanical equipments as proposed by him in the treatment train to achieve the required parameters.

**Accessory Units:**
(a) Process unit as per requirement of bid document.
(b) EOT cranes of adequate capacity at blower room.
(c) Flow measuring instruments after preliminary treatment.
(d) Reactor mechanism for the sequential batch reaction technology including the diffused aeration system, the decanter mechanism and all other accessory piping and mechanical arrangements.
(e) Online measuring equipments for Flow, Temperature, Dissolved Oxygen (DO) after aerobic removal of bio degradable organics as specified in "Technical specifications for electro-mechanical work"
(f) Centrifuge for sludge dewatering system.
(g) Chlorination system for treated effluent Sludge transfer pumps and mixing blowers
(h) Treated water pump house.
(i) Polyelectrolyte dosing
(j) The design, supply, erection and commissioning for all mechanical equipments shall be as per approval of Engineer-in-Charge.
1.3.7 **Electrical and Instrumentation / Automation Systems:**
The contractor shall design; shop testing, supply, transport, storing at site, erecting, testing and commissioning all electrical equipments and instruments required for the plant as per general specifications, specifications for electrical works, typical power distribution scheme and typical control system architecture.

1.3.8 **Disposal of sludge**
The dried sludge cakes from the centrifuge of the STP shall be dispose off by the contractor to a suitable location which is away from the residential area. The place of sludge disposal shall be as per the decision of the Engineer-in-charge. The responsibility of sludge withdrawal and disposing off lies with the contractor within the operation and maintenance period. The contractor should explore the possibility promoting it as manure.

1.3.9 **Disposal of Treated Effluent:**
The treated effluent from the STP shall be disposed as per direction of the department or Abandoned DEVA Distributory However, the contractor should explore the possibility for recycling the treated effluent for horticulture or any other purpose to use within the plant premises.

1.3.10 **Disposal of Excavated Stuff:**
It will be the responsibility of contractor to dispose all the excavated stuff within the HUDA limits as directed by Engineer-in-charge.

1.3.11 **Safety Equipment**
Safety Equipments should be provided at STP as per the recommendation of Inspector of Industries. Contractor shall also take care of safety compliance as applicable from time to time as per safety rules/Factory act/Indian Electricity regulations/ manuals/ manufacturer's special instructions.

1.3.12 **Model of the Project**
a) 1 No. On Wall Mounted process model: Electronic Plant Display model, with flow diagram and working. (Minimum size 3 m x 1.5 m)
b) 1 No, 3 Dimensional, Scaled Model with flow direction display with the lighting.

1.3.13 **Scope of Work for Operation & Maintenance**
The bidder shall operate and maintain the Sewage Treatment Plant and all other allied works under this contract, for a period of 4 years which can be extended for a further period of 4 years depending on the performance of the plant. For this period, the scope of work shall include, but not be limited to the Operation and Maintenance of the following:

- Operation & Maintenance of Raw Sewage Pumping Station of 15 MLD Capacity.
- Connection of Raw Sewage Pumping Main for conveyance of raw sewage to inlet chamber of Sewage Treatment Plant including interconnection for the future STP.
- Sewage Treatment Plant of capacity 15MLD including all the civil units and electro-mechanical equipments as per the bidder's proposal, to ensure that all the output guarantees are met.
- General facilities and utility services.
- PLC based automation system.
Connection shall been cost of all the material required.

The bidder shall also dispose off the sludge, screenings, grit and any other material, as per specifications and to the satisfaction of the Engineer-in-Charge. It is to be noted that all costs during the O&M period, excluding the cost of power and liquid chlorine is to be borne by the contractor. Within his quoted cost, the bidder is to ensure that the following guarantees are maintained:

- Guarantee for quality of treated effluent
- Guarantee for consumption of chemicals
- Guarantee for automation system

The bidder shall provide on job training to the HUDA staff as per specifications.

The bidder shall, at no extra cost to the HUDA, repair and re-condition all the mechanical equipments in the concluding year of the O&M contract to a condition so that they can operate for a further 4 years period with regular preventive and recommended maintenance. Necessary list of spares required during O & M shall be made available by the contractors vide quoting and showing the same to be maintenance with necessary replacement as and when required. The bidder's scope shall include supply of all necessary spares that may be required to operate for another 4 years. The list of critical spares shall be drawn up depending upon the maintenance record of equipments in the penultimate year of the contract and the spares shall be supplied in the concluding year of the contract.

1.3.14 Operation and Maintenance Cost
All the cost for operation and maintenance of the project such as manpower, fuel, oils, spares, tools, transportation, disposal of treated effluent, disposal of Sludge, disposal from Screenings and grit into pits of size 5 x 5 x 2.75 m to be cleaned periodically by the contractors, maintenance of Civil, Electrical, Mechanical pipelines, automation, including all other major/minor repairs, breakdowns, replacements etc. is in the scope of the bidder. No extra payment other than whatever has been quoted in Price Schedule will be entertained by Department.

The bidders are to quote O&M costs, and provide functional guarantees based on the following data which shall be used for technical evaluation of qualifying bids:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD</td>
<td>250 mg/l</td>
</tr>
<tr>
<td>TSS</td>
<td>400 mg/l</td>
</tr>
</tbody>
</table>

1.3.15 Contract Period
The total contract period under the contract shall be as follows:

<table>
<thead>
<tr>
<th>Period</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Period</td>
<td>15 months</td>
</tr>
<tr>
<td>Startup &amp; Trial Run</td>
<td>3 months</td>
</tr>
<tr>
<td>Defect Liability Period</td>
<td>12 months</td>
</tr>
<tr>
<td>O&amp;M Period</td>
<td>48 months after defect liability period start up &amp; trial run period (extendable by another 48 months depending on the performance during the 1st 48 months period and at the initial quoted rates )</td>
</tr>
</tbody>
</table>
SECTION - 2: INSTRUCTIONS TO TENDERERS

2.1. TENDER DOCUMENT
2.1.1 The tender document contains the following:
1. NIT.
2. Instructions to Tenderers.

2.2. PREPARATION OF TENDERS
2.2.1 Documents Comprising the Tender
2.2.1.1 The Tender submitted by the Tenderer shall comprise the following documents of three envelopes.
- Envelope A – Super scribed as “Earnest Money”
- Envelope B – Super scribed as “Post Qualification documents”.
- Envelope C – Super scribed as “Financial Bid”

In addition to three envelopes, Tenderer shall comprise of attachments as mentioned below:

(i) TECHNICAL PROPOSAL
(a) The Tenderer’s Proposal
The preliminary design forming the Tenderer’s Proposal to be submitted by the Tenderer shall demonstrate that the works offered by the Tenderer conform to the Departments’ Requirements. The preliminary design shall include literature, drawings, calculations and other data necessary for proper evaluation of the Tenderer's proposal. Detailed requirements of the form of the preliminary design are set out in the Tender Data Sheet enclosed.

(b) Power of Attorney
A power of attorney, duly authorized by a Notary Public, indicating that the person(s) signing the Tender has the authority to sign the Tender and that the Tender is binding upon the Tenderer during the full period of its validity.

(c) Eligibility and Conformity of facilities.
(ii) A list giving full particulars, including available sources, of all spare parts, special tools etc., necessary for the proper and continuing functioning of the facilities for the period named in the tender data sheet, following completion of facilities in accordance with the provisions of the contract and

(d) Power consumption
Power consumption details as required in tender document shall be furnished by the Tenderer.
(e) **Technical Schedules**
Technical schedules as required in Tender document shall be furnished by the Tenderer.

(f) **Working Methods and Programme**
The Tenderer shall submit proposals of design, manufacture and installation methods, testing, commissioning and training programme in sufficient detail to demonstrate the adequacy of the Tenderers proposals to meet the Departments Requirements within the Time of Completion stated in the Tender.

(g) **Original Tender Documents**
Original tender document issued to the Tenderer’s along with corrigendum's if any duly completed and signed, shall be furnished by the Tenderer.

( i ) Original tender document issued to the Tenderer duly completed and signed shall be furnished by the Tenderer.

### 2.2.2 Tender Prices

1. Tenderers shall quote for the entire works on a "single responsibility" basis such that the total Tender price covers all the Contractor's obligations mentioned in or to be reasonably inferred from the Tender documents in respect of the design, manufacture, including procurement, delivery, construction, installation and completion of the works. This includes - all requirements under the Contractor's responsibilities' for testing, pre-commissioning and commissioning of the works, the acquisition of all permits, approvals and licenses, etc.; the operation, maintenance and training services and such other items and services as may be specified in the Tender documents, all in accordance with the requirements of the Conditions of Contract.

2. Operations and maintenance shall be quoted separately in the price schedule.

3. Tenderers are required to quote the price for the commercial, contractual and technical obligations outlined in the Tender Documents.

### 2.2.3 Pre-tender Conference:

1. The Tenderer's designated representative is invited to attend a pre-tender meeting, which if convened will take place at the venue and time stipulated in the Tender Data Sheet. Tenderers representatives shall sign a register evidencing their attendance.

2. The purpose of the meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage.

3. The Tenderer is requested as far as possible, to submit any questions in writing. It may not be practicable at the meeting to answer questions received late, but questions and responses will be transmitted in accordance with the following Sub-Clause.

4. Minutes of meeting, including the text of the questions raised and the responses prepared after the meeting, will be transmitted to all purchasers of the tender documents. Any modification of the tender documents, which may become
necessary as a result of the pre-tender meeting, shall be made by the department either through the issue of an Addendum or through the minutes of meeting.

5 Non-attendance at the pre-tender meeting will not be a cause for disqualification of the Tenderer.

### 2.2.4 TENDER OPENING AND EVALUATION:

#### 2.2.4.1 Tender Opening:

1. Only those Tenderers who pass the technical evaluation will be invited at a later date, as informed by the Department, when their financial offers will be opened. The Tenderer’s names, the tender prices will be announced by the Department at the opening of the financial offers.

2. The Tenderers may please note, that, the prequalification criteria specified in Tender Notice is applicable only for issue of tender documents and the actual technical evaluation and technical acceptance of the Tenderer will be carried out on the basis of data furnished by the Tenderer in the documents in the "First Envelope Technical Proposal".

#### 2.2.4.2 Process to be Confidential:

Any effort by a Tenderer to influence the Departments processing of tenders or award decisions may result in the rejection of the Tenderer’s tender.

#### 2.2.4.3 Clarification of Tenders:

During tender evaluation, the Department may, at his discretion, ask the Tenderer for clarification of its Tender. The request for clarification and the response shall be in writing and no change in the price or substance of the Tender shall be sought, offered or permitted.
TENDER DATA SHEET

Data Information


<table>
<thead>
<tr>
<th><strong>Period of Completion</strong></th>
<th>Fifteen Months for completion of work, Three months Trial Run, 12 Months defect liability period and thereafter 4 Years Operation and Maintenance.</th>
</tr>
</thead>
</table>

The Tenderer's proposal shall include the following:

- **Drawings**
  The Tenderer shall furnish all the drawings as mentioned in the Departments Requirements as specified.

- **Technical Schedules**
  A list of Technical Schedules giving a detailed description of the essential technical and performance characteristics of the proposed Plant and Materials.

- **Functional Guarantees**
  The Tenderer shall insert his functional guarantees in the proforma provided in the section for the Tenderer's Design Calculations.

- **Design Calculations**
  The Tenderer shall furnish Design calculations.

- **Other Supporting Data**
  The Tenderer shall furnish all other supporting data.
2.2.75 BANK GUARANTEE FOR PERFORMANCE SECURITY DEPOSIT

1. In consideration of the HUDA, Haryana (hereinafter called “The Employer”) having agreed to exempt ________________________________ (hereinafter called “the said contractor(s) from the demand, under the terms and conditions of an Agreement dated made between ___________________ and _______________ for ___________________ (hereinafter called ’the said Agreement’) of security deposit for the due fulfillment by the contractor(s) of the terms and conditions contained in the said Agreement, on production of a Bank Guarantee for Rs. ____________________ (Rupees ______________________ only)we, _______________________________ (indicate the name of bank) (hereinafter referred to as “the Bank’ at the request of ____________________ contractor(s) do hereby undertake to pay the Employer an amount not exceeding Rs. ___________________ Against any loss or damage caused to or suffered or would be caused to or suffered by the Employer by reason of any breach by the said contractor(s) of any of the terms or conditions s contained in the said Agreement.

2. We _______________________________ (indicate the name of the bank) do hereby undertake to pay the amounts due and payable under this guarantee without any demur, merely on a demand from the Employer stating that the amount claimed is due by way of loss or damage caused to or would be caused to or suffered by the Employer by reason of breach by the said contractor(s) of any of the terms or conditions contained in the said Agreement or by reason of the contractor(s) failure to perform the said Agreement. Any such demand made on the bank shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs. ____________________

3. We undertake to pay the Employer any money so demanded notwithstanding any dispute to disputes raised by the contractor(s) / supplier(s) in any suit or proceeding pending before any court or Tribunal relating thereto our liability under this present being absolute and unequivocal. The payment so made by us under this bond shall be a valid discharge of our liability for payment there under and the contractor(s)/supplier(s) shall have no claim against us for making such payment.

4. We _______________________________ further agree that the guarantee contained shall remain in full force and effect during the period that would be taken for the performance of the said Agreement and that it shall continue to be enforceable till all the dues of the Employer under or by virtue of the said Agreement have been fully paid and its claims satisfied or discharged or till _______________________________.

Employer certified that the terms and conditions of the said Agreement have been fully and properly carried out by the said contractor(s) and accordingly discharges this guarantee. Unless a demand or claim under this guarantee is made on us in writing on or before ________________________________ - we shall be discharged from all liability under this guarantee thereafter.
5. We _____________________________ (indicate the name of the Bank) further agree with the Employer that the Employer shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said Agreement or to extend time of performance by the said contractor(s) from time to time or postpone for any time or from time to time any of the powers exercisable by the Employer against the said contractor(s) and to forbear or enforce any of the terms and conditions relating to the said Agreement and we shall not be relieved form our liability by reason of any such variation, or extension being granted to the said contractor(s) or for any forbearance, act or omission on the part of the Employer or any indulgence by the Employer to the said contractor(s) or by any such matter or thing whatsoever which under the law relating to sureties would, but for this provision, have effect of so relieving us.

6. This guarantee will not be discharged due to the change in the constitution of the Bank or the contractor(s) / supplier(s).

7. We _____________________________ (indicate the name of the bank) lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Employer in writing.

Dated the day of 200

For

(Indicate Bank’s name)
SECTION - 3: CONDITIONS OF CONTRACT

GENERAL CONDITIONS OF CONTRACT

3.1 Memorandum of understanding submitted along with application shall form part of tender.

3.2 Copy of the agreement along with memorandum of understanding between Technology provider & contractor is to be submitted duly notarised before start of the work.

3.3 After acceptance of tender and before issue of work order the contractor shall make agreement with Technical provider and attach a notarised copy of the same is to be submitted to the Department

1.4 Mobilization Advance
3.4.1 The contractor will be entitled to receive from HUDA, Haryana, mobilisation advance to the maximum extent of 10% of the amount put to the tender or of the cost after finalization of contract with the successful bidder whichever is higher.

3.4.2 The mobilisation advance will be paid to the contractor after signing the contract agreement and furnishing bank guarantee of equal amount. The bank guarantee shall be issued by any nationalised / scheduled bank, in the prescribed format.

3.4.3 The mobilisation advance will be paid to the contractor at the start of the project, before first RA bill and shall be recovered in three equal instalments, one each from 2nd, 3rd and 4th RA bill. However, entire mobilisation advance shall be recoverable within six months maximum from issue and deductions will be made accordingly through the RA bill submitted immediately after six months from the date of issue of Work Order.

3.4.4. Grant of advance shall be made only after receipt of non – revocable Bank Guarantee for the total advanced amount from the contractor.

The non-revocable Bank Guarantee shall be furnished as per “Form of Bank Guarantee to secure lump sum advance” which has been indicated in para (iv), from any local branch of a Nationalized Bank in Haryana.

3.4.5. Recovery of Advance:-
The recovery will be made in suitable installments commencing from the 2nd running bill or after 10% of the work is completed whichever is earliest. The entire amount shall be recovered before 80% of the work is completed. Payment of mobilization advance by itself shall not be considered as one running bill for this purpose. The percentage of progress referred to above shall be reckoned with reference to the gross value of work done, as shown in the bills.
3.4.6. Form of Bank Guarantee to secure a lump sum advance:

To,
The Executive Engineer HUDA
Division No. 1 Hissar Haryana,

In consideration of the Department of HUDA (hereinafter called HUDA which expression shall unless repugnant to the subject or context, include his successor and assigns) having agreed under the terms and conditions of contract number…………………… dated…………………… made between…………………… and the HUDA in connection with………………………………………… Thereinafter called the said contract to make at the request of the contractor a lump sum advance of Rs…………………. for utilizing to for the purposes of the contract on his furnishing as guarantee acceptable to the HUDA.

We, the ………………………………………………………………………… Bank Ltd. (hereinafter referred to as “The said Bank”) a company under the company’s Act, 1956 and having our registered office at ………… ………………………..  … do hereby guarantee the due recovery by the HUDA of the said advance with interest therein as provided according to terms and conditions of the contract, we …………………. …………. do hereby undertake to pay the amount due and payable under this guarantee without any demur, merely on a demand from the HUDA stating that the amount claimed is due to the Government under the said contract. Any such demand made on the ……………… …………………………… shall be conclusive as regards the amount due and payable by the ………………………………………………………………… under this guarantee and the liability of the ………………………………………………… to pay HUDA the amount so demanded shall be absolute and unconditional not withstanding any dispute or disputes raised by the contractor and not withstanding any legal proceeding pending in any court or tribunal relating thereto. However our liability under this Guarantee shall be restricted to an amount not exceeding Rs…………… ………………………………………

We ………………………………………………………………………… Bank Ltd. further agree that the HUDA shall be the sole judge of and as to whether the said contractor has not utilized the said advance or any part thereof for the purpose of the contract and the extent of loss or damage caused to or suffered by the HUDA on account of the said advance together with interest now being recovered in full and the decision of the HUDA that the said contractor has not utilized the said advance or any part thereof for the purpose of the contract and as to the amount or amounts of loss and damages caused to or suffered by the HUDA shall be final and binding on us.

We the said bank further agree that the Guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said contract and till the said advance with interest has been fully recovered and its claims satisfied or discharged and till ………………… certify that the said advance with interest has been fully recovered from the said contractor and accordingly discharges this guarantee subject, however, that the HUDA shall have no claims under this guarantee after ………………… years from the date of completion of the said contract as the case may be unless a notice of the claim under this guarantee has been served.

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on the bank before the expiry of the said period of .................. years in
which case the same shall be enforceable against the Bank not withstanding the fact
that the same is unforced after the expiry of the period of ............... Years.

The HUDA shall have fullest liberty without affecting in any way the liability of the
Bank under this guarantee or indemnity, from time to time to very any of the terms
and conditions of the said contract or the advance or to extend; the time of
performance by the said contractor or to postpone for any time and from time to time
any of the powers exercisable by it against the said contractor and either to enforce or
forbear from enforcing any of the rates and conditions Governing the said contract; or
advance of security available to the HUDA and the said bank shall not be released
from its liabilities under these presence by any exercise by the HUDA of the liberty
with reference to the matters aforesaid or by reasons of time being given to the said
contractor or any other forbearance, act or commission on the part of the HUDA or
any indulgence by the HUDA to the said contractor or of any other matter or thing
whatsoever which under the law relating to sureties would any for this provision have
the effect of so releasing the Bank from such liabilities.

It shall not be necessary for the HUDA to proceed against the contractor before
proceeding against the bank and the guarantee herein contained shall be enforceable
against the Bank not withstand any surety which the HUDA have obtained or obtain
from the contractor shall bat the time when proceeding are taken against the Bank
hereunder the outstanding on unrealized.

We the said lastly undertaken not to revoke these guarantee during its currency accept
with the previous consent of the HUDA in writing and agree that any change in the
constitution of the said contractor or the said Bank shall not be discharge our liability
hereunder.

Date this ................ ................. ..... day of ............ ...... 2011, for and on
behalf of the Bank.

( Name and Designation )

The above guarantee is accepted by the HUDA.

For and on behalf of the HUDA.

Date:- .........................
Note:-
Note:-

( Name and Designation)
For Proprietary Concerns:-

Shri………………………………………………..son of……………………………….
Carrying on business under the name and style of…………………………………. (hereinafter called the said contractor which expressing shall unless the context requires or otherwise include his heirs, executors, administrators and legal representatives)

For partnership concerns:-

Shri ……………………………….. son of……………………………………

Shri ……………………………….. son of……………………………………

And carrying on business in co-partnership under the name and style of ……
……………………………………. at……………………………………………. (hereinafter collectively called “The said contractor” which expression shall unless the context requires otherwise include such of them land their respective heirs, executors, administrators and legal representatives)

For companies:-

Shri…………………………………………………………… a company under the Companies Act 1956 and having its registered office at ……………………. In the state of ……………………………………………. (hereinafter called “The said contractor” which expression shall unless the context requires otherwise include its successors and assigns).

3.4.7 Detail activity chart and procurement schedule shall be prepared by the contractor and shall be got approved from the Engineer in charge. The dates of receipt of mechanical and electrical equipment/material on site shall be so adjusted that the related civil work would be ready for installation / erection within 15 days of receipt of equipment / material on site. The payment against receipt of equipment / material shall not be due to the contractor before the scheduled and approved date of receipt of equipment / material on site.

3.4.8 Deductions towards Income Tax, Works contract tax and other statutory recoveries shall be made from RA bills at the rates applicable from time to time. Certificates in effect of such deductions will be issued to the contractor wherever applicable.

3.4.9 The contractor shall be solely responsible for raising of funds and making available money for carrying out the work. The contractor will arrange cash flow during the entire period of the work to suit the schedule.
3.4.10 Department shall not transfer any legal rights either temporarily or permanently to the Tenderer / contractor or his funding/financing agency.

3.4.11 Department shall not furnish to the Tenderer / Contractor or his funding / financing agency any document which is intended as security or assurance for the purpose of raising of funds.

3.5 Submission and approval of drawings etc.

3.5.1 Six sets of all the working drawings and three sets of detailed design calculations/ specifications of equipment shall be furnished by the Contractor to the department. The engineer shall review and study such drawings/ design calculations/specifications of equipment and approve them if found suitable as per the requirement of the works. One set of such approved drawings/design calculations/ specifications will be returned to the Contractor for the purpose of using in execution of work.

All the design, drawing and specification required for the plant should be approved by the technology provider before submitting to the department.

Before submitting to the Department for approval it should be ensured that all Designs, Drawings and specification required for the plant should be as per the recommendation / suggestion of the technology provider and also within the guidelines / provision of Manual on Sewerage and Sewage Treatment Ministry of Urban Development Government of India.

3.5.2 Any additional information, further detailed calculations will have to be furnished by the contractor on demand by the engineer for the purpose of approval as described above.

3.5.3 The Contractor shall have to submit all the working drawings/sketches, diagrams to be used for the work of the department and all such drawings/design calculations/ specifications shall have to be got approved from the engineer before starting of any work related to them.

3.5.4 Even though the drawings/design calculations/specifications submitted by the contractor are approved by the engineer, such approval shall not absolve the Contractor from his duties, responsibilities and liabilities as expected for carrying out the work.

3.6 To define terms and explain plans

3.6.1 The various parts of the Contract are intended to be complementary to each other, but should any discrepancy appear, or any misunderstanding arise as to the import of anything contained therein, the explanation of the Engineer shall be final and binding.

3.6.2 Whenever, in the specifications or on the drawings which are a part of this contract or which may be furnished by the Contractor for use on this work, the terms and description of various qualities of workmanship, material, Structures, processes, plant or other features of the Contract described in general terms, the meaning of fulfilment of which must depend on judgment then in all such cases the question of fulfilment of such specification or requirements shall be decided by the Engineer and said materials shall be furnished, said work shall be done, and said structures, Process, plant or feature shall be constructed, furnished or carried on in full and complete accordance with, his interpretation of the same and to Engineers full satisfaction and approval, provided such interpretation is not In direct conflict with the drawings and specifications and generally accepted good practice.
3.6.3 Matter shown either on the drawing or in the specifications shall be done and furnished as it shown in both except where expressly excepted either in the specifications or on the drawings, figured dimensions shall be in all cases be taken in preference to scaled dimensions or measurements and detailed drawings consistent with general drawings in preference to general drawings of the same part of the work.

3.7 Water, Electricity and other facilities
Contractor shall have to make, his own provisions for supply of water and electricity from various agencies or from his sources for the execution of work:

3.8 Engineer to direct work and order alternations, modifications, deletions
3.8.1 The Engineer shall have the right to direct the manner in which all work under this contract shall be conducted in so far as may be necessary to secure the safe and proper progress and the specified quality of the work, and all work shall be done and all material shall be furnished to the satisfaction and approval of the Engineer.

3.8.2 Additional drawings and explanations to exhibit or illustrate details may be provided by the contractor. The written decision of the Engineer as to the true construction and meaning of the drawings and explanations shall be binding on the contractor.

3.8.3 If at any time the contractor's methods, materials or equipment appear to the Engineer to be unsafe, insufficient or inadequate for securing the safety of the workmen or the public, the quality or work or the rate of progress required, he may order the contractor to increase their safety, efficiency and adequacy, and the contractor shall comply with such orders. If at any time the contractor's working force and equipment are, in the opinion of the Engineer, inadequate for securing the necessary progress, as herein stipulated, the contractor shall, if so directed, increase the working force and equipment to such an extent as to give reasonable assurance of compliance with the schedule of completion. The failure of the Engineer to make such demands shall not relieve the contractor of his obligations to secure the quality, the safe conducting of the work and the rate of progress required by the contract, and the contractor alone shall be and remain liable and responsible for the safety, efficiency, and adequacy of his methods, materials, working force, equipment and timely completion of job irrespective of whether or not he makes any change as a result of any order or orders received from the Engineer.

3.8.4 The department/Engineer shall have the power to make any alterations in, omissions from, additions to the original specifications, drawings, designs and instructions that may appear to him to be necessary or advisable during the progress of the work and the contractor shall bound to carry out the work in accordance with any instructions that may be given to him in writing by the Department/Engineer and such alterations, omissions, additions or substitutions shall not invalidate the contract. Any altered, additional or substituted work which the contractor may be directed to do in the manner above specified as part of the work, shall be carried out by the contractor on the same conditions in all respects on which he agreed to do the main work and the similar rates as are specified in the tender for the main work, unless such alterations are not similar to or derivable from the items of work and form extra items.
3.8.5 The time for completion of the work shall be extended in the time proportion that the altered, additional or substituted work bears to the original contract and the decision of the Department shall be conclusive and binding on the contractor.

3.9 Contractor's Supervision

3.9.1 The contractor shall, during the whole time the work is in progress, employ a qualified engineer to be in charge of the works with adequate experience in handling of jobs of this nature and with the prior approval of the Department/Engineer. Such Engineer shall be constantly in attendance at the site during working hours. During Contractor's / Resident's Engineer's absence during working hours, if unavoidable, and also beyond working hours, when it may be necessary to give directions, orders may be given by the Engineer/Department and shall be received and obeyed by the contractor's superintendent or even foreman who may have charge of the particular part of the work in reference to which orders are given. If requested to do so, the Engineer/Department shall confirm such orders in writing. Any directions, instructions or notices given by the Engineers/Department to him, shall be deemed to have been given to the contractor. The representative of the contractor shall have all necessary powers to engage labour or purchase materials and proceed with the work as required for speedy execution.

3.9.2 None of the Contractor's superintendents, engineers, supervisors or labour should be withdrawn from the work without due notice being given to the Department/Engineer, further no such withdrawals shall be made if in the opinion of the department/engineer such withdrawals will jeopardize the required pace of progress/successful completion of the work.

3.9.3 The contractor shall employ in or about execution of the works only such persons as are careful, skilled and experienced in their respective trades. The department shall be at liberty to object to and require the contractor to remove any persons employed by the contractor, in or about execution of works who in the opinion of the department/engineer misconducts himself or is incompetent or negligent in the proper performance of his duties and all such persons shall not be employed upon the works without prior permission of the department.

3.10 Setting out works

3.10.1 The contractor shall set out the works and shall be responsible for true and perfect setting out of the same and for the correctness of the positions, levels, dimensions and alignment of all parts thereof. If at any time any error shall appear during the progress of any part of the work the Contractor, shall at his own expense rectify such error, if called upon, to the satisfaction of the Engineer.

3.10.2 The Contractor shall provide all facilities, instruments and attendance to the Engineer or his deputed representative to check his work. Instrument brought by the Contractor shall be in good working condition and are subject to approval of the Engineer. Checking in part or full or any setting out or any line or level by the engineer shall not in any way relieve the contractor of his responsibility for the correctness thereof.
3.10.3 The contractor shall establish and maintain base lines and bench marks adjacent of tilt: various sections of work. All such marks and stakes must be carefully preserved by the contractor and in case of their destruction be him or any of his employees, they will be replaced at the contractor's expense.

3.10.4 The contractor shall be responsible for the accuracy of all dimensions within the various sections of the work according to the figures of dimensions on the drawings.

3.11 **Access**

3.11.1 The Engineer, his representatives and the department shall at all reasonable times have free access to the works and / or to the workshops, factories or other place where materials are being prepared or constructed for the contract and also to any place where the materials are lying from which they are being obtained, the contractor shall give every necessary facility to the Engineer and his representatives for inspection and examination and test of the materials and workmanship even to the extent of discontinuing portions of the work temporarily or of uncovering or taking down portions of finished work.

3.11.2 When finished work is taken down for the purpose of inspection, the contractor shall stand all the expenses incidental thereto in the event that the work taken down is found to be in accordance with the specifications. In the latter case, the replacing or the covering up or the making good of any of the parts removed shall be paid for by the Department at the Contract Prices for the items of work done and uncovering or taking out of materials or parts shall be paid for on the basis of actual direct cost of material, labour and incidental expenses plus reasonable plant charges except that no percentage for the Contractor's profit shall be added to actual direct cost of material, labour and incidental expenses. However, no extension of time will be given for completion of works on this account. If the Contractor shall fail to replace any defective work or materials to be replaced and the expenses thereof shall be deducted from the amount to be paid to the Contractor.

3.11.3 If any work is to be done at a place other than the site of the works, the Contractor shall obtain the written permission of the Engineer for doing so.

3.12 **Failure by the Contractor to comply with the Engineer's instructions.**

If the Contractor after receipt of written notice from the Engineer requiring compliance with such further drawings and/or the Engineer's instructions fails within seven days to comply with the same, the Engineer may employ and pay other agencies to execute any such work whatsoever as may be necessary to give effect thereto and all costs incurred in connection therewith shall be recoverable from the Contractor by the Department on a certificate by the Engineer as a debt or may be deducted by him from any moneys due or to become due to the Contractor.

3.13 **Construction supervision and workmanship**

3.13.1 The Department will engage his own supervisory staff of works as may be deemed fit. The Contractor shall afford the supervisors every facility and assistance for examining the works and materials for checking and measuring the works and materials. The supervisors shall have no power to revoke, alter, enlarge or relax any requirement of the Contractor, but may sanction only day work, additions,
alterations, deviations or omissions, or any extra work whatever as may be
authorized by the Engineer.

3.13.2 The supervisors will act as representatives of the Department and shall have the
power to give notice to the Contractor or to his Foreman of non-approval of any
work or materials, and such work shall be suspended or the use of such material shall
be discontinued, until the decision of the Engineer is obtained.

3.13.3 The work shall be conducted under the general direction of the Engineer and is
subject to inspection by his supervisors to ensure strict compliance with the terms of
the Contract. No failure of the Engineer or his supervisors during the progress of the
work to discover or to reject materials, or work not in accordance with the
requirement of this Contract shall be deemed as acceptance thereof or a waiver of
defects therein and no payment by the Engineer on partial or entire occupancy of the
premises shall be construed to be an acceptance of the work or materials which are
not strictly in accordance with the requirements of this Contract. No changes
whatsoever to any provision of the specifications shall be made without written
authorization of the Department.

3.13.4 The Contractor shall execute the whole and every part of the work in the most
substantial and workmanlike manner as regards material and in all other respects.

3.13.5 The provisional acceptance of sections of the work shall not be construed so as to
prevent the Engineer for requiring replacement of defective work that may become
apparent after the said provisional acceptance and shall not be construed in any way
on the basis for a claim of extra compensation for any cause whatsoever by the
Contractor.

3.14 To remedy defective work and defects liability period.
3.14.1 If the work or any portion thereof shall be damaged in any way excepting by the acts
of the Department, or if defects not readily detected by proper inspection shall
develop before the final completion and acceptance of the whole work, the contractor
shall forthwith make good, without compensation, such damage or defects in a
manner satisfactory to the Engineer/Department, in no case shall defective or
imperfect work be retained.

3.14.2 Twelve calendar months from the date of successful completion of performance run
of the plant unless otherwise agreed in writing by the Department / Engineer will be
deemed as the "Defects Liability Period", in case any defects in the work due to
wrong assumptions in designs, bad materials and/or bad workmanship develop in the
work before the expiry of this period, the Contractor on notification by the
Department shall rectify or remedy the defects at his own Cost and he shall make his
own arrangements to provide materials, labour, equipment and any other appliances
required in this regard. In case even on due notification by the Department, the
Contractor fails to rectify or remedy the defects, the Department shall have the right
to get this done by other agencies and recover the cost incurred, by deductions from
any money due or that may become due to Contractor.
3.14.3 The Department may in lieu of such amending and making good by the Contractor, deduct from any money due to the Contractor a sum to be determined by the Department equivalent to the cost of amending such work and in the event of such due payment becoming insufficient, recover the balance from the Contractor together with any expense to the Department may have incurred in connection with such recovery.

3.14.4 The Contractor shall remain liable under the provisions of this clause notwithstanding the passing by the Department of any certificate, final or otherwise or the passing of any accounts.

3.14.5 The Contractor shall see that the excavated material or debris from the work under the contract shall be placed at a place and in a manner, as designated by the Engineer and he shall remove it from time to time as required by the Engineer so that their shall not be any, interference or obstruction to the departments or other Contractors work in the adjacent areas.

3.15 Night holiday working - Permission
3.15.1 The contractor is normally expected to work during daytime only and is required to complete the work in all respects as stipulated elsewhere. However, night work or holiday work may be permitted in exigencies with prior approval of the Engineer.

3.15.2 Sufficient light shall be provided to safe guard the workers and the public and to afford adequate facilities for property placing and inspecting the material when the night work is in progress.

3.16 Force Majeure
Force Majeure is herein is defined as (1) any clause which is beyond the control of the contractor or the Department, as the case may be, (2) natural phenomenon like floods, drought, earthquakes and epidemics notified by the Government, (3) acts of any Government authority, domestic or foreign, like war, declared or undeclared, government priorities, quarantine, embargoes, licensing control or production or distribution restrictions, (4) accidents and disruptions like fire and explosions, (5) transportation delay due to force majeure or accidents, (6) strikes, slowdowns, lockouts and sabotage by the persons other than those under control of the contractor, (7) riots and civil commotion, (8) failure or delay in contractors / Departments source of supply due to force majeure causes enumerated at 1 to 7 above.

3.17 Work in monsoon and dewatering
3.17.1 The construction and erection work may entail working in monsoon also. The contractor must maintain labour force as may required for the job and plan execute the construction and erection according to the prescribed schedule. No extra working period or payment will be considered for such work in monsoon.

During monsoon and other period it shall be the responsibility of the contractor to keep the construction site free from accumulation of water at his own cost.
ESSENTIALITY CERTIFICATE

It is specifically clarified Department's Engineer will assist if possible and permitted to do so the contractor to obtain any lawful exemptions from payment of Excise duty or Import duty or Sales Tax or Income Tax or any other admissible exemption from any kind of Tax or Duty on plant and materials which are to be incorporated as a part of the permanent works by issue of an “Essentiality Certificate” in the format indicated as Annexure-I, which certifies the estimated quantities of materials that are to be incorporated in to the works. The responsibilities for obtaining any such exemptions from competent Authorities will remain with contractor and Department's shall not in any way be responsible for admissibility of the claims or eligibility of the contractor.

Department's will not bear any responsibility of financial or any other sort on behalf of such issuance of certificate.
ANNEXURE - I

TO WHOMSOEVER IT MAY CONCERN

ESSENTIALITY CERTIFICATE

This is to certify that the work of Providing external Sewerage Scheme for Zone - III, Hisar. “Design, Construction, Supply, Erection, Testing & Commissioning of 15 MLD Capacity MPS & Cyclic Activated Sludge Process/SBR technology based 15MLD Sewage Treatment Plant including 3 months successful trial run, operation & maintenance for 12 months during defect liability period, and thereafter operation & maintenance for 4 years at Zone - III, Hisar. on turnkey basis has been awarded to M/s. ____________________________ (Name of Contractor) amount of Rs. ____________________________ (Rupees____________________________) (Amount of Contract Agreement) only, by the Executive Engineer HUDA Division No. 1 Hissar Haryana, India and their representatives, Executive Engineer HUDA Division No.1 Hissar Haryana, and being implemented from _______________ to ________________.

It is certify that M/s. ____________________________ (Name of Contractor) for the above project work requires to purchase ____________________________ (Quantity of materials and name of material) for the work of Providing external Sewerage Scheme for Zone - III, Hisar. “Design, Construction, Supply, Erection, Testing & Commissioning of 15 MLD Capacity MPS & Cyclic Activated Sludge Process/SBR technology based 15MLD Sewage Treatment Plant including 3 months successful trial run, operation & maintenance for 12 months during defect liability period, and thereafter operation & maintenance for 4 years at Urban Estate Hissar..on turnkey basis.

It is further certified that the aforesaid material is required for the execution of the said project.

The validity of this certificate is from _______________ to _______________ (Construction duration as per Agreement)

Executive Engineer
HUDA Division No.1
HISSAR
BID FORM (WITH OUT PRICE)

Bidders are required to fill up all blank spaces in this Bid Form

Executive Engineer
HUDA Division No.1
Hissar . Haryana.
Phone:
Fax :

Dear Sir,

Sub:- Providing external Sewerage Scheme for Zone - III, Hisar "Design, Construction,
Supply, Erection and Commissioning of Cyclic Activated Sludge Process/SBR technology based 15MLD Sewage Treatment Plant including 3 months successful trial run, operation & maintenance for 12 months during defect liability period, and thereafter operation & maintenance for 4 years at Zone - I, II, Hisar.

1. Having visited the site and examined the Bid Documents, Drawings, Conditions of Contract, Specifications, Schedules, Annexures, Preamble to and the Pricing Schedules etc. and to the above, for the execution of the above Contract, we the undersigned offer to procure engineered items, construct, complete, commission, operate and maintain the whole of the said Works for two years which is extendable by another two years as given in Conditions of Contract, Instruction to bidders and in conformity with the said Drawings, special Conditions of Contract, Specifications, Preamble to and the Pricing Schedules, Schedules, Annexures, Bidding Documents.

2. We agree that

1. if we fail to provide required facilities to the Engineer’s Representative for carrying out the inspection and testing of materials and workmanship.

2. if we incorporate into the works, materials before they are tested and approved by the Engineer’s Representative

3. if we fail to produce treated effluent of required quality or fail to satisfy other performance parameters, according to the conditions/stipulations of the contract, the Engineer-in-Charge will be at liberty to take any action as per the condition of this contract.

3. We undertake, if our Bid is accepted to complete and deliver the Works in accordance with the Contract within 60 months, inclusive of monsoons, from the commencement date.

4. We agree to abide by this Tender until........... {90days after the latest date of submission} and it shall remain binding upon us and may be accepted at any time before that date. We acknowledge that the Appendix forms part of this Letter of Tender.

5. In the event of our Bid being accepted, we agree to enter into a formal Contract Agreement with you incorporating the conditions of Contract hereto annexed but until such agreement is prepared, this Bid together with your written acceptance thereof shall constitute a binding Contract between us.
6. We agree, if our Bid is accepted, to furnish Performance Security in the forms and of value specified in the Special Conditions of Contract for due performance of the Contract.

7. We have independently considered the amounts of liquidated damages as specified in conditions of contract and special conditions of contract and agree that they represent a fair estimate of the damages likely to be suffered by you in event of the Work not being completed by us in time.

8. We understand that you are not bound to accept the lowest or any Bid you may receive.

Dated this …………… Day of ……………… 200….

______________________
(Name of the Person)

_____________________
(In the capacity of
_____________________
(Name of firm)

Company Seal

Duly authorised to sign bid for and on behalf of
(fill in block capitals)

Witness

Signature : _________________________________
Name : _________________________________
Address : _________________________________

Company Seal ___________________________ Signature of the Bidder
SECTION – 5: LETTER OF TENDER

LETTER OF TENDER

To:

The Executive Engineer
HUDA Division No.1
Hissar.

Phone:
Fax:

Name of Contract:- Providing external Sewerage Scheme for Zone - III, Hisar "Design, Construction, Supply, Erection and Commissioning of Cyclic Activated Sludge Process/SBR technology based 15MLD Sewage Treatment Plant including 3 months successful trial run, operation & maintenance for 12 months during defect liability period, and thereafter operation & maintenance for 4 years at Zone - III, Hisar.

Dear Sir,

We have examined the Conditions of Contract, Employer's Requirements, Schedules etc: of the above-named Works. We have examined, understood and checked these documents and have ascertained that they contain no errors or other defects. We accordingly offer to design, execute and complete the Works (including trial-run), remedy any defects therein, operate and maintain during defect liability period and Operation & Maintenance for a period of 48 months before handing over in conformity with this Tender which includes all these documents and the enclosed Proposal, for the lump sum costs. Further we agree to extend the O & M construct for a further period of 4 years, if desired by the department at out quoted rates and present terms & conditions.

We agree to abide by this Tender until......... [90 days after the latest date of submission] and it shall remain binding upon us and may be accepted at any time before that date. We acknowledge that the Appendix forms part of this Letter of Tender.

If this offer is accepted, we will provide the specified Performance Security, commence the Works as soon as is reasonably practicable by the Commencement Date, and complete the Works in accordance with the above-named documents within the Time for Completion.

This letter shall form a part of the agreement.

Signature in the capacity of duly authorised to sign tenders for and on behalf of

Address:
Date:

.............................................. ..............................................
Company Seal Signature of Bidder
SECTION – 6: DEPARTMENT REQUIREMENTS

6.1  GENERAL

6.1.1  GENERAL NOTES

The department requires that all goods and materials to be used in the works are new unused, of the most recent or current models and incorporate all recent improvements in design and material.

6.1.2  DESIGN, DRAWINGS, DOCUMENTS AND DATA

6.1.2.1  General Obligations

The Contractor shall carry out, and be responsible for, the design of the Works. Design shall be prepared by qualified designers/professionals who comply with the criteria stated in the Department Requirements. The Contractor undertakes that the designers shall be available to attend discussions with the Engineer-in-Charge at all reasonable times during the Contract Period.

6.1.2.2  BASIC DESIGN PARAMETERS

The bidder is required to examine and check the Department's design criteria, specifications etc., as included in the Bid documents to confirm their correctness in its bid and to assume full responsibility for them, thereafter.

6.1.2.3  SUBMISSION OF DESIGN CALCULATIONS, DRAWINGS AND OTHER DOCUMENTS BY THE CONTRACTOR

(a) After signing the Contract, within 28 days from the date intimated by the Department to proceed with the work, the Contractor shall supply to the Engineer-in-Charge 6 (six) hard copies (along with workable soft copies in a CD) each of the design calculations for the process and sizing of all components of the plant including mechanical and electrical equipment, supported by flow diagrams, and general arrangement drawings, reference catalogues /literature of manufacturers, other reference documents used for the design purpose, for approval of the Engineer-in-Charge. The Contractor shall incorporate all necessary comments of the Engineer-in-Charge in the above design and drawings, if any, and shall re-submit further 6 (six) copies each of the revised design and drawings within 14 (fourteen) days for final approval of the Engineer-in-Charge. The Contractor shall thereafter submit 6 (six) copies each of the approved design and 6 (six) copies each of the approved drawings together with one copy each of the reproducible tracings and workable soft copies of all approved designs, calculations and drawings. The entire cost shall be borne by the Contractor. Drawing and tracing papers shall be laminated and bound properly with civil, mechanical and electrical drawings in separate bindings. The contractor shall also supply the following:

1. Layout Diagram of Sewage Treatment Plant -2 plastic laminated boards of size 1.2m x 0.75m (TO BE CORRECTED AS PER COMMON PARAMETRS.)

(b) Design calculations and drawings shall be submitted in sequence as per schedule to be drawn and agreed upon mutually, immediately after submission of the general arrangement drawing. The entire process of submission of all such
documents by the Contractor in initial copies and final copies after approval of the Engineer-in-Charge shall be completed within 90 days from the date of the work order. These documents shall cover:

- Site Plan.
- Layout Plan and hydraulic flow diagram, process design, P & I diagram
- Architectural Drawings/Renderings, Landscape Plan
- GA drawing of each / individual unit
- Detailed structural design and good for execution drawings pertaining to all components of the plant and other associated works.
- Drawings showing the size, position and other necessary details of all mechanical and electrical equipment and fixtures.
- Wiring diagrams, pressure control, pumps and motor control gear particulars.
- Details of foundations, position of openings, etc., for the pumps, motors, starting cubicles, LT/HT panels, etc.
- Elementary diagram and manufacturers’ shop and part drawings for all equipments.
- Services like internal illumination and ventilation, building water supply, sanitation and plumbing, service roads, landscaping area lighting, etc.
- Power and control cable layout.
- Any other design and drawings to fulfill HUDA requirement.

6.1.2.4 Format of Drawings

All drawings submitted for approval shall be ISO standard size sheets. Every drawing shall have a title block in the bottom right corner showing:

Haryana Urban Development Authority

Contract No. : 
Contractor : 
Project : 
Drawing Title : 
Drawing Number : 
Revision Number : 
Date : 

Each drawing shall bear the signature of the Project Manager on behalf of the Contractor to the effect that the drawing whether his own or from any other source has been checked by the Contractor before submission to the department.

Each revision shall be properly recorded to show the number, date, specific description of revision(s) carried out, and signature of the Project Manager in the revision block. The Contractor shall be responsible for incorporating all the comments issued by the Engineer-in-Charge.
6.1.2.5 Construction Documents

The Contractor shall prepare Construction Documents in sufficient detail to satisfy all regulatory approvals, to provide suppliers and construction personnel sufficient instructions to execute the Works, and to describe the operation of the completed Works. The Engineer-in-Charge shall have the right to review and inspect the preparation of Construction Documents, wherever they are being prepared.

Six copies of the Construction Documents shall, when considered ready for use, be submitted to the Engineer-in-Charge for pre-construction approval. If the Engineer-in-Charge notifies the Contractor that such Construction Document fails to comply with the Department's Requirements, it shall be rectified and submitted and reviewed at the Contractor’s cost. Construction shall not commence prior to the approval of the Construction Documents by the Engineer-in-Charge.

If the Contractor wishes to modify any design or document, which has been previously submitted for such pre-construction review, the Contractor shall immediately notify the Engineer-in-Charge and shall subsequently submit revised documents. If the Engineer-in-Charge instructs that further Construction Documents are necessary for carrying out the Works, the Contractor shall upon receiving the Engineer-in-Charge’s instructions prepare such Construction Documents. Error, omissions, ambiguities, inconsistencies inadequacies and other defects shall be rectified by the Contractor at his cost.

The design, the Construction Documents, the execution and the completed Works shall comply with the Indian specifications, technical standards, building, construction and environmental regulations, regulations applicable to the product being produced from the Works and the standards specified in the Department’s Requirements, applicable to the Contractor’s Proposal and Schedules or defined by law.

The Contractor shall provide all design, calculations, drawings and all construction documents in six hard copies, soft copies and workable CDs along with 6 sets of all designs and drawings and 3 additional cloth mounted sets of all drawings for the use of Engineer-in-charge.

6.1.2.6 As-Built Drawings

The Contractor shall prepare, and keep up-to-date, a complete set of laminated “As Built” records of the execution of the Works, showing the exact “as built” location, sizes and details of the work as executed, with cross references to relevant specifications and data sheets. These records shall be kept on the Site and shall be used exclusively for the purposes of this Sub-clause. Two hard copies shall be submitted to the Engineer-in-Charge prior to the Tests on Completion.

In addition, the Contractor shall prepare and submit to the Engineer-in-Charge “As Built drawings” of the Works, showing all Works as executed. The drawings shall be prepared as the Works proceed, and shall be submitted to the Engineer-in-Charge for his inspection. The Contractor shall obtain the consent of the Engineer-in-Charge as to their size, the referencing system, and other pertinent details.

Prior to the issue of substantial completion Certificate, the Contractor shall submit to the Engineer-in-Charge one soft copy, workable CD, one full-size original copy and
six printed cloth mounted copies of the relevant “As Built Drawings”, and any further Construction Documents specified in the Department's Requirements. The Works shall not be considered to be completed for issue of substantial completion certificate until such documents have submitted to the Engineer-in-Charge. Failure in submission of “As Built” records shall attribute the delay in completion of the work and issue of substantial completion certificate, on the part of the contractor.

6.1.2.7 Coordination Drawings
Coordination drawings shall be prepared and shall comprise composite section drawings showing coordination of mechanical and electrical work to structural work. The composite drawings shall be in sufficient detail to show overall dimensions of ductwork, piping, conduit, and related items and clearance between structural members, lighting and related features for review and approval of relative locations of work in allocated spaces. The drawings shall indicate any conflicts of clearance problems between various trades. Coordination drawings shall be submitted to Employer's Representative. Coordination drawings will not be submitted for approval but for review only.

6.1.2.8 Equipment and Interconnection Diagram
Equipment room layout drawings shall be based on actual requirements of equipment furnished and be consolidated for all trades, shall be to scale and shall show all pertinent structural and penetration features and other items, such as electrical cabinets, which affect available space. All mechanical and electrical equipment including electrical conduits, accessories, ductwork and piping shall be shown to scale in plan and also in elevation and / or section and resolve any conflicts or clearance problems. Physical descriptions of the various mechanical and electrical items shown on these drawings shall be submitted concurrently.

6.1.2.9 Quality
Proof of quality of manufacture and reliability in field application. Such proof will normally constitute evidence that the product / equipment has been manufactured by the manufacturer, or fabricator of the quality assured for a unit or item over a period of time and has an established field service record. It shall include installation locations, dates and year of operating service. If there is no experience for an identical unit or item it may relate to a similar unit or item by the same manufacturer.

6.1.2.10 Manufacturer's Data
Manufacturer's data shall include catalog cuts, brochures, circular, specifications, equipment operations and maintenance manuals and other printed information in sufficient detail and scope to verify compliance to the requirements.

6.1.2.11 Performance Data
Performance Data shall include certified copies of equipment responses and performance characteristics as required.
6.1.2.12 Manufacturer's Color Charts and Samples

Manufacturer's Color Charts and samples of all applicable materials, products and items of equipment required.

6.1.2.13 Parts and Special Tools Lists

a) Parts lists shall include a complete list of component parts of an item of equipment together with an expanded view or equivalent means to identify the parts.

b) Special Tools lists shall include all tools and devices required for assembly, disassembly, operation and maintenance of the equipment and an indication of the use of each item.

c) The lists shall further identify the sources of manufacture and supply of consumable supplies and those parts, special tools and supplies that are normally furnished with the purchase of the equipment or are specified to be furnished.

d) In additions, a list shall be provided showing items recommended by the manufacturer to support normal maintenance based on the manufacturer's anticipated life cycle of the part for continuous normal operation.

6.1.2.14 Certificates of Compliance

Certificate of compliance shall include material or product manufacturer’s statement that the supplied items or systems conform to the specifications.

6.1.2.15 Test Reports

Test reports shall be provided as required and as follows:

a) Shop tests shall show the results of required shop tests of equipment or systems certified in writing by the manufacturer or it’s authorized Representative. However, department along with contractor is free to visit and inspect the equipment and systems at manufacturing unit as and when required. The cost toward such inspections shall be borne by the contractor.

b) Field test reports shall show the results of required field tests and compliance with approved procedures and shall be certified in writing.

6.1.2.16 Maintenance Instructions

Maintenance instructions shall cover finish material including but not limited to hard-surfaced materials. Instructions shall include cleaning, tarnishing, dents and stains from various chemicals.

6.1.3 CONSTRUCTION PHOTOGRAPHS

i) Work shall include progress photographs for each work of construction taken from minimum six viewpoints each month made by a professional photographer. Take one photograph from each viewpoint.

ii) Photographs shall show general extent of the works by both exterior and interior views. Each viewpoint will be selected and the number of monthly
repetitive photographs taken from exactly the same viewpoint as decided by
the department.

iii) Submit six 200mm x 254mm glossy color prints of each photograph to the
department at the first of each month duly attached / pasted in the Progress
Report.

iv) Title and month of each photograph per the department requirement. As a
minimum include on title: Project name, direction of view, and date when
taken.

v) Video shooting during major construction stages of plant or at least once every
month must be carried out by the contractor and shall be submitted to the
department.

6.1.4 QUALITY ASSURANCE

The Contractor shall institute a quality assurance system to demonstrate compliance
with the requirements of the Contract. Compliance with the quality assurance system
shall not relieve the Contractor of his duties, obligations or responsibilities.

Quality assurance shall include, but shall not be restricted to as noted herein.

The Quality Assurance system should ensure the quality and quantity continuously
through monitoring systems as envisaged in Project Management and Construction
(HUDA ) proformas so as to give daily progress report, labour / manpower deployed,
quantity executed on periodic basis, observations thereof through following HUDA
proformas placed at the end of this subsection.

- Bar bending schedule
- Pour Card
- Post Concreting check ups
- Form work check up
- Tests on materials

The above shall be conformed through records of precious materials viz. Cement,
steel, anti-termite chemicals, water proofing chemicals etc

a) The Contractor's provision and maintenance of a quality assurance program in
conjunction as approved by the department. The program shall provide
inspection and testing of products during fabrication and installation as
department may deem necessary to ensure that work is performed in compliance
with the Contract. Such inspection and testing shall be performed at no
additional expense to the department.

b) Inspection and testing required by the orders, laws, ordinances, rules and
regulations of local authorities.

c) Provision of inspection and testing instruments and devices required to ensure
proper performance of quality assurance at the job site.

d) Verification by certification that specified products meet requirements of
reference standards as specified in applicable codes / specification.

e) Testing, balancing and adjusting of equipment as specified in applicable codes.
6.1.5.1 QUALITY ASSURANCE IN GENERAL

i) Maintain continuity of quality assurance surveillance throughout fabrication of products and execution of work.

ii) Submit details of quality assurance tests and methods inclusive of the specification.

iii) Perform inspection and testing in accordance with specified reference standards, or as otherwise approved by the department.

iv) Calibrate measuring and testing devices periodically against certified standard equipment. Calibration shall be verified by inspection firm.

6.1.5.2 QUALITY ASSURANCE OF THE WORKS ON SITE

i) Provide an assurance system to ensure quality assurance by phased inspection as follows:

Preparatory Phase Inspection
Perform inspections prior to commencement of each part of the works which shall include a review of requirements with the supervisors directly responsible for that part of the works. Such review shall be in the form of written statements of the processes to be followed and critical characteristics, tests and similar evaluations which will be a part of inspection procedures. Verify that products incorporated with that part of the works which have been tested and applicable submissions have been made for control testing. Verify that preceding work has been completed and approved. Verify products incorporated with that part of the works conform to submission data and Contract requirements and that necessary materials and equipment are easily and readily available.

Continuing Inspection
Perform inspection on a continuing basis as each part of the works commences and on a regular basis to ensure constant compliance with the requirements:

ii) Provide samples of materials to be tested in required quantities at locations where testing is performed.

iii) Provide labour, instruments, testing devices, facilities and required shelter at the site:
   a) To determine ambient and material temperature by thermometers with Celsius scale.
   b) To determine relative humidity of air and moisture content of materials.
   c) To facilitate inspection and tests.
   d) For obtaining and handling of samples at site and plant.

iv) Upon receipt of items at the job site, the Contractor's quality assurance representative at the site shall be responsible on receipt of items at the site for
noting damage suffered by them during transit and for directing that they be replaced.

v) The Contractor shall be responsible for protecting and maintaining items on the site free from damage during storage, erection, installation and maintenance.

vi) When it is discovered on inspection that work is proceeding with incorrect materials or methods, ensure that corrections are immediately made and that improperly complete work is replaced.

6.1.5.3 QUALITY ASSURANCE OF OFF-SITE WORKS

i) The Contractor shall impose quality assurance methods at the location of manufacture, fabrication and assembly of items to be incorporated in the works to ensure that they conform to requirements of the Contract Documents.

ii) The Contractor's quality assurance representative off-site shall be responsible for the release of items for transit to the job site.

iii) In addition to the Contractor shall provide notice to the department in writing at least 4 weeks in advance of packing of every batch of product components or assemblies so that the Employer or department and their designated representatives may have opportunity at his / their choice of inspecting any such product components or assemblies prior to transportation at the cost of the bidder.

iv) The products requiring factory, shop, supplier's inspection are identified in relevant specification in the specific codes.

v) Acceptance of product components or assemblies prior to transportation shall not imply final acceptance under the Contract.

6.1.5.4 SCHEDULE OF QUALITY ASSURANCE OPERATIONS

Provide the department with a minimum of three copies of a schedule of quality assurance operations, both on-site and off-site, to outline the procedures, instructions and reports which will be used, as follows:

i) Quality assurance organization.

ii) Qualifications of quality assurance personnel.

iii) Authority and responsibilities of each quality assurance person.

iv) Schedule of inspections and tests with personnel assigned to each task and duration of each task.

v) Schedule of required services to be provided by inspection and testing firms.

vi) Coordination required in order that quality assurance is integrated.

vii) Test methods which will be utilized.

viii) Methods of performing and documenting quality assurance operations.
6.1.5.5 TESTS REQUIRED BY JURISDICTIONAL AUTHORITIES

i) The Contractor shall be responsible for inspection and testing required by jurisdictional authorities in conformance with the performance requirements.

ii) If the Engineer-in-Charge so desires, he may delegate inspection and testing of materials or Plant by an independent body / agency. Any such delegation shall be effected for this purpose shall be considered as an assistant of the Engineer – in -Charge. Notice of such appointment shall be given by the Engineer-in-Charge to the Contractor.

6.1.5.6 QUALITY ASSURANCE REPORTS

i) Document each test and inspection on a report and submit the report in triplicate to the department.

ii) Reports shall be in an approved format and shall certify off-site items produced correctly for on-site work of installed correctly, as applicable. Similarly the report shall certify items that are defective with a statement of records on corrective measures taken.

iii) Include on each report the purpose of the inspection or test, a description of methods used, observations made and personnel involved.

iv) The Contractor shall also maintain in the approved format a log book of all tests performed which shall include the date of test, type of test and the results of the test.

v) If inspection and testing procedures are sub-contracted to an approved inspection and testing firm, only copies of test reports signed by the approved inspection and testing firm will be acceptable.
AFFIDAVIT / UNDERTAKING

I/We /M/S__________________________________________________________________________
R/o ____________________________________________________________________________

under take that after the completion of work (Name of work to be executed)
“________________________________________________________________________________” Sector No. _____
Urban Estate _______________________ will shift the labourers immediately with adequate
indemnifying arrangement, which was temporarily located at the site of work. In the event of
failure to shift the labour by me/us. I/We, am/are liable for penal action either in the shape of
penalty equal to 10% of the total cost of work or my/our enlistment with HUDA or any other
department of Haryana shall be liable to be concealed.

DEPONENT

Place ....................
Dated ....................

Verification :-

I, the above named deponent to hereby verify that the above statement is true
and correct to the best of my knowledge and belief and nothing has been concealed therein.

DEPONENT

Place ....................
Dated ....................
SITE

FORMAT

&

ANNEXURE - A
Name of the Project

**DAILY PROGRESS REPORT**

<table>
<thead>
<tr>
<th>S. No</th>
<th>Activity</th>
<th>Start</th>
<th>Finish</th>
<th>Quantity</th>
<th>Unit</th>
<th>Work done till</th>
<th>Work done on</th>
<th>Cumulative work done</th>
<th>Overall Completion</th>
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<td>Actual</td>
<td>Target</td>
<td>Actual Completion</td>
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## DAILY PROGRESS REPORT

**Name of Project**: …………………………………

**Client**: M/s …………………………………,

**Contractor**: M/s …………………………………,

**Name of Unit**: …………………………………

**Date**: __/__/__

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<th>ITEM DESCRIPTION</th>
<th>UNIT</th>
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<th>CUM. QTY.</th>
<th>REMARKS</th>
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<td>Pedestals</td>
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<td>Kota stone</td>
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<td>Aluminium</td>
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<td>Steel</td>
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BAR BENDING SCHEDULE

Name of Project: ........................................
Client: M/s ................................................
Contractor: M/s ...........................................
Name of Unit: ...........................................
DRG. NO.: ..............................................
Date: ___/___/___

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<tr>
<th>MEMBER NO.</th>
<th>BAR NO.</th>
<th>DIA OF BARS</th>
<th>NO. PER MEMBER</th>
<th>NO. OF MEMBER</th>
<th>TOTAL NO. OF BARS</th>
<th>CUTTING LENGTH</th>
<th>TOTAL LENGTH</th>
<th>SHAPES</th>
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</table>
# POST CONCRETE CHECK LIST

Name of Project:  
Client:  
Contractor:  
Name of Building:  
Concrete Element & Location:  
Approved Drawing No.:  
Inspection Request No.:  

Y=Yes, N=No and Na= Not Applicable.

<table>
<thead>
<tr>
<th>S.NO</th>
<th>Name of the Activities</th>
<th>Contractor’s Engineer</th>
<th>Engineer in charge</th>
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<tbody>
<tr>
<td>1</td>
<td>Concrete started on</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Concrete completed on</td>
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<tr>
<td>3</td>
<td>Curing satisfactory</td>
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<tr>
<td>4</td>
<td>Cube strength</td>
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<tr>
<td>5</td>
<td>Concrete surface condition</td>
<td></td>
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<tr>
<td>6</td>
<td>Any repairing required</td>
<td></td>
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</tr>
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</table>

1. Remarks for Rectification by ENGINEER-IN-CHARGE

Concrete Quality Acceptable: Yes/ No

INSPECTED BY: (Contractor’s Engineer)  
APPROVED BY: (Engineer-in-Charge)

Name: Sig. & Date  
Name: Sig. & Date
## SLUMP TEST REGISTER

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>Date/ Time</th>
<th>Mix/Grade of Concrete</th>
<th>Location of Concrete Pouring</th>
<th>Slump in mm</th>
<th>Contractor’s Engineers Sign.</th>
<th>ENGINE ER-IN-CHARGE</th>
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# BRICK TESTING REGISTER
## (DIMENSIONAL TOLERANCE)

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<tbody>
<tr>
<td>Client</td>
<td>:</td>
</tr>
<tr>
<td>Contractor</td>
<td>:</td>
</tr>
<tr>
<td>Date of Test</td>
<td>:</td>
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</tbody>
</table>

1. **Dimensions of Brick**
   - Make: …………………
   - Limits as per PWD specifications for Class 10

<p>| | |</p>
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<tr>
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<tbody>
<tr>
<td>Length of 20 bricks</td>
<td>Length : 441 to 459 cm</td>
</tr>
<tr>
<td>Width of 20 bricks</td>
<td>Width : 218 to 226 cm</td>
</tr>
<tr>
<td>Height of 20 bricks</td>
<td>Ht./ thickness : 138 to 142 cm</td>
</tr>
</tbody>
</table>

**INSPECTED BY:**
(Contractor’s Engineer)

**APPROVED BY:**
(Engineer-in-Charge)

<table>
<thead>
<tr>
<th>Name:</th>
<th>Name:</th>
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<tbody>
<tr>
<td>Sig. &amp; Date</td>
<td>Sig. &amp; Date</td>
</tr>
</tbody>
</table>
1.0 TECHNICAL SPECIFICATIONS FOR CIVIL WORKS

1.1 GENERAL

This section deals with Civil construction of the entire plant, piping etc. complete work under this contract.

i) All the civil & structural works shall be carried out as per latest PWD specifications with up to date corrections slips issued up to the date of submission of tender unless otherwise specified herein. In case the PWD specifications are not found applicable or inadequate, then the relevant BIS specifications (latest version) on the date of submission of tender shall be used. Further, in case, any of above two is not applicable, to particular/specialized works, then the manufacturer’s specifications or their relevant instructions shall be followed. Specifications mentioned anywhere in the bid document will prevail over PWD Specifications and BIS specifications as the case may be.

ii) All raw materials including Cement and reinforcement/structural steel wherever to be used by the contractor shall confirm the latest PWD specifications. All mandatory tests as required by PWD specifications shall be carried out and test certificates to be submitted to Engineer - in-charge. However, the contractor shall be fully responsible for required performances of civil/structural work. Costs of such tests are to be borne by the contractor.

iii) For testing of all materials, following shall be strictly adhered to -

   a) All the tests shall be done in laboratories approved by Department. The contractor is required to take written approval from Engineer-in-charge, in this respect.
   
   b) Cement and Steel shall be of a make approved by the Department as detailed out in respective material sections of this document.

1.2 MATERIALS

1.2.1. Cement

i) The cement used shall be of 43 grade, unless otherwise stated separately confirming to BIS specifications, ordinary Portland cement, as required in the work only, from reputed manufacturers such as, ACC, Gujarat Ambuja, Cement Corporation of India, Vikram, J.P. etc. of cement having a production capacity of one million tones per annum or more, and as approved by Department, Ministry of Industry, Government of India and holding license to use BIS certification mark for their product, whose name shall be got approved from Engineer-in-Charge. Supply of cement shall be taken either in silos or in 50 kg. bags bearing manufacturer’s name and BIS marking.

ii) The cement godown of the sufficient capacity should be constructed by the contractor and at all time it should have a stock of minimum of 500 bags. The contractor shall facilitate the inspection of the cement godown by the Engineer-in-Charge at any time. Storage of cement shall be as per PWD specification.
iii) Cement brought at site and cement remaining unused after completion of work shall not be removed from site without written permission of the Engineer-in-charge.

1.2.3 Steel

(a) Corrosion Resistant Steel & Structural Steel

i) The contractor shall procure CTD of high strength deformed CRS steel reinforcement bars and structural steel conforming to relevant BIS codes (Gr Fe 415/500, BIS code1786-1985) from main producers such as SAIL, TISCO, RINL, TOR or as approved by the Ministry of Steel. The steel reinforcement, structural steel shall be brought to the site in bulk supply of 10 tonnes or more as decided by the Engineer-in-Charge. For small or occasional quantities of TOR steel reinforcement bars that less than 10 MT, the Engineer-in-Charge may authorize the contractor to purchase the same from authorized dealers of the approved manufacturers. The contractor shall have to obtain and furnish test certificates to the Engineer-in-Charge in respect of all supplies of steel brought by him to the site of work. Samples shall also be taken and got tested by the Engineer-in-Charge as per the provisions in this regard in relevant PWD/BIS codes. Cost of such tests shall be borne by the contractor. In case the test results indicate that the steel arranged by the contractor does not conform to PWD/BIS codes, the same shall stand rejected and shall be removed from the site of work by the Contractor at his cost within a week's time after written orders from the Engineer-in-Charge.

ii) The steel reinforcement, structural steel shall be stored by the contractor at site of work in such a way as to prevent distortion and corrosion. Bars of different sizes and lengths shall be stored separately.

iii) For checking nominal mass, tensile strength, band test, re-band-test etc. specimen of sufficient length shall be cut from each size of the bar at random at frequency not less than that specified below:

<table>
<thead>
<tr>
<th>Size of Bar</th>
<th>For consignment below 100 tonnes</th>
<th>For consignment over 100 tonnes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 10 mm dia</td>
<td>One sample for each 25 tonnes or part thereof</td>
<td>One sample for each 40 tonnes or part thereof.</td>
</tr>
<tr>
<td>10mm to 16 mm dia.</td>
<td>One sample for each 35 tonnes or part thereof</td>
<td>One sample for each 45 tonnes or part thereof.</td>
</tr>
<tr>
<td>Over 16 mm dia</td>
<td>One sample for each 45 tonnes or part thereof</td>
<td>One sample for each 50 tonnes or part thereof.</td>
</tr>
</tbody>
</table>

iv) Steel brought to site and steel remaining unused shall not be removed from site without the written permission of the Engineer-in-charge.
1.2.4. **Quarry Materials**

The Contractor shall be wholly responsible to identify the suitable sources for quarry materials required for the Works, such as earth, sand, stone, murrum, etc., and to make his own arrangements for collection and transportation of the materials irrespective of the leads and lifts required. The quarry thus identified by the Contractor should have proper license from the concerned Government. All materials supplied by the Contractor shall satisfy the requirements set forth in the Specifications and shall be subject to the approval of the Engineer-in-Charge. The Contractor shall take this into account while offering his rates, and no claims whatsoever shall be entertained for extra costs on this account.

1.2.5. **Precautions During Execution**

i) The successful tenderer shall comply all instructions in all respects issued by the Department in respect of road maintenance and inter utility code of conduct for excavating trenches across and along various roads and other places. In case of non compliance he will liable to pay penalty for various lapses as indicated below:

ii) The contractor shall have to provide GI sheet barricading up to a minimum height of 2 metres above ground level all around the site of excavation and trenches as per direction of Engineer-in-Charge. Such barricading must be provided before taking up the excavation work and must remain in position till complete filling back of excavated trenches and resurfacing work, if any. The GI sheets must be painted in red & White stripes with fluorescent paint.

iii) Proper supporting of all underground services such as water mains, sewers, cables, drains, water and sewer connections shall be provided by the contractor without any additional cost. If the services/connections are damaged the contractor will be responsible for the restoration of the same to original specifications at his own cost.

iv) The contractor shall provide necessary red flickering lights (blinkers) at all roads and required places at night for diversion/smooth flow of traffic without any extra cost. He shall also provide necessary sign boards painted and written with luminous paint for traffic diversion as per direction of Engineer-in-Charge. The warning notice boards should be put at least 100 metres before the approach to the area on either side where the work is going on. In addition proper lighting arrangement will be made for all excavations works.

v) Proposed alignment of rising mains are to cross roads, nallahs, cables, water mains, and other underground services. Contractor shall be required to work under these constraints. Costs of such items are to be included in the bid of the contractor. Necessary statutory permission for road cutting will have to be arranged by the Contractor at his own cost and fee deposited to the concerned dept. will be reimbursed by the Department on actual basis.

vi) As a result of excavation of trenches, the underground services (UGS) such as water mains, electric poles/cables/Telephone cable and sewer line etc. may become exposed and unsupported. It will be the responsibility of the
contractor to make suitable and necessary arrangement for supporting such UGS to keep them functional. Such arrangement will be done as per direction of the Engineer-in-Charge. No separate payment for supporting the services will be made by the dept. Any damages caused to the above mentioned underground services due to negligence of the contractor or otherwise shall be made good by the contractor at his own cost. After laying the pipe, the contractor shall have to construct masonry pillars, to support the water lines/U.G.S. before the temporary supports are removed and filling of trenches is done.

vii) If necessary, the excavation below sub soil water level shall be classified as excavation in saturated soil. The trench shall be kept in dry condition during the laying of pipelines and construction of manholes etc.

viii) Existing drains shall not be blocked by excavated earth or any other materials, the contractor shall ensure that sullage/storm water flow uninterruptly.

1.2.6 Rebound Hammer Test

As per PWD specification Rebound Hammer Test for concrete is mandatory and the same shall be carried out as per the provision. Rebound Hammer required for conducting the test shall be procured by the contractor at his own cost for testing and the same shall be made available at site as and when required by the Engineer-in-Charge.

1.2.7 Bar Bending Schedule

The Contractor will be required to prepare the bar bending schedule prior to taking up all the reinforcement cutting and bending works at site. No reinforcement work will be allowed without the bar bending schedule.

Note: All the data and details as provided are indicative only and bidders are advised to verify them before submission of their offer. No extra payments shall be made against any discrepancy found anywhere in the bid document.
1.3 CIVIL AND BUILDING WORKS

1.3.1 GENERAL

This part of the specification covers the design loads to be considered and specifications of material and workmanship for the civil works. Material used and workmanship for the civil works of Sewage treatment plant, campus development, civil works associated with pipe laying etc. to be done under the contract will adhere to the provisions laid down in this chapter.

The bidder shall have to get Soil Analysis carried out for determining the Safe Bearing Capacity (SBC) of the soil as per relevant code through a reputed firm. The charges for the same shall be included in the offer.

The bidder should ascertain about the actual Sub Soil Water Table at site. Price quoted shall be inclusive of cost of pumping Sub Soil Water / seepage water from any other source required for execution of work. No extra payment shall be made due to variation in Sub Soil Water Level if mentioned anywhere in the tender documents either for designing or execution, on account of fluctuation due to any reason whatsoever.

Materials for which specifications are not given the requirement of respective Indian Standards are to be fulfilled. The contractor shall get prior approval of the materials proposed to be used under the contract from the Engineer-in-Charge.

1.3.2 Design Considerations:

1.3.2.1 Design Submissions

The contractor shall be responsible for the safety of structures, correctness of design and drawings, even after the approval of the same by Engineer-in-Charge. Complete detailed design calculations of foundations and superstructure together with general arrangement drawings and explanatory sketches shall be submitted to the Engineer-in-charge. Separate calculations for foundations or superstructures submitted independent of each other shall be deemed to be incomplete and will not be accepted by the Engineer-in-charge.

The design considerations described hereunder establish the minimum basic requirements of plain and reinforced concrete structures, masonry structures and structural steel works. However, any particular structure shall be designed for the satisfactory performance of the functions for which the same is being constructed.

1.3.2.2 Design Standards

All designs shall be based on the specifications as specified in clause 1.0 of chapter 1-General".

1.3.2.3 Design Loading

1.3.2.3.1 General

All buildings and structures shall be designed to resist the worst combination of the following loads/stresses under test and working conditions: dead load, live load, wind
load, seismic load, stresses due to temperature changes, shrinkage and creep in materials
dynamic load, vehicular load and uplift pressure etc.

**Dead Load**

This shall comprise all permanent construction including walls, floors, roofs, partitions, stairways fixed, service equipments and other items of machinery. In estimating the loads of process equipment for the purpose of design, the empty weight of the equipment including all fixtures and attached piping, but excluding contents, shall be considered. Dead loads shall be taken as per relevant BIS codes.

**Live Load**

Live loads shall be in general as per BIS: 875. However, the following minimum loads shall be considered in the design of structures:

- a) Live load
  - Building (non-plant) : 250 kg/sqm.
  - Roof of Building Structures : 150 kg/sqm.
- b) Live load on floors supporting equipment as pumps, blowers, compressors, etc. : 1000 kg/sqm.
- c) Live load on all other floors and walkways /cable trench covers : 500 kg/sqm.
- d) Live load on roof of Tanks/Plant structure : 250 kg/sqm.
- e) Live load on Stairways : 500 kg/sqm.
- f) Surcharge load for underground structures, if any : As per actual condition.
- g) Equipment load : As per manufacturers specification.

In the absence of any suitable provisions for live loads in BIS codes or as given above for any particular type of floor of structure, assumptions made must receive the approval of the Department / prior to taking up the design work. Apart from the specified live loads or any other load due to material stored, any other equipment load or possible overloading during maintenance or erection shall be considered and shall be partial or full whichever causes the most critical condition.

**Wind Load**

Wind loads shall be as per BIS: 875.

**Earthquake Load**

Earthquake load shall be computed as per B.I.S. 1893 taking into consideration soil foundation system, importance factor appropriate to the type of structure, basic
horizontal seismic coefficient/ seismic zone factor & average acceleration coefficient as applicable for zone v.

An importance factor of 1.5 shall be considered for design of all the structures. The soil foundation system coefficient shall be considered as 1.2.

**Dynamic Load**

Dynamic Loads due to working of machines / equipments such as pumps, blowers, compressors, switch gears, travelling cranes, etc. shall be considered in the design of structures as given by the manufacturers or in BIS code, which ever is more.

**Vehicular Load**

IRC Class AA (wheeled vehicle) loading shall be considered for design of structures under or by the side of roads.

### 1.3.2.3.2 Design Conditions for Underground or Partly Underground Liquid Retaining Structures

Liquid retaining/conveying structures including the members covering the same (such as roof of a chamber, channel etc.) shall be designed by uncracked method of design as per BIS:3370 and 6494. Basement RC walls and slabs below ground shall also be designed by uncracked method of design as liquid retaining structures. Shear shall be checked by working stress method as per BIS:456. Minimum temperature and shrinkage reinforcement shall be 0.3% in each direction.

All underground or partly underground liquid containing structures shall be designed for the following conditions:

- liquid depth up to full height of wall including free board : no relief due to soil pressure from outside to be considered;
- structure empty (i.e. empty of liquid, any material, etc.) : full earth pressure and surcharge pressure wherever applicable, to be considered;
- partition wall between dry sump and wet sump : to be designed for full liquid depth up to full height of wall; i/e free board
- partition wall between two compartments : to be designed as one compartment empty and other full including free board;
- structures shall be designed for uplift in empty conditions with the water table and due care should be taken for seasonal variation on higher side. Factor of safety against uplift shall be 1.2.
- walls shall be designed under operating conditions to resist earthquake forces from earth pressure mobilization and dynamic water loads;
- underground or partially underground structures shall also be checked against stresses developed due to any combination of full and empty compartments with appropriate ground/uplift pressures below base slab. The design shall be such that the minimum gravity weight (empty conditions) exceeds the uplift
pressure at least by 20%.

- For design purpose, sub soil water level is to be considered as one meter below the average natural ground level.

### 1.3.2.3.3 Foundations

Foundation depths and the type of footings shall be appropriately computed from the parameters given in the soil report obtained during the soil testing by the contractor and got reviewed and approved by department.

**Earth fill above virgin ground level till formation level shall be taken as a surcharge load and shall be added in the loads coming on foundations appropriately.**

In some special cases, where contractor wishes to provide the footing in continuation of the sloping floor and taking the wall footing to the minimum depths as mentioned below is not possible, the shortfall in the founding depth shall be made up by PCC fill of grade M-10.

i) The minimum depth of foundations for all structures, equipments, buildings and frame foundations and load bearing walls shall be as per the recommendation of BIS provided adequate bearing pressure is available at that depth.

ii) Bearing capacity of soil shall be determined as per BIS : 6403.

iii) Care shall be taken to avoid the foundations of adjacent buildings or structure foundations, either existing or not within the scope of this contract. Suitable adjustments in depth, location and sizes may have to be made depending on site conditions. No extra claims for such adjustments shall be accepted by department.

iv) A structure subjected to groundwater pressure shall be designed to resist floatation. The dead weight of empty structure shall provide a factor of safety of 1.2 against uplift during construction and service.

v) Where there is level difference between the natural ground level and the foundations of structure or floor slab, this difference shall be filled up in the following ways.

- In case of non-liquid retaining structures the natural top soil shall be removed till a firm strata is reached (minimum depth of soil removed shall be 500 mm) and the level difference shall be made up as per specifications. However the thickness of each layer shall not exceed 150 mm. The area of backfilling for floor slabs shall be confined to prevent soil from slipping out during compaction.

- In case of liquid retaining structures, the natural top soil shall be removed as described above and the level difference shall be made up with Plain Cement Concrete of M-10 grade.

Wherever the plinth level is above the ground level, a curtain wall shall have to be provided from plinth level upto 300 mm below ground level, but not less than 1m in total height.
If pile foundations are used, the contractor shall conduct the initial routine test as per IS 2911 at his own cost, to determine the safe load bearing capacity of piles.

If pile foundations are considered desirable by the tenderer for some/all the units the piles shall be *bored cast-in-situ piles* only. To verify the load carrying capacity of the piles a minimum of two initial load tests shall be conducted and routine load tests as required as per the relevant BIS code shall also be conducted. Soil report should provide capacity of various dia. of pile considering the lowest sub soil condition.

### 1.3.2.3.4 Pressure Release Valve

Use of pressure release valves to reduce uplift pressure due to ground water table shall not be allowed.

### 1.3.2.4 Design Requirements

#### 1.3.2.4.1 General

The Civil & Structural design shall be carried out in accordance to BIS: 456, and BIS: 3370 and other relevant Indian Codes. For the seismic forces, the structure should be designed as per IS: 1893 and all the factors as applicable for zone V.

Special care should be taken for design of base slab of Tanks having liquid depth more than 5 metre such base slabs should be designed for a settlement of 40 mm before laying the mud mat concrete. The area for the base slab should be compacted with Coarse Sand till 90% proctor density is achieved.

The following are the design requirements for all reinforced or plain concrete structures.

a) All blinding and leveling concrete shall be of minimum 100 mm thickness of concrete mix- M10, unless otherwise specified.

b) Liquid Retaining Structures/Buildings:

   All structural reinforced concrete for liquid retaing structures or buildings shall be of a minimum M30 grade with a maximum 20 mm aggregate size.

c) The minimum reinforcement in walls, floors and roofs of liquid retaining structures in each of two directions at right angles shall be 0.3% using HYSD bars.

d) All buildings shall be provided with damp proofing for basement and floors and water proofing for roofs as specified in specific requirements.

e) Any structure or pipeline crossing below roads shall be designed for Class AA of IRC loading or as classified by the respective authority. NP3 RCC pipe (with encases) shall be used below roads inside the plant.

f) All pipes and conduits laid below the structural units such as PST, FST etc. shall be embedded in reinforced concrete of grade M20 of minimum thickness 150 mm.

f) Suitable admixtures may be used with the approval of engineer in charge.
1.3.2.4.2 **Minimum Thickness**

The following minimum thickness shall be used for different reinforced concrete members, irrespective of design thickness.

(i) Walls for liquid retaining structures except at (x) below
(ii) Roof slabs for liquid retaining structures (other than flat slabs)
(iii) Bottom slabs for liquid retaining structures
(iv) Floor slabs including roof slabs, walkways, canopy slabs
(v) Wall of cables/pipe trenches, underground pits
(vi) Column footings
(vii) Parapets, Chajja
(viii) Pre-Cast trench cover
(ix) Beams, columns
(x) Channels, launder

1.3.2.4.3 **Minimum Cement Content:**

The following Minimum cement content shall be used for different grades of concrete:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Grade of Concrete</th>
<th>Minimum Cement in Concrete (Kg/m³ of finished concrete)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M15</td>
<td>330</td>
</tr>
<tr>
<td>2</td>
<td>M20</td>
<td>360</td>
</tr>
<tr>
<td>3</td>
<td>M25</td>
<td>410</td>
</tr>
<tr>
<td>4</td>
<td>M30</td>
<td>430</td>
</tr>
</tbody>
</table>

1.3.2.5 **Materials & Standards**

The term “materials” shall mean all materials, goods and articles of every kind whether raw, processed or manufactured and equipment of every kind to be supplied by the Contractor for incorporation in the Works.

Except as may be otherwise specified for particular parts of the works the provision of clauses in “Materials and Workmanship” shall apply to materials and workmanship for any part of the works.

All materials shall be new and of the kinds and qualities described in the Contract and shall be at least equal to approved samples.

Materials and workmanship shall comply with the relevant CPWD Specification (with amendments) current as on the date of submission of the tender.
Where the relevant standard provides for the furnishing of a certificate to the Engineer-in-charge, at his request, stating that the materials supplied comply in all respects with the standard, the Contractor shall obtain the certificates and forward it to the Engineer-in-charge.

The specifications, standards and codes listed below are considered to be part of this Bid specification. All standards, specifications, codes of practices referred to herein shall be the latest editions including all applicable official amendments and revisions as on the date of submission of the tender.

In case of discrepancy between two standards the provisions more stringent shall be followed.

<table>
<thead>
<tr>
<th>BIS No.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>4082</td>
<td>Recommendation on stacking and storage of construction materials at site (first revision)</td>
</tr>
<tr>
<td>7969</td>
<td>Safety code for handling and storage of building materials</td>
</tr>
<tr>
<td>1498</td>
<td>Classification and identification of soils for general engineering purposes (first revision) (Amendments 2) (Reaffirmed)</td>
</tr>
<tr>
<td>2682 : 1984</td>
<td>Chlordane emulsifiable concentrates (second revision) (Amendment 1) (Reaffirmed 1994)</td>
</tr>
<tr>
<td>3764: 1992</td>
<td>Excavation work - Code of safety (first revision)</td>
</tr>
<tr>
<td>6313(Part2)</td>
<td>Code of practice for anti-termite measures in buildings : Part 2 Pre-constructional chemical treatment measures (Reaffirmed)</td>
</tr>
<tr>
<td>875 (Part 1)</td>
<td>Code of practice for design loads (other than earthquake) for buildings and structures : Part 1 Dead loads - Unit weights of building material and stored materials</td>
</tr>
<tr>
<td>875 (Part 2)</td>
<td>Code of practice for design loads (other than earthquake) for buildings and structures : Part 2 Imposed loads</td>
</tr>
<tr>
<td>875 (Part 3)</td>
<td>Code of practice for design loads (other than earthquake) for buildings and structures : Part 3 Wind loads</td>
</tr>
<tr>
<td>875 (Part 4)</td>
<td>Code of practice for design loads (other than earthquake) for buildings and structures : Part 4 Snow loads</td>
</tr>
<tr>
<td>875 (Part 5)</td>
<td>Code of practice for design loads (other than earthquake) for buildings and structures : Part 5 Special loads and load combinations</td>
</tr>
<tr>
<td>1080 : 1986</td>
<td>Code of practice for design and construction of shallow foundations on soils (other than raft, ring and shell)</td>
</tr>
<tr>
<td>1904</td>
<td>Code of practice for design and construction of foundations in soils: General requirements</td>
</tr>
<tr>
<td>2974(Part2)</td>
<td>Code of practice for design and construction of machine foundations:</td>
</tr>
<tr>
<td>BIS No.</td>
<td>Title</td>
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<tr>
<td>2974(Part3)</td>
<td>Design and construction of machine foundations - Code of practice:</td>
</tr>
<tr>
<td></td>
<td>Part 3 Foundations for rotary type machines (medium and high</td>
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<td></td>
<td>frequency)</td>
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<tr>
<td>2974(Part4)</td>
<td>Code of practice for design and construction of machine foundations:</td>
</tr>
<tr>
<td></td>
<td>Part 4 Foundations for rotary type machines of low frequency</td>
</tr>
<tr>
<td>2974(Part5)</td>
<td>Code of practice for design and construction of machine foundations:</td>
</tr>
<tr>
<td></td>
<td>Part 5 Foundation for impact machines other than hammers (forging</td>
</tr>
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<td></td>
<td>and stamping press, pig breakers, drop crusher and jolter)</td>
</tr>
<tr>
<td>6403</td>
<td>Code of practice for determination of bearing capacity of shallow</td>
</tr>
<tr>
<td></td>
<td>foundations.</td>
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<tr>
<td>8009(Part1)</td>
<td>Code of practice for calculation of settlement of foundations:</td>
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<tr>
<td></td>
<td>Part 1 Shallow foundations subject to symmetrical static vertical</td>
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<td></td>
<td>loads</td>
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<tr>
<td>8009(Part2)</td>
<td>Code of practice for calculation of settlement of foundations:</td>
</tr>
<tr>
<td></td>
<td>Part 2 Deep foundations subjected to symmetrical static vertical</td>
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<td>11089</td>
<td>Code of practice for design and construction of ring foundation</td>
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<tr>
<td>13094</td>
<td>Guidelines for selection of ground improvement techniques for</td>
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<td></td>
<td>foundation in weak soils.</td>
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<tr>
<td>13301</td>
<td>Guidelines for vibration isolation for machine foundations</td>
</tr>
<tr>
<td>SP 36</td>
<td>Compendium of Indian Standards on soil engineering: Part 2 Field</td>
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<td>(Part 2):</td>
<td>testing</td>
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<td>1988</td>
<td></td>
</tr>
<tr>
<td>2720</td>
<td>Methods of test for soils</td>
</tr>
<tr>
<td>(Parts 1 to</td>
<td></td>
</tr>
<tr>
<td>41)</td>
<td></td>
</tr>
<tr>
<td>6452</td>
<td>Specification for high alumina cement for structural use</td>
</tr>
<tr>
<td>6909</td>
<td>Specification for supersulphated cement</td>
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<tr>
<td>8041</td>
<td>Rapid hardening Portland cement</td>
</tr>
<tr>
<td>8042</td>
<td>White Portland cement</td>
</tr>
<tr>
<td>8043</td>
<td>Hydrophobic Portland cement</td>
</tr>
<tr>
<td>8112</td>
<td>43 grade ordinary Portland cement</td>
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<td>13330</td>
<td>Sulphate resisting Portland Cement</td>
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<td>383</td>
<td>Coarse and fine aggregates from natural sources for concrete</td>
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<td>432 (Part 1&amp;</td>
<td>Mild steel and medium tensile steel bars and hard-drawn steel wire</td>
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<td>2)</td>
<td>for concrete reinforcement</td>
</tr>
<tr>
<td>456</td>
<td>Code of practice for plain and reinforced concrete</td>
</tr>
<tr>
<td>516</td>
<td>Method of test for strength of concrete</td>
</tr>
<tr>
<td>650</td>
<td>Standard sand for testing of cement</td>
</tr>
<tr>
<td>1199</td>
<td>Methods of sampling and analysis of concrete</td>
</tr>
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<td>BIS No.</td>
<td>Title</td>
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<tr>
<td>1343</td>
<td>Code of practice for Prestressed concrete</td>
</tr>
<tr>
<td>1566</td>
<td>Hard-drawn steel wire fabric for concrete reinforcement</td>
</tr>
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<td>1786</td>
<td>High strength deformed steel bars and wires for concrete reinforcement</td>
</tr>
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<td>2386</td>
<td>Methods of test for aggregates for concrete (Part 1 to 8)</td>
</tr>
<tr>
<td>2502</td>
<td>Code of practice for bending and fixing of bars for concrete reinforcement</td>
</tr>
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<td>2595</td>
<td>Code of practice for radiographic testing</td>
</tr>
<tr>
<td>2645</td>
<td>Integral cement waterproofing compounds</td>
</tr>
<tr>
<td>3025</td>
<td>Methods of sampling and test (physical and chemical) for water used in industry</td>
</tr>
<tr>
<td>3085</td>
<td>Method of test for permeability of cement mortar &amp; concrete</td>
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<tr>
<td>3370</td>
<td>Code of practice for concrete structures for the storage of liquids (Part 1 to 4)</td>
</tr>
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<td>Masonry cement</td>
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<tr>
<td>3812</td>
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<td>4031</td>
<td>Methods of physical tests for hydraulic cement (Part 1)</td>
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<tr>
<td>5816</td>
<td>Method of test for splitting tensile strength of concrete cylinders</td>
</tr>
<tr>
<td>6452</td>
<td>Specification for high alumina cement for structural use</td>
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<tr>
<td>7861</td>
<td>Code of practice for extreme weather concreting (Part 1)</td>
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In addition to the above-referred codes, CPHEEO manual on sewerage and sewage treatment and other relevant codes shall be applicable as per requirement.

Copies of all relevant codes, reference literature to be submitted to the Public Works Department, Haryana.

1.3.2.5.1 Samples and Tests of Materials

The Contractor shall submit samples of such materials as may be required by the Engineer-in-charge and shall carry out the specified tests directed by the Engineer-in-charge at the Site, at the supplier’s premises or at a laboratory approved by the Engineer-in-charge. Samples shall be submitted and tests carried out sufficiently early to enable further samples to be submitted and tested if required by the Engineer-in-charge. The cost of such test and material shall be borne by the contractor and nothing shall be paid on this account.
1.3.2.6 EARTHWORK

1.3.2.6.1 GENERAL

Excavation may be involved in all types of soils including rock including saturated soil, sub-soil water or running sand including pumping or bailing out of water.

The Contractor shall furnish all tools, plant instruments, qualified supervisory personnel, labour, materials, any temporary works, consumables, any and everything necessary, whether or not such items are specifically stated herein for completion of the work in accordance with the Department’s Requirements.

The Contractor shall survey the site before excavation and set out all lines and establish levels for various works such as grading, basement, foundations, plinth filling, roads, drains, cable trenches, pipelines etc. Such survey shall be carried out by taking accurate cross sections of the area perpendicular to established reference/grid lines at 10 m in case of buildings and 30 m in case of roads and pipe lines works intervals or nearer, if necessary, based on ground profile and thereafter properly recorded.

The excavation shall be carried out to correct lines and levels. This shall also include, where required, proper shoring to maintain excavations and also the furnishing, erecting and maintaining of substantial barricades around excavated areas and warning lamps at night.

Excavated material shall be dumped in regular heaps, bunds, riprap with regular slopes and levelling the same so as to provide natural drainage. Rock/soil excavated shall be stacked properly as approved by the Engineer-in-charge. 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.

Topsoil shall be stock piled separately for later re-use.

1.3.2.6.2 Clearing

The area to be excavated /filled shall be cleared of fences, trees, plants, logs, stumps, bush, vegetation, rubbish, slush, etc. and other objectionable matter. If any roots or stumps of trees are encountered during excavation, they shall also be removed. The material so removed shall be disposed off as approved by the Engineer-in-charge.
Where earthfill is intended, the area shall be stripped of all loose/soft patches, top soil containing objectionable matter/materials before fill commences.

1.3.2.6.3 Excavation

Excavation for permanent work shall be taken out to such widths, lengths, depths and profiles as are shown on the approved drawings or such other lines and grades as may be agreed with the Engineer-in-charge. Rough excavation shall be carried out to a depth of 150 mm above the final level. The balance shall be excavated with special care. Soft pockets shall be removed below the final level and extra excavation filled up with material as approved by the Engineer-in-charge. The final excavation should be carried out just prior to laying the blinding course.

To facilitate the permanent works the Contractor may excavate, and also backfill later, outside the lines shown on the approved drawings or as agreed with the Engineer-in-charge. Should any excavation be taken below the specified elevations, the Contractor shall fill it up with concrete upto the required elevation at no cost to the department.

Any undulation in ground level, loose pockets or extra excavation done at “wherever necessary due to soft soil or low lying area shall be made good with M10 cement concrete and no extra claim shall be entertained on this account.

All excavations shall be to the minimum dimensions required for safety and ease of working. Prior approval of the Engineer-in-charge shall be obtained by the Contractor in each individual case, for the method proposed for the excavation, including dimensions, side slopes, dewatering, disposal, etc. This approval shall not in any way relieve the Contractor of his responsibility for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner. Side slopes shall be as steep as will stand safely for the actual soil conditions encountered. Every precaution shall be taken to prevent slips. Should slips occur, the slipped material shall be removed and the slope dressed to a modified stable slope.

All loose boulders, detached rocks partially and other loose material which might move therewith not directly in the excavation but so close to the area to be excavated as to be liable, in the opinion of Engineer-in-charge, to fall or otherwise endanger the workmen, equipment, or the work shall be stripped off and removed from the area of the excavation. The method used shall be such as not to render unstable or unsafe the portion, which was originally sound and safe.

Any material not requiring removal in order to complete the permanent works, but which, in the opinion of Engineer-in-charge, is likely to become loose or unstable later, shall also be promptly and satisfactorily removed.

1.3.2.6.4 Fill, Backfilling and Site Grading

1.3.2.6.4.1 General

All fill material shall be subject to the Engineer-in-charge’s approval. If any material is rejected by Engineer-in-charge, the Contractor shall remove the same forthwith from the site. Surplus fill material shall be deposited/disposed off as directed by Engineer-in-charge after the fill work is completed.
No earthfill shall commence until surface water discharges and streams have been properly intercepted or otherwise dealt with to the approval of the Engineer-in-charge.

1.3.2.6.4.2 Material
To the extent available, selected surplus soil from excavations shall be used as backfill. Backfill material shall be free from lumps, organic or other foreign material. All lumps of earth shall be broken or removed unless otherwise stated. Where excavated material is mostly rock, the boulders shall be broken into pieces not larger than 150 mm size, mixed with properly graded fine material consisting of murrum or earth to fill the voids and the mixture used for filling.

If fill material is required to be imported, the Contractor shall make arrangements to bring such material from outside borrow pits. The material and source shall be subject to the prior approval of the Engineer-in-charge. The approved borrow pit areas shall be cleared of all bushes, roots of trees, plants, rubbish, etc. Top soil containing foreign material shall be removed. The materials so removed shall be disposed of as directed by Engineer-in-charge. The Contractor shall provide the necessary access roads to borrow areas and maintain the same if such roads do not exist.

1.3.2.6.4.3 Filling in pits and trenches around foundations of structures, walls, etc.
The spaces around the foundations, structures, pits, trenches, etc., shall be cleared of all debris, and filled with earth in layers not exceeding 15 cm, each layer being watered, rammed and properly consolidated to the satisfaction of Engineer-in-charge. Earth shall be rammed with approved mechanical compaction machines. Usually no manual compaction shall be allowed unless the Engineer-in-Charge is satisfied that in some cases manual compaction by tampers cannot be avoided. The final backfill surface shall be trimmed and leveled to a proper profile to the approval of the Engineer-in-charge.

The filling shall be done after the concrete or masonry is fully set and done in such a manner as not to cause undue thrust on any part of the structure.

1.3.2.6.4.4 Plinth Filling
Plinth filling shall be carried out with approved material such as soil, sand or murrum as in layers not exceeding 15 cm, 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 settlement at a later stage. The finished level of the filling shall be trimmed to the level/slope specified.

Compaction of large areas be carried out by means of 12 ton rollers smooth wheeled, sheep-foot or wobbly wheeled rollers. In case of compaction of granular material such as sands and gravel, vibratory rollers shall be used. A smaller weight roller may be used only if permitted by the Engineer-in-charge. As rolling proceeds, water sprinkling shall be done to assist consolidation. Water shall not be sprinkled in case of sandy fills.
The thickness of each unconsolidated fill layer can in this be up to a maximum of 300 mm. The Contractor will determine the thickness of the layers in which fill has to be consolidated depending on the fill material and equipment used and the approval of the Engineer-in-charge obtained prior to commencing filling.

The process of filling in the plinth, watering and compaction shall be carried out by the contractor in such a way as not to endanger the foundation columns, plinth walls etc. already built up. Under no circumstances Black cotton soil shall be used for plinth in filling.

Rolling shall commence from the outer edge and progress towards the centre and continue until compaction is to the satisfaction of Engineer-in-charge, but in no case less than 10 passes of the roller will be accepted for each layer.

The compacted surface shall be properly shaped, trimmed and consolidated to an even and uniform gradient. All soft spots shall be excavated, then filled and consolidated.

At some locations/areas, it may not be possible to use rollers because of space restrictions, etc. The Contractor shall then be permitted to use pneumatic tampers, rammers, etc. and he shall ensure proper compaction.

1.3.2.6.4.5 Sand Filling in Plinth and Other Places
Where backfilling is required to be carried out with local sand it 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. The surface of the consolidated sand shall be shaped to required level or slope.

1.3.2.6.4.6 General Site Grading
Site grading shall be carried out as indicated in the approved drawings.

If no compaction is required, the fill may be deposited to the full height in one operation and levelled. If the fill has to be compacted, it shall be placed in layers not exceeding 200 mm and levelled uniformly and compacted before the next layer is deposited.

To ensure that the fill has been compacted as specified, field and laboratory tests shall be carried out by the Contractor.

Field compaction tests shall be carried out in each layer of filling until the fill to the entire height has been completed. The fill will be considered as incomplete if the desired compaction has not been obtained.

The Contractor shall protect the earth fill from being 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.

1.3.2.6.4.7 Fill Density

Unless otherwise specified the compaction, where so called for, shall comply with minimum 90% compaction by Standard Proctor at moisture content differing not
more than 4% from the optimum moisture content. The Contractor shall demonstrate adequately by field and laboratory tests that the specified density has been obtained.

1.3.2.7 Timber Shoring

The provisions of relevant BIS shall apply.

1.3.2.8 Dewatering

The Contractor shall ensure at his cost that the excavation and the structures are free from water during construction and shall take all necessary precautions and measures to exclude ground/ rain water / seepage water so as to enable the works to be carried out in reasonably dry conditions in accordance with the construction programme. Sumps made for dewatering must be kept clear of the excavations/ trenches required for further work. The method of pumping shall be approved by Engineer-in-charge, but in any case, the pumping arrangement shall be such that there shall be no movement of subsoil or blowing in due to differential head of water during pumping. Pumping arrangements shall be adequate to ensure no delays in construction. The dewatering shall be continued for at least (7) seven days after the last pour of the concrete. The Contractor shall, however, ensure that no damage to the structure results on stopping of dewatering.

The Contractor shall study the sub-soil conditions carefully and shall conduct any test necessary at the site with the approval of the Engineer-in-charge to test the permeability and drainage conditions of the sub-soil for excavation, concreting etc., below ground level.

The scheme for dewatering and disposal of water shall be approved by the Engineer-in-charge. The Contractor shall suitably divert the water obtained from dewatering from such areas of site where a build up of water in the opinion of the Engineer-in-charge obstructs the progress of the work, leads to unsanitary conditions by stagnation, retards the speed of construction and is detrimental to the safety of men, materials, structures and equipment.

When there is a continuous inflow of water and the quantum of water to be handled is considered in the opinion of Engineer-in-charge, to be large, a well point system- single stage or multistage, shall be adopted. The Contractor shall submit to the Engineer-in-charge, details of his well point system including the stages, the spacing number and diameter of well points, headers etc., and the number, capacity and location of pumps for approval.

If any foundation pits are filled due to accumulation of surface flow during the progress of work or during rainy season, or due to any other cause, all pumping required for dewatering the pits & removing silt shall be done without extra cost.

1.3.2.9 Rain Water Drainage

Grading in the vicinity of excavation shall be such as to exclude rain/ surface water draining into excavated areas. Excavation shall be kept clean of rain and such water as the Contractor may be using for his work, by suitably pumping out the same. The scheme for pumping and discharge of such water shall be approved by the Engineer-in-charge.
1.4.0 **PLAIN & REINFORCED CEMENT CONCRETE**

1.4.1 **GENERAL**

Cement used shall be of minimum 43 grade Ordinary Portland Cement. All plain or reinforced cement concrete shall comply with the following specifications unless specified otherwise:

a) Lean/blinding concrete below foundations shall be in the following minimum thicknesses and grades.

Below all foundations/ rafts unless mentioned otherwise - 100mm(M-10)
Below column footings, cable trenches - 100mm (M-10)

b) Structural concrete shall be of the following grades.

<table>
<thead>
<tr>
<th>Mix</th>
<th>Type of Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>M 30</td>
<td>RCC works for all tanks holding sewage/sludge or treated effluent</td>
</tr>
<tr>
<td>M 20</td>
<td>For all plant buildings</td>
</tr>
</tbody>
</table>

Minimum cover to main reinforcement shall be as follows.

a) Walls and foundation of Liquid retaining/conveying structures

   i) Sewage face/foundation/raft (top and bottom) : 50 mm

   ii) Other face : 25 mm

b) Bottom cover of building foundation : 75mm

c) For other structures cover shall conform to the requirements of BIS:456 & BIS: 3370.

d) For proper cover, plastic cover block of different sizes shall be used and readymade steel spacers shall be provided by the contractor.
Necessary lapping of the reinforcement shall be done as per BIS codes of practice and tied with GI binding wire of required gauge as per IS codes of practice. Welding of reinforcing bars shall not be done. Welding can be permitted by Engineer-in-Charge in exceptional cases where due care will be exercised as per IS Specifications.

The Engineer-in-Charge shall have the right at all times 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 the Engineer-in-Charge’s approval obtained, prior to starting of concrete work. This shall, however, not relieve the Contractor of any of his responsibilities. All materials which do not conform to the Specifications shall be rejected. Volumetric mix concrete will not be allowed.

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 generally be used. Other materials may be used after approval of the Engineer-in-Charge and after establishing their performance suitability based on previous data, experience or tests.

1.4.2 Foundation Bedding
All earth surfaces upon which or against which concrete is to be placed, shall be well compacted and free from standing water, mud or debris. Soft or spongy areas shall be cleaned out and filled with either soil-cement mixture, lean concrete or clean sand compacted as approved by the Engineer-in-Charge. The surfaces of absorptive soils shall be moistened.

1.4.3 Repair and Replacement of Unsatisfactory Concrete

Immediately after the shuttering is removed, all defective areas such as honey-combed surfaces, rough patches, holes left by form bolts etc, shall be inspected by the Engineer-in-Charge who may permit patching of the defective areas or reject the concrete work.

Rejected concrete shall be removed and replaced by the Contractor at no additional cost to the Employer.

For patching of defective areas all loose materials shall be removed and the surface shall be prepared as approved by the Engineer-in-Charge.

Bonding between hardened and fresh concrete shall be done either by placing cement mortar or by applying epoxy. The decision of the Engineer-in-Charge as to the method of repairs to be adopted shall be final and binding on the Contractor. The surface shall be saturated with water for 24 hours before patching is done with cement sand mortar. The use of epoxy for bonding fresh concrete shall be carried out as approved by the Engineer-in-Charge.

1.4.4 Hot Weather Requirements
Concreting during hot weather shall be carried out as per BIS 7861 (Part I). Adequate provision shall be made to lower concrete temperatures, which shall not exceed 40 deg C at time of placement of fresh concrete.
Where directed by the Engineer-in-Charge, the Contractor shall spray non-wax based curing compound on unformed concrete surfaces at no extra costs.

1.4.5 Cold Weather Requirements
Concreting during cold weather shall be carried out as per BIS:7861(Part II).

The ambient temperature during placement and upto final set shall not fall below 5°C. Approved antifreeze/accelerating additives shall be used where directed.

For major and large scale concreting works the temperature of concrete at times of mixing and placing, the thermal conductivity of the formwork and its insulation and stripping period shall be closely monitored.

1.4.6 Testing Concrete Structures for Leakage
The Contractor shall take special care for concrete for liquid retaining structures, underground structures and those others specifically called for to guarantee the finish and water tightness.

The Contractor shall make all arrangements for hydro-testing of structure as per BIS: 3370 part I, all arrangements for testing such as temporary bulk heads, pressure gauges, pumps, pipe lines etc.

Any leakage that may occur during the hydro-test or subsequently during the defects liability period shall be effectively stopped either by cement/epoxy pressure grouting, guniting or such other methods as may be approved by the engineer-in-charge. All such rectification shall be done by the contractor to the entire satisfaction of the engineer-in-charge at no extra cost to the department.

Hydrostatic test for water tightness shall be done at full storage level i.e free board as may be directed by the Engineer-in-Charge, as described below:

In the case of structures whose external faces are exposed, the requirements of the test shall be deemed to be satisfied if the external faces show no sign of leakage or sweating and remain completely dry during the period of observation of seven days after allowing a seven day period for absorption after filling with water.

In the case of structures whose external faces are buried and are not accessible for inspection, such as underground tanks, the structures shall be filled with water and after the expiry of seven days after the filling; the level of the surface of the water shall be recorded. The level of water shall be recorded again at subsequent intervals of 24 hrs over a period of seven days. The total drop in surface level over a period for seven days shall be taken as an indication of water tightness of the structure. The Engineer-in-Charge shall decide on the actual permissible nature of this drop in the surface level, taking into account whether the structures are open or closed and the corresponding effect it has on evaporation losses. Unless specified otherwise, a structure whose top is covered shall be deemed to be water tight if the total drop in the surface level over a period of seven days does not exceed 40 mm.
Each compartment/segment of the structure shall be tested individually and then all together.

For structures such as pipes, tunnels etc. the hydrostatic test shall be carried out by filling with water, after curing as specified, and subjecting to the specified test pressure for specified period. If during this period the loss of water does not exceed the equivalent of the specified rate, the structure shall be considered to have successfully passed the test.

1.4.7 Sand
Only good washed sand conforming to PWD specifications shall be used for the concrete and masonry work. The sand will not contain more than 8% silt.

Whenever a mention of “fine sand” has been made the same shall be made by mixing in proportion of 1 part of coarse sand (Badarpur) and 2 parts of Jamuna sand by volume.

In all plain and reinforced concrete work coarse sand shall be used.

1.4.8 Shuttering
The centering and shuttering for all RCC and concrete work shall be of steel/plywood as per PWD specification and as approved by the Engineer-in-Charge. Joints shall be sufficiently tight to prevent loss of cement slurry from concrete. All joints and holes in form work shall be caulked with putty, cloth or other approved material. Care shall be taken to ensure that such filling is kept away from reinforcement. All formwork shall be leveled, aligned and all rubbish particularly clippings, wood shavings, sand dust and adhered grout shall be removed from the interior of the forms before the concrete is placed.

All formwork shall be removed without causing shock vibration to the concrete. Before the soffit and struts are removed, the concrete surface shall be exposed wherever necessary in order to ascertain that the concrete has sufficiently hardened.

Contractor shall submit and obtain approval of design calculations for centering and shuttering for pump house.

No through bolts shall be permitted in the form work for liquid retaining structures. Wall ties with plastic cones as per PWD specification shall be used.

The surface on the RCC/ concrete work obtained after removal of shuttering shall be smooth and without honey combing/pin holes, undulations and shall be such that it does not require any plastering. If at all any pin hole/undulations are required to be made good, this shall be done with cement mortar 1:2 using coarse sand and finished smooth with steel trowel or as directed by Engineer-in-Charge.
1.5.0 STRUCTURAL STEEL WORK

1.5.1 GENERAL

As much fabrication work as is reasonably practicable, shall be completed in shops, where steel work is fabricated.

All workmanship and finish shall be of the best quality and shall conform to the best approved method of fabrication. All materials shall be finished straight and shall be machined/ground smooth true and square where so specified. All holes and edges shall be free of burrs. Shearing and chipping shall be neatly and accurately done and all portions of work exposed to view shall be neatly finished. Tolerances for fabrication of steel structures conform BIS 7215. Tolerances for erection of steel structures shall conform to BIS 12843.

1.5.2 Minimum thickness of metal - Corrosion Protection

Unless, otherwise specified, the thickness of steel section shall be governed as below:

a) Steel work exposed to weather

Where steel work is directly exposed to weather and is fully accessible for clearing and repairing the thickness shall not be less than 6 mm (excluding corrosion allowance); and where steel is exposed to weather and is not accessible for cleaning and painting, the thickness shall not be less than 8 mm. This shall not apply for hot rolled sections covered by Indian Standards.

b) Steel work not directly exposed to weather

The thickness of steel work not directly exposed to the weather shall be not less than 6 mm. The thickness of steel in secondary members shall be not less than 6 mm. For hot rolled sections to Indian Standards, the mean thickness of flange be considered and not the web thickness.

c) The requirements (a) and (b) above does not apply to light structural work or sealed box section or to steel work in which special provision against corrosion has been made and also in case of steel work exposed to highly corrosive fumes or vapour in which case the thickness shall be as approved by the Engineer-In-Charge.
d) Corrosion allowance of 2mm shall be taken over and above the minimum thickness as mentioned above or design thickness.

1.5.3 Drawings prepared by the Contractor
The contractor shall prepare all fabrication working and erection drawings for the entire work. The drawings shall preferably be of one standard size and the details shown there in shall be clear and legible.

All fabrication drawings shall be submitted to the Engineer-In-Charge for approval.

No fabrication drawings will be accepted for Engineer-In-Charge’s approval unless checked and approved by the contractor’s qualified structural engineer and accompanied by an erection plan showing the location of all pieces detailed. The contractor shall ensure that connections are detailed to obtain ease in erection of structures and in making field connections.

Fabrication shall be started by the contractor only after Engineer-In-Charge’s approval of fabrication drawings. Approval by the Engineer-In-Charge of any of the drawing shall not relieve the contractor from the responsibility for correctness of engineering and design of connections, workmanship, fit of parts, details, material, errors or omissions or any and all work shown thereon.

The drawings prepared by the contractor and all subsequent revisions etc. shall be at the cost of the contractor for which no separate payment will be made.

1.5.4 Connections
Shop/field connections shall be as per approved fabrication drawings.

In case of bolted connections, taper washers or flat washers or spring washers shall be used with bolts as necessary. In case of high strength friction grip bolts, hardened washers shall be used under the nuts or the bolt heads whichever are turned to tighten the bolts. The length of the bolt shall be such that at least one thread of the bolt projects beyond the nut, except in case of high strength friction grip bolts where this projection shall be at least three times the pitch of the thread.

In all cases where bearing is critical, the unthreaded portion of bolt shall bear on the members assembled. A washer of adequate thickness may be provided to exclude the threads from the bearing thickness, if a longer grip bolt has to be used for this purpose.

All connections and splices shall be designed for full strength of members or loads. Column splices shall be designed for the full tensile strength of the minimum cross section at the splice.

All members, likely to collect rain water shall have drain holes provided.

1.5.5 Riveting
Rivets shall be heated uniformly throughout their length without burning or excessive scaling and shall be of sufficient length to provide a head of standard dimensions. They shall, when driven, completely fill the holes and if counter sunk, the counter sinking shall be fully filled by the rivet; any protrusion of the countersunk head being dressed off flush if required.
Riveted members shall have all parts firmly drawn and held together before and during riveting and special care shall be taken in this respect for all single riveted connections. For multiple riveted connections, a service bolt shall be provided for every third or fourth hole.

Wherever practicable, machine riveting shall be carried out by using machines of the steady pressure type. All loose bored or otherwise defective rivets shall be cut out and replaced before the structure is loaded and special care shall be taken to inspect all single riveted connections.

Special care shall be taken in heating and riveting long rivets.

1.5.6 Inspection

1.5.6.1 General
The Contractor shall give due notice to the Engineer-in-Charge in advance of the works being made ready for inspection. All rejected material shall be promptly removed from the shop and replaced with new material for the Engineer-in-Charge’s inspection. The fact that certain material has been accepted at the Contractor’s shop shall not invalidate final rejection at site by the Engineer-in-Charge if it fails to conform to the requirements of these specifications, to be in proper condition or has fabrication inaccuracies which prevent proper assembly nor shall it invalidate any claim which the employer may make because of defective or unsatisfactory materials and /or workmanship.

No materials shall be painted or dispatched to site without inspection and approval by the Engineer-in-Charge unless such inspection is waived in writing by the Engineer-in-Charge. Cost of such inspections shall be borne by the contractor.

The Contractor shall provide all the testing and inspection services and facilities for shop work except where otherwise specified.

For fabrication work carried out in the field the same standard of supervision and quality control shall be maintained as in shop fabricated work. Inspection and testing shall be conducted in a manner satisfactory to the Engineer-in-Charge. Inspection and tests on structural steel members shall be as set forth below.

1.6 Material Testing
If mill test reports are not available for any steel materials the same shall be tested by the Contractor to the Engineer-In-Charge’s satisfaction to demonstrate conformity with the relevant specification.

1.6.1 Tests on Welds

(a) Radiographic Inspection
All full strength butt welds shall be radiographed in accordance with the recommended practice for radiographic testing as per relevant IS code.

(b) Dimensions, Workmanship & Cleanliness
Members shall be inspected at all stages of fabrication and assembly to verify that dimensions, tolerances, alignment, surface finish and painting are in accordance with the requirements shown in the Contractor’s approved fabrication drawings.

1.6.2 Test Failure
In the event of failure of any member to satisfy inspection or test requirement, the Contractor shall notify the Engineer-in-Charge. The Contractor must obtain permission from the Engineer-in-Charge before any repair is undertaken. The quality control procedures to be followed to ensure satisfactory repair shall be subject to approval by the Engineer-in-Charge.

The Engineer-in-Charge has the right to specify additional testing as he deems necessary, and the additional cost of such testing shall be borne by the contractor.

The Contractor shall maintain records of all inspection and testing which shall be made available to the Engineer-in-Charge.

1.6.3 Shop Matching
For structures like, bunkers, tanks, etc. shop assembly is essential. For other steel work, such as columns along with the tie beams/bracings may have to be shop assembled to ensure satisfactory fabrication, obtaining of adequate bearing areas etc., if so desired by the Engineer-in-Charge. All these shop assemblies shall be carried out by the Contractor.

1.6.4 Shop Assembly
a) The steel work shall temporarily shop assembled complete or as arranged with the Authority so that accuracy of fit may be checked before dispatched. The parts shall be shop assembled with sufficient numbers of parallel drifts to bring and keep the parts in place.

b) In case of parts drilled or punched, through steel jigs with bushes resulting in all similar parts being interchangeable the steel work may be shop erected in such position as arranged with the Authority.

1.6.5 Packing
All projecting plates or bars and all ends of members at joints shall be stiffened, all straight bars and plates shall be bundled, all screwed ends and machined surfaces shall be suitably packed; and all rivets, bolts, nuts, washers and small loose parts shall be packed separately in cases so as to prevent damage or distortion during transit.

1.6.6 Inspection and Testing
a) The Engineer-in-Charge shall have free access at all reasonable times to those parts of the manufacturers’ works which are concerned with the fabrication of steel work and shall be afforded all reasonable facilities to satisfy that the fabrication is being undertaken in accordance with the specifications.

b) Unless specified otherwise, inspection prior to dispatch shall not interfere with the operation of the work.
1.6.7 Site Erection

a) Plant and Equipment

The suitability and capacity of all plant and equipment used for erection shall be to the satisfaction of the Engineer-in-charge.

b) Storing and Handling

All structural steel should be so stored and handled at the site that the members are not subject to excessive stresses and damage.

c) Setting Out

The positioning and leveling of all steelwork, the plumbing of stanchions and the placing of every part of the structure with accuracy shall be in accordance with approved drawings and to the satisfaction of Engineer-in-charge.

d) Security during Erection

Safety precaution during erection shall conform to BIS 7205:1974. During erection, the steel work shall be securely bolted or otherwise fastened and, when necessary, temporarily braced to provide for all load to be carried by the structure during erection including those due to erection equipment and its operation.

No riveting, permanent bolting or welding should be done until proper alignment has been obtained.

1.6.8 Field Connections

All field assembly by bolts, rivets and welding shall be executed in accordance with the requirements of shop fabrication excepting such as manifestly apply to shop conditions only. Where the steel has been delivered painted, the paint shall be removed before field welding, for a distance of 50 mm at least on either side of the joint.

1.6.9 Painting after Erection

a) All the surfaces of structural steel shall be cleaned by sand blasting.

b) Before painting of such steel which is delivered, all surfaces to be painted shall be dry and thoroughly cleaned from all loose scale and rust.

c) The specified protective treatment shall be completed after erection. All rivet and bolt heads and site welds after de-sludging shall be cleaned. Damaged or deteriorated paint surfaces shall be cleaned. Damaged or deteriorated paint surfaces shall be first made good with the same type of paint as the shop coat. Where specified, surfaces which will be in contact after site assembly shall receive a coat of paint (in addition to any shop priming) and shall be brought together while paint is still wet.

d) Where the steel has received a metal coating in the shop, this coating shall be completed on site so as to be continuous over any welds and site rivets and
bolts; but subject to the approval of Authority, protection may be completed by painting on site. Bolts which have been galvanized or similarly treated are exempted from this requirement.

e) Surfaces which will be inaccessible after site assembly shall receive the full specified treatment before assembly.

f) Site painting should not be done in frosty or foggy weather, or when humidity is such as to cause condensation on the surfaces to be painted.

1.6.10 Marking of Members

After checking and inspection, all members shall be marked for identification during erection. This mark shall correspond to distinguishing marks on approved erection drawings and shall be legibly painted and stamped on it. The erection mark shall be stamped with a metal dye with figures at least 20 mm high and to such optimum depth as to be clearly visible.

All erection marks shall be on the outer surface of all sections and near one end, but clear of bolt holes. The marking shall be so stamped that they are easily discernible when sorting out members. The stamped marking shall be encircled boldly by a distinguishable paint to facilitate easy location.

Erection marks on like pieces shall be in identical locations. Members having lengths of 7.0 m or more shall have the erection mark at both ends.

1.6.11 Errors

Any error in shop fabrication which prevents proper assembling and fitting up of parts in the field by moderate use of drift pins or moderate amount of reaming will be classified by the Engineer-in-Charge as defective workmanship. Where the Engineer-in-Charge rejects such material or defective workmanship, the same shall be replaced by materials and workmanship conforming to the Specifications by the Contractor, at no additional cost to department.
1.7 WATER SUPPLY AND SANITARY WORKS

1.7.1 Sanitary Installation

All sanitary appliances including sanitary fittings, fixtures, toilet requisites shall be of size, and design as approved by the Engineer-In-Charge.

All porcelain fixtures, such as washbasin, sink drain board, water closet pan, urinal, ‘P’ trap etc., shall have hard durable glazed finish. They shall be free from cracks and other glazing defects. No chipped porcelain fixtures shall be used. The colour and shades of fixtures must be got approved from department.

Joints between iron pipes shall be made perfectly air and watertight by lead caulking.

1.7.1.1 Indian Type Water Closet

This shall be the long pan pattern with separate footrests made of glazed earthenware, glazed vitreous china or of glazed fire clay. The general requirements shall conform to BIS: 2556 (Parts III and X). Pans shall be provided with 100 mm vitrious china trap ‘P’ or ‘S’ type with a minimum 50 mm water seal and 50 mm dia. Vent horn. Pan shall be laid at the correct location and level over a bed of cement-sand admixture. It shall be 1st quality WC, Orissa pan of size 580 mm x 440 mm.

1.7.1.2 European Type Water Closet

Water closets shall be of glazed vitreous china as specified and shall be of “Double Siphonic type” conforming to BIS:2556 (Part VIII). The closets shall be of one piece construction with approved plastic/bakelite seat and cover. Each water closet shall have 4 fixing holes having a minimum diameter of 6.5 mm for fixing to floor and shall have an integral flushing rim of suitable type.

1.7.1.3 Urinals

Urinals shall be of the bowl pattern, either flat back or angle back type lipped in front. They shall be of glazed vitreous china and of size 610 x 400 x 80 mm conforming to BIS 2556 (Part VI) with 25 mm dia. GI waste pipe coupling etc. The urinals shall be of one piece construction. Each urinal shall be provided with not less than two fixings holes of a minimum dia of 6.5 mm on each side. Each urinal shall have an integral flushing box rim of suitable type and inlet or supply horn for connecting the flush pipe. The flushing rim and inlet shall be of the self-draining type. It shall have a weep-hole at the flushing inlet of the urinal. At the bottom of the urinal, an outlet horn for connecting to an outlet pipe shall be provided. The exterior of the outlet horn shall not be glazed and the surface shall be provided with grooves at right angles to the axis of the outlet to facilitate fixing to the uniform and smooth throughout to ensure efficient flushing.
1.7.1.4 Flushing Cisterns
The flushing cisterns shall be automatic or manually operated, high level or low level, as approved by the Engineer-In-Charge. For water closets and urinals high level cistern is intended to operate with minimum height of 125 cm and a low level cistern a maximum height of 30 cm between the top of the pan and the underside of the cistern. They shall be of glazed vitreous china or of PVC as per BIS 774. Automatic flushing cistern for urinals shall conform to BIS 2326.

1.7.1.5 Wash Basins
a) Wash basins shall be of glazed vitreous china as approved by the Engineer-In-Charge and conforming to BIS 2556.

<table>
<thead>
<tr>
<th>Type</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat Back</td>
<td>630 x 450 mm</td>
</tr>
<tr>
<td>Flat Back</td>
<td>550 x 400 mm</td>
</tr>
</tbody>
</table>

b) Wash basins shall be of one piece construction, including a combined overflow. All internal angles shall be designed so as to facilitate cleaning. Each shall have rim sloping inside towards the bowl on all sides except skirting at the back. Basins shall be provided with single or double tap holes as approved. The tap holes shall be square. A suitable tap hole button shall be supplied if one tap hole is not required in installation. Each basin shall have a circular waste hole to which the interior of basin shall drain. The waste hole shall be either rebated or bevelled internally with diameter of 65 mm at top and a depth of 10 mm to suit a waste plug having 64 mm diameter. Each basin shall be provided with a non ferrous 32 mm waste fittings. Stud slots to receive the brackets on the under side of the wash basins shall be suitable for a bracket with stud not exceeding 13 mm diameter, 5 mm high and 305 mm from the back of basin to the centre of the stud. The stud slots shall be of depth sufficient to take 5 mm stud. Every basin shall have an integral soap holder recess or recesses which shall fully drain into the bowl. The position of the chain stay-hole shall not be lower than the overflow slot. A slot type of overflow having an area of not less than 5 sqcm shall be provided and shall be so designed as to facilitate cleaning of the overflow. The Department’s Requirements for waste plug, chain and stay shall be the same as given for sinks.

c) All the waste fittings shall be chromium plated, Bottle trap shall conform to BIS 5434. The chromium plating shall be of service grade No. 2 conforming to BIS 1068.

1.7.1.6 Sinks
a) The sinks shall be of glazed vitreous china as approved by the Engineer-In-Charge conforming to BIS 2556 (Part V) and shall be of the following sizes.

450 x 300 x 150 mm.
600 x 450 x 200 mm.
b) They shall be of one piece construction, including a combined overflow. The floor of the sink shall gently slope towards the outlet. The outlet shall in all cases be suitable for waste fitting having flange of 64 mm. diameter and the waste hole shall have a minimum diameter of 65 mm at the bottom to suit the waste fittings. The waste hole shall be either rebated or bevelled having a depth of 10 mm. Each sink shall be provided with a non-ferrous 40 mm dia. waste fitting. The sink shall have overflow of the weir type and the inverts shall be 30 mm below the top edge. Each sink shall be provided with a waste plug, of suitable dia. chain and stay. The plug shall be of rubber or other equally suitable material and shall be water tight when fitted. Plug chains shall be of brass wire chromium plated. It shall have an overall length from the collar to the stay of not less than 300 mm. There shall be a triangular or D shackle at each end, one of which shall be brazed to the plug and the other securely fixed to the stay. The 150 mm long shank of the waste shall be threaded conforming to the requirements of BIS 2556 for sinks only. The waste fittings and plug fittings shall be chromium plated. The chromium plating shall be of service grade No. 2 conforming to BIS. 1068.

1.7.1.7 Stop Cock and Bib Cock

A bibcock (bibtap) is a draw off tap with a horizontal inlet and free outlet and stopcock (stoptap) is a valve with a suitable means of connections for insertion in a pipeline for controlling or stopping the flow. They shall be of specified size and shall be of the screw down type. The closing device should work by means of a disc carrying a renewable non-metallic washer, which shuts against water pressure on a seating at right angles to the axis of the threaded spindle which operates it. The handle shall be either crutch or butterfly type securely fixed to the spindle. The cocks shall open in anti-clockwise direction. When the bib cocks and stop cocks are required to be chromium plated, the chromium plating shall be of service Grade No. 2 conforming to IS 1068 in finish and appearance, the plated articles shall be free from plating defects such as blisters, pits, roughness and shall not be stained or discoloured.

These fittings shall be of brass heavy class, chromium plated (C.P.) and of approved manufacture and pattern with screwed of flanged ends as specified. The fittings shall in all respects comply with the requirements of BIS 781. The standard size of brass fittings shall be designated by the nominal bore of the pipe to which the fittings are attached. A sample of each kind of fitting shall be approved by the Engineer in charge and all supplies made according to the approved samples.

All cast fittings shall be sound and free from laps, blow holes and fittings, both internal and external surfaces shall be clean, smooth and free from sand etc. Burning, plugging stopping or patching of the casting shall not be permitted. The bodies, bonnets, spindles and other parts shall be truly machined and when assembled the parts shall be axial, parallel and cylindrical with surfaces smoothly finished. The area of the water way of the fittings shall not be less than the area of the nominal bore.

The fittings shall be fully examined and cleared of all foreign matter before being fixed. The fittings shall be fitted in the pipeline in a workman like manner. The joints between fittings and pipes shall be made leak-proof. The joints and fitting shall be
leak proof when subjected to a pressure test approved by the Employer’s Representative and the defective fittings and joints shall be replaced or redone.

1.7.1.8 Cast Iron Soil Waste and Vent Pipes and Fittings
All cast iron pipes and fittings shall be of uniform thickness with strong and deep sockets, free from flaws, air holes, cracks, sand holes and other defects and conform to BIS 1536. The diameter approved shall be internal diameter of pipe. The pipes and fittings shall be true to shape, smooth and cylindrical and shall ring clearly when struck over with a light hand hammer. All pipes and fittings shall be properly cleaned of all foreign material before being fixed.

All plug bends of drainage pipes shall be provided with inspection and cleaning caps, covers, which shall be fixed with nuts and screws. Pipes shall be fixed to the wall by W.I. or M.S. holder bat clamps, unless projecting ears with fixing holes are provided at socket end of pipe. The clamps shall be fixed to the walls by embedding their hooks in cement concrete blocks (1:2:4) 10 cm x 10 cm making necessary holes in the walls at proper places. All holes and breakages shall be made good. The clamps shall be kept 25 mm clear of the finished face of the walls to facilitate cleaning and painting of pipes.

C.I. pipes and fittings which are exposed shall be first cleaned and then painted with a coat of red lead primer. Two coats of zinc paint with white base and mixed with pigment of required colour to get the approved shade shall be given over the base primer coat.

The thickness of fittings and their socket and spigot dimensions shall conform to the thickness and dimensions approved for the corresponding sizes of straight pipes.

The connection between the main pipe and branch pipes shall be made by using branches and bends with access for cleaning. Floor traps shall be provided with 25 mm dia puff pipe where the length of the waste is more than 1800 mm or the floor trap is connected to a waste stack through bends.

All cast iron pipes and fittings including joints shall be tested by a smoke test to the satisfaction of the Engineer-In-Charge and left in working condition after completion. The smoke test shall be carried out as stated under:

Smoke shall be pumped into the pipe at the lowest end from a smoke machine which consists of a bellow and a burner. The material usually burnt is greasy cotton waste which gives out a clear pungent smoke which is easily detectable by sight as well as by smell if there is a leak at any point of the pipeline.

Water test and air test shall be conducted as stipulated in BIS 5329.

1.7.1.9 Galvanised Mild Steel (G.I.) Pipes
The pipes shall be galvanised mild steel welded pipes and seamless screwed and sockets types conforming to the requirements of BIS 1239, for medium grade. They shall be of the diameter (nominal bore) approved. The sockets shall be designated by the respective nominal bores of the pipes for which they are intended. The pipes and sockets shall be finished neatly, well galvanised on both inner and outer surfaces, and
shall be free from cracks, surface flaws, laminations and other defects. All screws, threads shall be clean and well cut. The ends shall be cut cleanly and square with the axis of the tube.

All screwed tubes and sockets shall have pipe threads conforming to the requirements of BIS 554. Screwed tubes shall have taper threads while the sockets shall have parallel threads.

The fittings shall be of galvanised or mild steel types complying with all the appropriate requirements as approved for pipes. The fittings shall be designated by the respective nominal bores of the pipes for which they are intended. The fittings shall have screw threads at the ends conforming to the requirements of BIS 554. Female threads on fittings shall be parallel and male threads (except on running nipples and collars of unions) shall be tapered.

The pipes shall be cleaned and cleared of all foreign matter before being laid. In jointing the pipes, the inside of the socket and the screwed end of the pipes shall be oiled and rubbed over tight white lead and few turns of spun yarn wrapped around the screwed end of the pipe. The end shall then be screwed in the socket, tee, etc. with the pipe wrench. Care should be taken that all pipes and fittings are properly jointed so as to make the joints completely water tight and pipes are kept at all times free from dust and dirt during fixing. Burrs from the joint shall be removed after screwing. After laying, the open ends of the pipes shall be temporarily plugged to prevent access of soil or any other foreign matter.

Any threads exposed after jointing shall be painted or in the case of underground piping thickly coated with approved anticorrosive paint to prevent corrosion.

For internal work the galvanised iron pipes and fittings shall run the surface of the walls or ceiling (not in chase) unless otherwise specified. The fixing shall be done by means of standard pattern holder bat clamps, keeping the pipes about 1.5 cm clear of the wall. Pipes and fittings shall be fixed truly vertical/horizontal, when it is found necessary to conceal the pipes, chasing may be adopted or pipes fixed in the ducts of recesses etc. provided there is sufficient space to work on the pipes with the usual tools. The pipes shall not ordinarily be buried in walls or solid floors. Where unavoidable, pipes may be buried for short distances provided adequate protection is given against damage, but the joints in pipes shall not be buried. M.S. pipe sleeve shall be fixed at a place where a pipe is passing through a wall or floor for reception of the pipe and to allow freedom for expansion/contraction and the movements/maintenance. In case the pipe is embedded in walls or floors it should be painted with anti-corrosive bituminastic paint of approved quality. The pipe should not come in contact with lime mortar or lime concrete as the pipe is affected by lime. Under the floors the pipes shall be laid in layer of sand filling or as approved by the Engineer-In-Charge.

The work of excavation and backfilling shall be done true to line and gradient in accordance with general requirements for earthworks in trenches for pipes laid underground.
The pipes shall be laid on a layer of 10.0 cm sand and filled upto 15 cm above the pipes. A sand cushion of 15 cm on either side of the pipe shall also be provided. The remaining portion of the trench shall then be filled with excavated earth. The surplus earth shall be got rid of as directed. When excavation is done in rock the bottom shall be cut deep enough to permit the pies to be laid on a cushion of sand 75 mm minimum.

The pipes and fittings after they are laid and jointed shall be subjected to hydrostatic pressure test as approved by the Engineer-In-Charge and shall satisfactorily pass the test. Pipe line system shall be tested in sections as the work proceeds, keeping the joints exposed for inspection. Pipes shall be slowly and carefully charged with water allowing all air to escape. All draw off taps shall then be closed and water pressure gradually raised to test pressure. Care shall be taken to ensure that pressure gauge is accurate and preferably should have been recalibrated before the test. Pump used having been stopped, the section of the pipeline shall maintain the test pressure for at least half an hour. Any joints or pipes found leaking shall be removed and replaced by the Contractor.

The exposed pipes shall be painted with two coats of white paint over a ready mixed priming coat and all underground pipes should be painted with two coats of anti-corrosive bitumastic paint.

1.7.1.10 Soak Pit
Soak pit shall be constructed at the location specified by the Engineer-In-Charge. Earthwork excavation shall be carried out to the exact dimensions. Brick masonry lining with open joints shall be constructed in the pit upto 150 mm below the outlet pipeline. Brick in cement mortar 1:6 shall be constructed above this level upto ground. Well burnt brick aggregates of nominal size 40 mm to 80 mm and coarse sand shall be filled within the chamber. Construction of pit lining and filling of the brick ballast shall progress simultaneously.

1.7.1.11 Frame and Covers
Frame and covers for manholes shall be of required type and dimensions as per the relevant drawings prepared by the Contractor. The following information shall be clearly marked on each cover.

i) Year of Manufacture,
ii) Identification mark of the purchaser,
iii) Sewers/ Storm water drainage (SWD),
a) D.I. Cover
1.8  BUILDING WORK

1.8.1  BRICKWORK

1.8.1.1  Materials

Bricks used in the works shall conform to the requirements laid down in PWD Specification. Bricks shall be sound, hard, homogeneous in texture, well burnt in kiln without being vitrified, hand/ machine moulded, deep red, cherry or copper coloured, of regular shape and size and shall have sharp and square edges with smooth rectangular faces. The bricks shall be free from pores, cracks, flaws and nodules of free lime. They shall have smooth rectangular faces with sharp corners and shall be uniform in colour. Hand moulded bricks shall be moulded with a frog and those made by extrusion process may not be provided with a frog. Bricks shall give a clear ringing sound when struck.

Brick shall conform and be tested as per relevant PWD specification.

1.8.1.2  Preparation of mortar

   Materials

(i) Water:
Water used shall be clean and reasonably free from injurious or deleterious materials such as oils, acids, alkalis, and salts. Quality of water shall confirm to requirement of PWD specification for construction purposes.

Cement:
Minimum 43 Grade Ordinary Portland Cement shall be used and conform to the requirements of BIS:8112.

Sand :
Sand for masonry mortars shall confirm to BIS: 2116.

Mortars shall be prepared and tested as per BIS: 2250. Mixing of cement mortar shall be done in a mechanical mixer.
1.8.1.3 Workmanship

Workmanship of brickwork shall conform to BIS: 2212 / PWD specification. All bricks shall be thoroughly soaked in clear water for at least one hour immediately before being laid. The cement mortar for brick masonry work shall be as specified in the respective item of work prepared by the Contractor. Brick work 230 mm thick and over shall be laid in English Bond unless otherwise specified. 100mm/ 115mm thick brickwork shall be laid with stretchers. For laying bricks, a layer of mortar shall be spread over the full width of suitable length of the lower course. Each brick shall be slightly pressed into the mortar and shoved into final position so as to embed the brick fully in mortar. Only full size bricks shall be used for the works and cut bricks utilised only to make up required wall length or for bonding. Bricks shall be laid with frogs uppermost.

All brickwork shall be plumb, square and true to dimensions shown. Vertical joints in alternate courses shall come directly one over the other and be in line. Horizontal course shall be leveled. The thickness of brick courses shall be kept uniform. In case of one brick thick or half brick thick wall, at least one face should be kept smooth and plane, even if the other is slightly rough due to variation in size of bricks. For walls of thickness greater than one brick both faces shall be kept smooth and plane. All interconnected brickwork shall be carried out at nearly one level so that there is uniform distribution of pressure on the supporting structure and no portion of the work shall be left more than one course lower than the adjacent work. Where this is not possible, the work be raked back according to bond (and not saw toothed) at an angle not exceeding 45 deg. But in no case the level difference between adjoining walls shall exceed one meter. Brick work shall not be raised more than one meter per day.

Bricks shall be so laid that all joints are well filled with mortar. The thickness of joints shall not be less than 6 mm and not more than 10 mm. The face joints shall be raked to a minimum depth of 10 mm/ 15 mm by raking tools during the progress of work when the mortar is still green, so as to provide a proper key for the plastering/pointing respectively to be done later. When plastering or pointing is not required to be done, the joints shall be uniform in thickness and be struck flush and finished at the time of laying. The face of brickwork shall be cleaned daily and all mortar droppings removed. The surface of each course shall be thoroughly cleaned of all dirt before another course is laid on top.

During harsh weather conditions, newly built brick masonry works shall be protected by tarpaulin or other suitable covering to prevent mortar being washed away by rain.

Brickwork shall be kept constantly moist on all the faces for at least seven days after 24 hrs of laying. The arrangement for curing shall be got approved from the Engineer-in-Charge.

Double scaffolding having two sets of vertical supports shall be provided to facilitate execution of the masonry works. The scaffolding shall be designed adequately considering all the dead, live and possible impact loads to ensure safety of the workmen, in accordance with the requirements stipulated in BIS : 2750 and BIS : 3696 (Part - I). Scaffolding shall be properly maintained during the entire period of construction. Single scaffolding shall not be used on important works and will be permitted only in certain cases as decided by the Engineer-in-Charge. Where single
scaffolding is adopted, only minimum number of holes, by omitting a header shall be left in the masonry for supporting horizontal scaffolding poles. All holes in the masonry shall be carefully made good before plastering/pointing.

In the event of usage of traditional bricks of size 230 mm x 115 mm x 75 mm, the courses at the top of the plinth and sills as well as at the top of the wall just below the roof/floor slabs and at the top of the parapet shall be laid with bricks on edge.

All brickwork shall be built tightly against columns, floor slabs or other structural members.

To overcome the possibility of development of cracks in the brick masonry following measures shall be adopted.

For resting RCC slabs, the bearing surface of masonry wall shall be finished on top with 12 mm thick cement mortar 1:3 and provided with 2 layers of Kraft paper Grade 1 as per BIS: 1397 or 2 layer of 50 micron thick polyethylene sheets.

RCC/steel beams resting on masonry wall shall be provided with reinforced concrete bed blocks of 150 mm thickness, projecting 150mm on either sides of the beam, duly finished on top with 2 layer of Kraft paper Grade 1 as per BIS: 1397 or 2 layers of 50 micron thick polyethylene sheets.

Steel wire fabric shall be provided at the junction of brick masonry and concrete before taking up plastering work.

Bricks for partition walls shall be stacked adjacent to the structural member to pre deflect the structural member before the wall is taken up for execution. Further, the top most course of half or full brick walls abutting against either a de shuttered slab or beam shall be built only after any proposed masonry wall above the structural member is executed to cater for the deflection of the structural element.

Reinforced cement concrete transomes and mullions of dimensions as indicated in the construction Drawings to be prepared by the Contractor are generally required to be provided in the half brick partition walls.

Where the drawings prepared by the Contractor indicate that structural steel sections are to be encased in brickwork, the brickwork masonry shall be built closely against the steel section, ensuring a minimum of 20 mm thick cement-sand mortar 1:4 over all the steel surfaces. Steel sections partly embedded in brickwork shall be provided with bituminous protective coating to the surfaces at the point of entry into the brick masonry.

### 1.8.2 Uncoursed Random Rubble Masonry, in Foundation Plinth and Superstructure

#### 1.8.2.1 Materials

Stones for the works shall be of the specified variety which are hard, durable, fine grained and uniform in colour (for superstructure work) free from defects like cracks, sand holes, patterns of soft/loose materials veins, other defects. Quality and work shall conform to the requirements specified in BIS: 1597 (Part-I). The percentage of water absorption shall not exceed 5 percent as per test conducted in accordance with BIS: 1124. The Contractor shall supply sample stones to the Engineer-in-Charge for approval. Stones shall be laid with its grains horizontal so that
the load transmitted is always perpendicular to the natural bed.
Cement-stand mortar for stone masonry works shall be as per BIS: 2250.

1.8.2.2 Scaffolding
Type of scaffolding to be used shall be as specified in the section of brick masonry.

1.8.2.3 Workmanship

For all works below ground level the masonry shall be random rubble uncoursed with ordinary quarry dressed stones for the hearting and selected quarry dress stones for the facing.

For all R.R. masonry in superstructure the masonry shall be well bounded, faced with hammer dressed stones with squared quoins at corners. The bushing on the face shall not be more that 40 mm on an exposed face and on the face to be plastered it shall not project by more than 12 mm nor shall it have depression more than 10mm from the average wall surface.

Face stones shall extend back sufficiently and bond well with the masonry. The depth of stone from the face of the wall inwards shall not be less than the height or breadth at the face. The length of the stone shall not exceed three times the height and the breadth on base shall not be greater than three-fourths the thickness of wall nor less than 150 mm. The height of stone may be upto a maximum of 300 mm. Face stones or hearting stones shall not be less than 150 mm in any direction.

Chips and spalls shall be used wherever necessary to avoid thick mortar joints and to ensure that no hollow spaces are left in the masonry. The use of chips and spalls in the herating shall not exceed 20 percent of the quantity of stone masonry. Spalls and chips shall not be used on the face of the wall and below hearting stones to bring them to the level of face stones.

The maximum thickness of joints shall not exceed 20 mm. All joints shall be completely filled with mortar. When plastering or pointing is not required to be done, the joints shall be struck flush and finished as the work proceeds. Otherwise, the joints shall be raked to a minimum depth of 20 mm by a raking tool during the progress of the work while the mortar is still green.

Through or bond stones shall be provided in wall upto 600 mm thick and in case of wall above 600mm thickness, a set of two or more bond stones overlapping each other by at least 150mm shall be provided in a line from face to back. Each bond stone or a set of bond stones shall be provided for every 0.5 sq.m of wall surface.

All stones shall be sufficiently wetted before laying to prevent absorption of water from the mortar. All connected walls in a structure shall be normally raised uniformly and regularly. However if any part of the masonry is required to be left behind, the wall shall be raked back (and not saw toothed) at an angle not exceeding 45 deg. Masonry work shall not be raised by more than one metre per day.

Green work shall be protected from rain by suitable covering. Masonry work shall be kept constantly moist on all the faces for a minimum period of seven days for proper curing of the joints.
1.8.3 Coursed Rubble Masonry (First Sort) for Superstructure

1.8.3.1 Materials

The materials specification for the work shall be as specified in the section of random rubble masonry above.

1.8.3.2 Scaffolding

Type of scaffolding to be used shall be as specified in the section of brick masonry.

1.8.3.3 Workmanship

All Courses shall be laid truly horizontal and shall be of the same height in any course. The height of course shall not be less than 150mm and not more than 300mm. The width of stone shall not be less than its height. Face stones shall tail into the work for not less than their height and at least 1/3rd the number of stones shall tail into the work for a length not less than twice their height but not more than three-fourths the thickness of the wall whichever is smaller. These should be laid as headers and stretchers alternately to break joints by at least 75mm. The face stones shall be squared on all joints and bed; the bed joints being hammer or chisel dressed true and square for at least 80 mm back from the face and the side joints for at least 40 mm. The face of the stone shall be hammer dressed so that the bushing shall not be more than 40mm on an exposed face and 10mm on a face to the plastered. No portion of the dressed surface shall show a depth of gap more than 6mm from a straight edge placed on it. The remaining unexposed portion of the stone shall not project beyond the surface of bed and side joints.

No spalls or pinning shall be allowed on the face. All bed joints shall be horizontal and side joints shall be vertical and no joints shall be more than 10mm in thickness. When plastering or pointing is not required to be done, the joints shall be struck flush and finished as the work proceeds. Otherwise, the joints shall be raked to a minimum depth of 20mm by raking tools, during the progress of the work while the mortar is still green.

Hearting shall consist of flat bedded stones carefully laid on their proper beds and solidly bedded in mortar. The use of chips shall be restricted to the filling of interstices between the adjacent stones in hearting and these shall not exceed 10 percent of the quantity of the stone masonry. Care shall be taken so that no hollow spaces are left any where in the masonry.

The requirement regarding through or bond stones shall be as specified in clause with the further stipulation that these shall be provided at 1.5m to 1.8m apart clear in every course but staggered at alternate courses.

The quoins, which shall be of the same height as the course in which they occur, shall not be less than 450mm in any direction. Quoin stones shall be laid as stretchers and headers alternately. They shall be laid square on their beds, which shall be rough chisel dressed to a depth of at least 100mm from the face. These stones shall have a minimum uniform chisel draft of 25mm width at four edges, all the edges being in the same plane.
1.8.4 Damp-proof Course

1.8.4.1 Materials and Workmanship

All the walls in a building shall be provided with damp-proof course covering plinth to prevent water from rising up the wall. The damp-proof course shall run without a break throughout the length of the wall, even under the door or other opening. Damp-proof course shall consist of minimum 50mm thick cement concrete of 1:2:4 nominal mix with nominal reinforcement and approved water-proofing compound admixture conforming to BIS: 2645 in proportion as directed by the manufacturer. Concrete shall be with 10mm down graded course aggregates.

The surface of brick work/stone masonry work shall be leveled and prepared before laying the cement concrete. Side shuttering shall be properly fixed to ensure that slurry does not leak through and is also not disturbed during compaction. The upper and side surface shall be made rough to afford key to the masonry above and to the plaster. Damp-proof course shall be cured properly for at least seven days after which it shall be allowed to dry for taking up further work.

1.8.5 Miscellaneous Inserts, Bolts etc.

All the miscellaneous inserts such as bolts, pipes, plate embedment etc., shall be accurately installed in the building works at the correct location and levels, all as detailed in the construction drawings to be prepared by the Contractor. Contractor shall prepare and use templates for this purpose, if so directed by the Engineer-in-Charge. In the event, of any of the inserts are improperly installed, contractor shall make necessary arrangement to remove and reinstall at the correct locations/levels all as directed by the Engineer-in-Charge.

1.8.6 Wood work in doors, Windows, Ventilators & partitions

Timber to be used shall be first class Teak wood as per BIS: 4021. Timber shall be of the best quality and well seasoned by the suitable process before being planed to the required sizes. The maximum permissible moisture content shall be from 10 to 16 percent for timber 50mm and above in thickness and 8 to 14 percent for timber less than 50mm in thickness for different regions of the country as stipulated in BIS: 287. Timber shall be close grained, of uniform colour and free from decay, fungal growth, boxed heart, pitch pockets of streaks on the exposed edges, borer holes, splits and cracks. Flush door shutters of the solid core type with plywood face panel shall conform to BIS: 2202 (Part-1).

Transparent sheet glass conform to the requirements of BIS: 2835 or BIS: 2553 (Part-1). Wired and figured glass shall be as per BIS: 5437. Builder’s hardware for fittings and fixtures shall be of the best quality from approved manufacturers. Each wooden door shutter shall have a minimum of three hinges and two fastenings like tower bolt, handle and latches, mortise lock etc. floor stoppers, handles, kick plates etc. shall also be provided. Each window shutter shall have minimum of 3 hinges and one fastening like tower bolt and one handle for opening and closing.

1.8.7 Steel Doors, Windows and Ventilators
Hot rolled steel sections for the fabrication of steel doors, windows and ventilators shall conform to BIS: 7452 which are suitable for single glazing.

Pressed steel door frames for steel flush doors shall be out of 1.25mm thick mild steel sheets of profiles as per BIS: 4351.

Transparent sheet glass shall conform to the requirements of BIS: 2835. Wired and figured glass shall be as per BIS: 5437.

Builder’s hardware of fittings and fixtures shall be of the best quality from the approved manufacturers.

Hot rolled sections shall confirm to BIS 7452 Fire check doors shall conform to BIS: 3614 Part 1 & 2. Steel windows for industrial buildings shall confirm to BIS 1361.

All steel doors, windows and ventilators shall be of the type as specified in the respective items of work prepared by the Contractor and of sizes as indicated in the Drawings prepared by the contractor. Steel doors, windows and ventilators shall conform to the requirements as stipulated in BIS: 1038. Steel windows shall conform to BIS: 1361 if so specified.

1.8.8 Aluminium Doors, Windows, Ventilators & Partitions

1.8.8.1 Materials

Aluminium alloy used in the manufacturer of extruded sections of the fabrication of doors, windows, ventilators shall conform to designation HE9-WP of BIS: 733.

Transparent sheet glass shall conform to the requirements of BIS: 2835. Wired and figured glass shall be as per BIS: 5437.

All Aluminium doors, windows, ventilators and partitions shall be of the type and size as specified. The doors, windows, ventilators shall conform to the requirements of BIS: 1948. Aluminium windows shall conform to BIS: 1949; if so specified.

All Aluminium units shall be supplied with anodized finish, the minimum anodic film thickness shall be 0.015mm.

Doors windows and ventilators shall be of an approved manufacture. Fabrication of the units shall be with the extruded sections, cut to correct lengths, mitred and welded at the corners to a true right angle conforming to the requirements of BIS: 1948. Tolerance in overall dimensions shall be within ± 1.5 mm. The frames and shutters shall be free from warp or buckle and shall be square and truly plane. Punching of holes, slots and other provisions to install fittings or fixtures later shall be made at the correct locations, as per the requirements.

Aluminium swing type doors, Aluminium sliding windows, partitions shall be as specified.
BIS:1948 and BIS :1949 referred to incorporates the sizes, shapes, thickness and weight per running metre of extruded sections for the various components of the units. However, new sizes, shapes, thickness with modifications to suit snap-fit glazing clips etc. are being continuously being added by various leading manufacturers of extruded sections, which are available in the market. as such, the sections of the various components of the unit proposed by the Contractor, will be reviewed by the Engineer-in-Charge and will be accepted only if they are equal to or marginally more than that given in the codes/ad specified.

The framework of partitions with mullions and transomes shall be with anodised aluminium box sections. Anodised aluminium box sections shall be in-filled with timber of class 3 (silver oak or any other equivalent) as per BIS : 4021. The outer frame shall be of size 101.6 x 44.45 x 3.11mm rectangular tubular section and the shutter shall be made out of specially extruded tubular section of size for sill member shall be 99.2 x 44.45 x 3.18mm including glazing of 5.5 mm thick plain glass PVC/Neoprene weather stripping screwless aluminium bidding fixer such as lock, handle, tower bolt and self closing device of approved make. Panels of double / single glazing/plywood shall be fixed as per details indicated in the Drawing to be prepared by the Contractor. Partitions shall be fixed rigidly between the floor and the structural columns/beams including provision of necessary shims for wedging etc. Finished work shall be of rigid construction, erected truly plumb to the lines and levels, at locations as per the construction Drawings to be prepared by the contractor.

Specific provisions as stipulated for steel doors, windows, ventilators under clause 7.6 shall also be applicable for this item work. Glazing beads shall be of the snap-fit type suitable for the thickness of glazing proposed as indicated in the items of works prepared by the contractor. a layer of clear transparent lacquer shall be applied on aluminium sections to protect them from damage during installation. This lacquer coating shall be removed after the installation is completed.

1.8.9 Steel Rolling Shutters
Rolled shutters shall be of an approved manufacture, conforming to the requirements specified in BIS: 6248.

The type of rolling shutter shall be self coiling type (manual) for clear areas upto 12 sq.m, gear operated type (mechanical) for clear areas upto 35 sq.m and electrically operated type for areas upto 50 sq.m. mechanical type of rolling shutters shall be suitable for operation from both inside and outside with the crank handle or chain gear operating mechanism duly considering the size of wall/column. Electrical type of rolling shutter shall also be provided with a facility for emergency mechanical operation.

Rolling shutters shall be supplied duly considering the type, specified clear width/height of the opening and the location of fixing as indicated in the Drawings prepared by the Contractor.

Rolling shutters of approved make, made of 80 x 1.25mm MS laths interlocked together through their entire length and jointed together at the end by end locks mounted on specially designed pipe shaft with brackets, side guides and arrangements
for inside and outside locking with mechanical device chain and crank operation for
operating rolling shutters exceeding 10.00 Sqm including spring hooks, providing and
fixing necessary 25.3 cm long wire springs grade No.2 and MS top cover 1.25 mm
thick (RS). Shutters shall be built up of interlocking laths 75mm width between
rolling centres formed from cold rolled steel strips. The thickness of the steel strip
shall not be less than 0.90mm for shutters upto 3.50m width and not less than 1.20mm
for shutters above 3.50m width. Each lath section shall be continuous single piece
without any welded joint.

1.8.10 Flooring

1.8.10.1 Base Concrete

The thickness and grade of concrete and reinforcement shall be as specified in items
of works prepared by the Contractor.

Before placing the blinding concrete, the sub-base of rubble packing shall be properly
wetted and rammed. Concrete for the base shall then be deposited between the forms,
thoroughly tamped and surface finished level with the top edges of the forms. Two or
three hours after the concrete has been laid in position, the surface shall be roughened
using steel wire brush to remove any scum or laitance and swept clean so that the
course aggregates are exposed. The surface of the base concrete shall be left rough to
provide adequate bond for the floor finish to be provided later.

1.8.10.2 Terrazzo Tile flooring

Terrazzo tiles shall generally conform in all respects to standards stipulated in BIS :
1237. Tiles shall be of the best quality manufactured adopting hydraulic pressure of
not less than 14 N/mm².
The type, quality, size, thickness, colour etc., of the tiles for flooring/dado/skirting
shall be as specified.

The aggregates for terrazzo topping shall consist of marble chips which are hard,
sound and dense. Cement to be used shall be white cement with light colouring
pigments. The bidder mix shall be with 3 parts of cement to 1 part of marble powder
by weight. The proportion of cement shall be inclusive of any pigments. For every
one part of cement -marble powder binder mix, the proportion of aggregates shall be
1.75 parts by volume, if the chips are between 1 mm to 6 mm and 1.50 parts by
volume if the chips are between 6 mm to 25 mm.

The minimum thickness of wearing layer of terrazzo tiles shall be 5 mm for tiles with
chips of size varying from 1 mm upto 6 mm or from 1 mm upto 12 mm. This shall be
6 mm for tiles with chips varying from 1 mm upto 25 mm. The minimum thickness of
wearing layer of cement /coloured cement tiles shall be 5 mm. This shall be 6 mm for
heavy duty tiles. Pigment used in the wearing layer shall not exceed 10 percent of the
weight of cement used in the mix.

Laying and finishing of tiles shall conform to the requirements of workmanship
stipulated in BIS :1443.
Tiling work shall be commenced only after the door and window frames are fixed and plastering of the walls/ceiling is completed. Tiles which are fixed to the floor adjoining the wall shall go 10 mm under the plaster. Wall plastering shall not be carried out upto about 50 mm above the level of proposed skirting /dado.

1.8.10.3      Kota Stone Slab Work
1.8.10.3.1    Materials

The slab shall be of approved selected quality, hard, sound, dense and homogeneous 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 BIS: 1124.

The slabs shall be hand or machine cut to the required thickness. Tolerance in thickness for dimensions of tile more than 100mm shall be ± 5mm. This shall be ± 2 mm on dimensions less than 100 mm.

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.

1.8.10.3.2    Workmanship

The type, size, thickness and colour/shade etc. of the slabs for flooring/dado/skirting shall be as specified in the respective items of works prepared by the Contractor.

The thickness of the slabs for dado/skirting work shall not be more than 25mm. Slabs shall be so placed that the back surface is at a distance of 12 mm. If necessary, slabs shall be held in position temporarily by suitable method. After checking for verticality, the gap shall be filled and packed with cement sand mortar of proportion 1:3. After the mortar has acquired sufficient strength, the temporary arrangement holding the slab shall be removed.

1.8.10.4      Glazed Tile Finish

Glazed earthenware tiles shall conform to the requirements of BIS: 777. 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 BIS: 777.

The total thickness of glazed tile finish including the bedding mortar shall be 20 mm in flooring /dado/skirting. The minimum thickness of bedding mortar shall be 12 mm for flooring and 10 mm for dado/skirting work.
The bedding mortar shall consist of 1 part of cement to 3 parts of sand mixed with just sufficient water to obtain proper consistency for laying. Sand for the mortar shall conform to BIS:2116 and shall have minimum fineness modulus of 1.5.

Tiles shall be soaked in water for about 10 minutes just before laying. Where full size tiles cannot be fixed, tiles shall be cut to the required size using special cutting device and the edges rubbed smooth to ensure straight and true joints.

All the joints shall be cleaned of gray cement with wire brush to a depth of at least 3 mm and all dust, loose mortar etc. shall be removed. White cement with or without pigment shall then be used for flush pointing the joints. Curing shall then be carried out for a minimum period of 7 days of the bedding and joints to set properly. The surface shall then be cleaned using a suitable detergent, fully washed and wiped dry.

1.8.10.5 PVC Sheet/Tile Flooring

PVC floor covering shall be of either unbacked homogeneous flexible type in the form of sheets/tiles conforming to BIS :3462 or homogeneous PVC asbestos tiles conforming to BIS : 3461.

The surface of the sheet/tiles shall be free from any physical defects such as pores, blisters, cracks etc. which affects the appearance and serviceability. Tiles /sheets shall meet with the tolerance limits in dimensions specified in the BIS. Contractor shall submit the test certificates, if so desired by the Engineer-in-Charge.

Each tile/sheet shall be legible and indelibly marked with the name of the manufacturer or his trade mark, BIS certificate mark, and batch number.

The adhesive to be used for laying the PVC flooring shall be rubber based and of the make as recommended and approved by the manufacturer of PVC sheets/tiles.

PVC Floor covering shall be provided over an underbed of cement concrete floor finish over the base concrete or structural slab. It is essential that the sub-floor and the underbed are perfectly dry before laying the PVC flooring. This shall be ensured by methods of testing as stipulated in Appendix -A of BIS :5318.

The surface of the underbed shall have trowelled finish without any irregularities which creates poor adhesion. Surface shall be free of oil or grease and thoroughly cleaned of all dust, dirt and wiped with a dry cloth.

PVC sheets/tiles shall be brought to the temperature of the area in which they are to be laid by stacking in a suitable manner within or near the laying area for a period of about 24 hours. Where air-conditioning is installed, the flooring shall not be laid on the underbed until the A/C units have been in operation for at least 7 days. During this period, the temperature range shall be between 20 deg. C and 30 deg. C and this shall be maintained during the laying operations and also for 48 hours thereafter.

Metallic edge strips shall be used to protect the edges of PVC sheets/tiles which are exposed as in doorways/stair treads.

Hot sealing of joints between adjacent PVC sheet flooring to prevent creeping of water through the joints shall be carried out, using special equipment as per manufacturer’s instructions.
1.8.10.6  Granite Topping

Floor Hardener topping shall be provided either as integrally finished over the structural slab/grade slab or laid monolithically with the concrete/granolithic floor finish on top of hardened concrete base of 40mm thickness.

Floor hardener of the metallic or non-metallic type suitable for the performance of normal/medium/heavy duty function of the floor, the quantum of ingredients and the thickness of topping shall be as specified in the respective items of work prepared by the contractor.

For monolithic application with the floor finish/slab the thickness of the layer shall be 12mm. The topping shall be laid within 2 to 3 hours after concrete is laid when it is still plastic but stiffened enough for the workmen to tread over it by placing planks. The surface for the concrete layer shall be kept rough for providing adequate bond for the topping. Laitance shall be removed before placing the topping. The topping shall be screed and thoroughly compacted to the finished level. Trowelling to smooth finish also to be carried out. After the surface has hardened sufficiently, it shall be kept continuously moist for atleast 10 days.

The procedure for mixing the floor hardener topping shall be as per manufacturer's instructions.

Surface shall be prevented from any damages due to subsequent building operations by covering with 75 mm thick layer of sand.

1.8.10.7  Acid Resisting Brick / Tiling Work

The ceramic unglazed vitreous acid resisting tiles shall conform to the requirements of BIS: 4457. Acid resistant bricks shall conform to the requirements of BIS: 4860.

The finished tile/brick when fractured shall appear fine grained in texture, dense and homogeneous. Tile/brick shall be sound, true to shape, flat, free from flaws and any manufacturing defects affecting their utility. Tolerance in dimensions shall be within the limits specified in the respective BIS.

The tiles/bricks shall be bedded and jointed using chemical resistant mortar of the resin type conforming to BIS: 4832 (Part II). Method of usage shall generally be as per the requirements of BIS: 4443.

The mortar joints shall be cured for a minimum period of 72 hours with 20 to 25% hydrochloric acid or 30 to 40% sulphuric acid. After acid curing, the joints shall then be washed with water and allowed to thoroughly dry. The joints shall then be filled with mortar to make them smooth and plane. Acid curing is not required to be carried out if epoxy or polyester and furane type of resin is used for the mortar.

Resin mortars are normally self curing. The area tiled shall not be put to use before 48 hours in case epoxy, polyester and furane type of resin is used for the mortar. If phenolic or cashew nut shell liquid resin is used for the mortar, the area tiled shall not be put to use for 7 to 28 days respectively, without heat treatment. This period shall be 2 to 6 days respectively, if heat treatment is given with infrared lamp.
1.8.11 Epoxy Lining Work

The epoxy resin and hardener formulation for laying of joint less lining work in floors and walls of concrete tanks/trenches etc. shall be as per the requirements of BIS : 9197.

1.8.12 Cement Plastering Work

The proportions of the cement mortar for plastering shall be 1:4 (one part of cement to four parts of sand). Cement and sand shall be mixed thoroughly in dry condition and then just enough water added to obtain a workable consistency. The quality of water and cement shall be as per relevant BIS standards. The quality and grading of sand for plastering shall conform to BIS : 1542.

Preparation of surfaces and application of plaster finishes shall generally conform to the requirements specified in BIS: 1661 and BIS: 2402.

Plastering operations shall not be commenced until installation of all fittings and fixtures such as door/ window panels, pipes, conduits etc. are completed.

All joints in masonry shall be raked as the work proceeds to a depth of 10 mm / 20mm for brick/ stone masonry respectively with a tool made for the purpose when the mortar is still green. The masonry surface to be rendered shall be washed with clean water to remove all dirt, loose materials, etc., Concrete surfaces to be rendered shall be roughened suitably by hacking or bush hammering for proper adhesion of plaster and the surface shall be evenly wetted to provide the correct suction. The masonry surfaces should not be too wet only damp at the time of plastering. The dampness shall be uniform to get uniform bond between the plaster and the masonry surface.

a) Interior plain faced plaster

This plaster shall be laid in a single coat of 20 mm thickness. The mortar shall be dashed against the prepared surface with a trowel. The dashing of the coat shall be done using a strong whipping motion at right angles to the face of the wall or it may be applied with a plaster machine. The coat shall be trowelled hard and tight forcing it to surface depressions to obtain a permanent bond and finished to smooth surface. Interior plaster shall be carried out on jambs, lintel and sill faces, etc. as shown in the drawing and as directed by the Engineer-in-Charge.

b) Plain Faced Ceiling plaster

This shall be applied in a single coat of 6 mm thickness. Application of mortar shall be as stipulated in above paragraph.

1.8.13 Water-Proofing Admixtures
Water-proofing admixtures shall conform to the requirements of BIS : 2645 and shall be of approved manufacture. The admixture shall not contain calcium chloride. The quantity of the admixture to be used for the works and method of mixing etc. shall be as per manufacturer’s instructions and as directed by the Engineer-in-Charge.

1.8.14 Painting of Concrete, Masonry & Plastered Surfaces

1.8.14.1 Materials

Oil bound distemper shall conform to BIS : 428. The primer shall be alkali resistant primer of the same manufacture as that of the distemper.

Lead free acid, alkali and chlorine resisting paint shall conform to BIS: 9862.

Colour wash shall be made by addition of a suitable quantity of mineral pigment, not affected by lime, to the prepared white wash to obtain the shade/ tint as approved by the Engineer-in-Charge.

All the materials shall be of the best quality from an approved manufacturer. Contractor shall obtain prior approval of the Engineer-in-Charge for the brand of manufacture and the colour/ shade. All materials shall be brought to the site of works in sealed containers.

1.8.14.2 Workmanship

Contractor shall obtain the approval of the Engineer-in-Charge regarding the readiness of the surfaces to receive the specified finish, before commencing the work on painting. Painting of new surfaces shall be deferred as much as possible to allow for thorough drying of the sub-strata.

The surfaces to be treated shall be prepared by thoroughly brushing them free from dirt, mortar droppings and any loose foreign materials. Surfaces shall be free from oil, grease and efflorescence. Efflorescence shall be removed only by dry brushing of the growth. Cracks shall be filled with Gypsum. Workmanship of painting shall generally conform to BIS : 2395.

1.8.14.3 White Wash

The prepared surfaces shall be wetted and the finish applied by brushing. The operation for each coat shall consist of a stroke of the brush first given horizontally from the right and the other from the left and similarly, the subsequent stroke from bottom upwards and the other form top downwards, before the first coat dries. Each coat shall be allowed to dry before the next coat is applied. Minimum of 2 coats shall be applied unless otherwise specified. The dry surface shall present a uniform finish without any brush marks.
1.8.14.4 Colour Wash

Colour wash shall be applied in the same way as for white wash. A minimum of 2 coats shall be applied unless otherwise specified. The surface shall present a smooth and uniform finish without any streaks. The finished dry surface shall not show any signs of peeling/ powdery and come off readily on the hand when rubbed.

1.8.14.5 Cement Paint

The prepared surfaces shall be wetted to control surface suction and to provide moisture to aid in proper curing of the paint. Cement paint shall be applied with a brush with stiff bristles. The primer coat shall be a thinned coat of cement paint. The quantity of thinner shall be as per manufacturer’s instructions. The coats shall be vigorously scrubbed to work the paint into any voids for providing a continuous paint film free form pinholes for effective water proofing in addition to decoration. Cement paint shall be brushed in uniform thickness and the covering capacity for two coats on plastered surfaces shall be 3 to 4 kg/ sq.m. A minimum of 3 coats of the same colour shall be applied. Atleast 24 hours shall be left after the first coat to become sufficiently hard before the second coat is applied. The painted surfaces shall be thoroughly cured by sprinkling with water using a fog spray at least 2 to 3 times a day. Curing shall commence after about 12 hours when the paint hardens. Curing shall be continued for atleast 2 days after the application of final coat. The operations for brushing each coat shall be as detailed above.

1.8.14.6 Oil bound Distemper

The prepared surfaces shall be dry and provided with one coat of alkali resistant primer by brushing. The surface shall be finished uniformly without leaving any brush marks and allowed to dry for atleast 48 hours. A minimum of two coats of oil bound distemper shall be applied, unless otherwise specified. The first coat shall be of a lighter tint. Atleast 24 hours shall be left after the first coat to become completely dry before the application of the second coat. Broad, stiff, double bristled distemper brushed shall be used for the work. The operations for brushing each coat shall be as detailed above.

1.8.14.7 Acid, Alkali Resisting Paint

A minimum of 2 coats of acid/ alkali resisting paint shall be applied over the prepared dry surfaces by brushing. Primer coat shall be as per manufacturer’s instructions.

1.8.14.8 Acrylic Emulsion Paint

Acrylic emulsion paint shall be applied in the same way as for plastic emulsion paint. A minimum of 2 finishing coats over one coat of primer shall be provided unless otherwise specified.

1.8.15 Painting & Polishing of Wood Work
1.8.15.1 Materials

- Wood primer shall conform to BIS : 3536
- Filler shall conform to BIS : 110
- Varnish shall conform to BIS : 337
- French polish shall conform to BIS : 348
- Synthetic enamel paint conform to BIS : 2932

All the materials shall be of the best quality from an approved manufacturer. Contractor shall obtain prior approval of the Engineer-in-Charge for the brand of manufacture and the colour/shade. All materials shall be brought to the site of works in sealed containers.

1.8.15.2 Workmanship

The type of finish to be provided for woodwork of either painting or polishing, the number coats, etc. shall be as specified in the respective items of work to be prepared by the Contractor.

Primer and finish paint shall be compatible with each other to avoid cracking and wrinkling. Primer and finish paint shall be from the same manufacturer.

Painting shall be either by brushing or spraying. Contractor shall procure the appropriate quality of paint for this purpose as recommended by the manufacturer. The workmanship shall generally conform to the requirements of BIS : 2338 (Part I).

All the wood surfaces to be painted shall be thoroughly dry and free from any foreign matter. Surfaces shall be smoothened with abrasive paper using it across the grains and dusted off. Wood primer coat shall then be applied uniformly by brushing. The number of primer coats shall be as specified in the item of work to be prepared by the Contractor. Any slight irregularities of the surface shall then be made up by applying an optimum coat of filler conforming to BIS : 110 and rubbed down with an abrasive paper for obtaining a smooth surface for the undercoat of synthetic enamel paint conforming to BIS : 2932. Paint shall be applied by brushing evenly and smoothly by means of crossing and laying off in the direction of the grain of wood. After drying, the coat shall be carefully rubbed down using very fine grade of sand paper and wiped clean before the next coat is applied. At least 24 hours shall elapse between the application of successive coats. Each coat shall vary slightly in shade and this shall be got approved by the Engineer-in-Charge. The number of coats of paint to be applied shall be as specified in the item of work to be prepared by the Contractor.

All the wood surfaces to be provided with clear finishes shall be thoroughly dry and free from any foreign matter. Surfaces shall be smoothened with abrasive paper using it in the direction of the grains and dusted off. Any slight irregularities of the surface shall be made up by applying an optimum coat of transparent liquid filler and rubbed down with an abrasive paper for obtaining a smooth surface. All dust and dirt shall be thoroughly removed. Over this prepared surface, varnish conforming to BIS : 337 shall be applied by brushing. Varnish should not be retouched once it has begun to set. Staining if required shall be provided as directed by the Engineer-in-Charge. When two coats of varnish is specified, the first coat should be a hard-drying undercoat or flatting varnish which shall be allowed to dry hard before applying the finishing coat.
The number of coats to be applied shall be as specified. For works where clear finish of French polish is specified the prepared surfaces of wood shall be applied with the polish using a pad of woollen cloth covered by a fine cloth. The pad shall be moistened with polish and rubbed hard on the surface in a series of overlapping circles to give an even finish over the entire area. The surface shall be allowed to dry before applying the next coat. Finishing shall be carried out using a fresh clean cloth over the pad, slight dampening with methylated spirit and rubbing lightly and quickly in circular motions. The finished surface shall have a uniform texture and high gloss. The number of coats to be applied shall be as specified.

1.8.16 Painting of Steel Work

1.8.16.1 Materials

- Zinc chrome primer shall conform to BIS : 2074
- Synthetic enamel paint shall conform to BIS : 2932
- Aluminium paint shall conform to BIS : 2339

All the materials shall be of the best quality from an approved manufacturer. Contractor shall obtain prior approval of the Engineer-in-Charge for the brand of manufacture and the colour/ shade. All the materials shall be brought to the site in sealed containers.

1.8.16.2 Workmanship

Painting work shall be carried out only on thoroughly dry surfaces. Painting shall be applied either by brushing or by spraying. Contractor shall procure the appropriate quality of paint for this purpose as recommended by the manufacturer. The workmanship shall generally conform to the requirement of BIS : 1477 (Part 2).

The type of paint, number of costs etc. shall be as specified in the respective items of work.

Primer and finish paint shall be compatible with each other to avoid cracking and wrinkling. Primer and finish paint shall be from the same manufacturer.

All the surfaces shall be thoroughly cleaned of oil, grease, dirt, rust and scale. The methods to be adopted using solvents, wire brushing, power tool cleaning etc., shall be as per BIS: 1477 (Part - I) and as indicated in the item of work.

It is essential to ensure that immediately after preparation of the surfaces; the first coat of red oxide-zinc chrome primer shall be applied by brushing and working it well to ensure a continuous film without holidays. After the first coat becomes hard dry, a second coat of primer shall be applied by brushing to obtain a film free from ‘holidays’. After the second coat of primer is hard dry, the entire surface shall be wet rubbed cutting down to a smooth uniform surface. When the surface becomes dry, the under coat of synthetic enamel paint of optimum thickness shall be applied by brushing with minimum of brush marks. The coat shall be allowed to hard-dry. The under coat shall then be wet rubbed cutting down to a smooth finish, taking adequate care to ensure that at no place the undercoat is completely removed. The surface shall then be allowed to dry.
The first finishing coat of paint shall be applied by brushing and allowed to hard-dry. The gloss from the entire surface shall then be gently removed and the surface dusted off. The second finishing coat shall then be applied by brushing.

Atleast 24 hours shall elapse between the application of successive coats. Each coat shall vary slightly in shade and this shall be got approved by the Engineer-in-Charge.

1.8.16.3 General Requirements:

All the building and structure works shall generally comply with the following Requirements:

1. All building works shall be reinforced concrete framework with concrete floors and roofs.
2. All internal partition walls except for toilet shall be in 230 mm thick brick masonry built in cement mortar 1:5 with transomes and mullions as in (2) above. Toilet partition walls shall be in 115 mm thick brick masonry built in cement mortar 1:4 and shall have transomes and mullions similar to (2) above and shall form panels not exceeding 1200 mm x 1200 mm in size.
3. Toilet floor slab shall be filled with brick bat cobs (broken bricks in lime) and provided with waterproofing as per the specifications of an approved specialist waterproofing company.
4. The finished floor level in toilet areas shall be 25 mm below general finished floor level elsewhere in the building.
5. The toilet facilities shall be provided in Administration-cum-Laboratory building separately for men and women which include at least:
   i) 2 Nos. Toilet (1 no. for men and 1 no. for women) with white porcelain Orissa pan minimum 580 mm long with flushing cistern of 10 litres capacity.
   ii) 2 Nos. wash basins (1 no. for men and 1 no. for women) of size 510 mm x 400 mm in white porcelain with inlet, outlet and overflow arrangements,
   iii) 2 Nos. mirrors (1 no. for men and 1 no. for women) of size 400 mm x 600 mm wall mounted type fitted over wash basins.
   iv) 2 Nos. plastic liquid soap bottles (1 no. for men and 1 no. for women)
2 Nos. chromium plated brass towel rails (1 no. for mean and 1 no. for women) minimum 750 mm long,

   All stopcocks, valves and pillar cocks shall be heavy-duty chromium plated brass.
   All fittings such as "P" or "S" traps, floor traps, pipes, downtake pipes etc.
   The sewage from toilet blocks shall be led to the nearest PMC sewerage network sewer line.
6. All staircase shall have 25 mm thick chequered mosaic tiles for treads and 25 mm thick plain mosaic tiles of approved shade for risers set in cement mortar or lime mortar to give an overall thickness of 50 mm.
7. All floor cut-outs and cable ducts, etc. shall be covered with pre-cast concrete covers in outdoors areas and mild steel chequered plates of adequate thickness in indoor areas. All uncovered openings shall be protected with galvanized MS hand railing.
8. All staircases shall be provided with SS galvanized and SS hand railing for protection.
9. For the entire finished roof surface shall have adequate slope to drain quickly the rainwater to rainwater down take inlet points.
10. For roofing drainage, CI rainwater down takes with CI bell mouth and MS grating at top shall be provided. For roof areas up to 40 sq.m. minimum two nos. 100 mm diameter down take pipes shall be provided. For every additional area of 40 sq.m. or part thereof, at least one no. 100 mm diameter down take pipe shall be provided.
11. Top surfaces of chajjas and canopies shall be made waterproof by providing a screed layer of adequate slope or application of an approved roof membrane and sloped to drain the rainwater.
12. All doors, windows, rolling shutters shall have lintels above. Chaija protection to lintels on external walls shall be such as to prevent the rainwater splashing into the building. The minimum width of chajja for doors, windows, and rolling shutter shall be 750 mm, 600 mm, and 900 mm respectively.
13. All windows and ventilators shall have 25 mm thick Tandoor/Kota stone still bedded in cement mortar (1:3).
14. All concrete channels and ducts use for conveying liquid shall have inside width; be less than 500 mm. All open channels shall be provided with hand railings. All such channels, which are more than 1000 mm above finished plot level, shall provided with walkways for access.
15. Kerbs to be provided below the hand railing on the catwalks/pathways should be; per relevant sections of Factor Act.
16. Wherever equipment and machinery are to be moved for inspection, servicing, replacement etc., suitable movable gantry of minimum capacity of 2 tons or more; required shall be provided with monorail and operating equipment.
17. The design of buildings shall reflect the climatic conditions existing on site. Provision shall be as far as is possible permit the entry of natural light.
18. The Laboratory, Chlorine House and office building shall be provided with a sink with two drinking water taps of 20 mm size with adequate inlet and outlet connections.
19. The sidewalls of buildings shall, except those used for storage and handling Chlorine gas comprise at least 15% ventilation areas. Ventilated brickwork louvers shall not be used where the ingress of driven rain could affect plant or stored materials.
20. All walkways, staircase, platforms etc, shall be minimum 1200 mm wide and will provided with hand railing on one or both sides as required.
21. All hardware fittings and fixtures for doors, windows and louvers (e.g. Hinges, locks, latches, stay doorstops, door closers, floor springs) shall be heavy matching to the size and weight of the door window/ventilator shutters. These operate easily without hindrance secure properly without jamming; require nominal maintenance durable under prevailing site/weather conditions.
22. Suitable steps and/or ramp with overhead RCC Canopy shall be provided as requirement, at the entrances of the buildings.
23. 1,000 mm wide Plinth Protection (Apron) shall be provided all around Building/Sheds.
### 1.8.17 Architectural Details of The Building

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<td>RCC framed</td>
<td>230</td>
<td>Acid / Alkali Tiling/ Acid / Alkali Tiling/</td>
<td>Teak</td>
<td>Acrylic Power Coated</td>
<td>MS</td>
<td>20 mm thick in CM 1:4</td>
<td>12 mm thick</td>
</tr>
<tr>
<td>Administra-tion cum laboratory ground floor</td>
<td>Foyer</td>
<td>230</td>
<td>Vitrified Tiles</td>
<td>Teak</td>
<td>Al. Glazed Powder Coated with</td>
<td>20 mm thick in CM 1:4</td>
<td>12 mm thick</td>
<td>6 mm thick in CM 1:3</td>
</tr>
<tr>
<td>Plant in charge room</td>
<td>Vitrified Tiles</td>
<td>Teak</td>
<td>Al. Glazed Powder Coated with</td>
<td>20 mm thick in CM 1:4</td>
<td>12 mm thick</td>
<td>6 mm thick in CM 1:3</td>
<td>Luster Paint</td>
<td>Cement Paint</td>
</tr>
<tr>
<td>Staff Room</td>
<td>Vitrified Tiles</td>
<td>Teak</td>
<td>Al. Glazed Powder Coated with vanishin</td>
<td>20 mm thick in CM 1:4</td>
<td>12 mm thick</td>
<td>6 mm thick in CM 1:3</td>
<td>Luster Paint</td>
<td>Cement Paint</td>
</tr>
<tr>
<td>Building</td>
<td>Storage Room Type</td>
<td>Main Structure</td>
<td>Wall</td>
<td>Flooring</td>
<td>Doors / Windows</td>
<td>Plaster</td>
<td>Painting</td>
<td>Roof Water Proofing</td>
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</tr>
<tr>
<td>All pumps house</td>
<td>Ground</td>
<td>RCC frame</td>
<td>230 / 300mm</td>
<td>115</td>
<td>Kota</td>
<td>Teak</td>
<td>Acrylic Powder Coated</td>
<td>M/S</td>
</tr>
<tr>
<td>MCC &amp; PLC room</td>
<td>GH</td>
<td>RCC frame</td>
<td>230/300mm</td>
<td>115</td>
<td>Vitrified Tiles</td>
<td>Teak</td>
<td>Al. Glazed Powder Coated</td>
<td>M/S</td>
</tr>
<tr>
<td>Blower room</td>
<td>Ground</td>
<td>RCC frame</td>
<td>230/300zm</td>
<td>115</td>
<td>Kota</td>
<td>Teak</td>
<td>Acrylic Powder Coated</td>
<td>M/S</td>
</tr>
<tr>
<td>Building Type</td>
<td>Storage Type</td>
<td>Room Type</td>
<td>Main Structure</td>
<td>Wall Finishing</td>
<td>Flooring</td>
<td>Doors / Windows</td>
<td>Plaster</td>
<td>Painting</td>
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<td></td>
<td></td>
<td>Laboratory</td>
<td></td>
<td>Vitrified Tiles</td>
<td>Teak</td>
<td>Al. Glazed Powder Coated</td>
<td>20 mm thk.</td>
<td>Luster Paint</td>
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<tr>
<td></td>
<td></td>
<td>Toilet</td>
<td>Glazed Sintex</td>
<td>Al. Glazed Teak Al. Glazed Powder Coated</td>
<td>12 mm thk.</td>
<td>6 mm thk.</td>
<td>Luster Paint</td>
<td>Cement Paint</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Passage</td>
<td>Kota / Vitrified</td>
<td>Teak Al. Glazed Powder Coated</td>
<td>6 mm thk.</td>
<td>Luster Paint</td>
<td>Oil Paint</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Security Cabin</td>
<td>3m x 3m</td>
<td>Kota Teak Al. Glazed Powder Coated</td>
<td>6 mm thk.</td>
<td>Oil Paint</td>
<td></td>
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<td></td>
<td></td>
<td>Works hop</td>
<td>IPS Teak Al. Glazed Powder Coated</td>
<td>MS</td>
<td>Oil Paint</td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td>Toilet for labourers</td>
<td>2 WC, 2 Bathing, Anti Slud</td>
<td>20 mm thk.</td>
<td>Oil Paint</td>
<td>Oil Paint</td>
<td></td>
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</tr>
</tbody>
</table>
2.2 GENERAL SPECIFICATIONS FOR E & M

2.3.1 GENERAL

All the E&M works shall be carried out as per latest department Electrical Specifications with up to date corrections slips issued up to the date of submission of bid. In case the department specifications are not found applicable and adequate than the relevant BIS specifications shall be used. Further in case, any of these are not applicable to particular tools, Equipments and machinery, then the manufacturer’s specifications or their relevant instructions shall be followed.

2.3.1.1 Lighting System

2.3.1.1.1 Drawings and Data

a) The contractor shall furnish relevant descriptive and illustrative literature on lighting fixtures and accessories dimensioned drawings/ data for the respective lighting fixtures with manufacturer’s catalogue numbers.

b) It shall be the responsibility of the contractor to work out a detailed layouts in order to provide the level of installations as indicated under Design Criteria and shall be furnished for the approval of the Engineer-in-Charge before commencement of installation.

2.3.1.1.2 General Requirements

The Lighting system includes the following items:

- Lighting fixtures complete with Lamps and accessories
- Lighting system equipment
  - Light control switches, receptacle units with control switch units, lighting wires, conduits and other similar items necessary to complete lighting system
  - Lighting fixture supports and street lighting poles
  - Lighting main distribution board, lighting panels.
- Multi core cables for street, boundary and flood lighting
- Provision of automatic on-off road switches through solar system

2.3.1.3 Design Requirements

It shall be responsibility of the contractor to work out a detailed layout for different units/areas in order to provide the levels of illumination as indicated in the design requirement above. The contractor shall be responsible for measuring the levels of illumination after installation and establish compliance with the specification.
The design, manufacture and performance of equipment shall conform to the latest amended Indian standard and following design and general criterion is given below:

Project Title : 10 MLD Sewage Treatment Plant
Location : Urban Estate Hissar
Access Road : All weather roads available
Ambient Air Temp : Max. 45°C
Min. 5°C

2.3.1.2 INSPECTION, PRE-DESPATCH INSPECTIONS AND TESTING BY DEPARTMENT AUTHORITIES/AUTHORISED REPRESENTATIVE

i) The Executive Engineer HUDA Division Hissar reserves the right for pre-dispatch inspection of Equipment at the manufacturer’s place in India or abroad by the representatives of the Board and Consultants along with Contractor or his/their representatives. The total cost of to & fro by Air or any other better conveyance charges, wherever the air routes are not available, boarding and lodging etc., shall be borne by the Contractor. In case the equipments are not found suitable for dispatch or whatsoever the defects may by, and another inspection is required that visit also shall be arranged and borne by the contractor. The department shall not entertain any request on this account, even such inspection may be one or more, as may be required, before the dispatch of the Equipments. The discrepancies of such equipments as pointed out by the representatives of the department and the shall be rectified at the cost of the Contractor or the Manufacturer and the department shall not hold any liability on this account, what so ever may be.

ii) A mutually agreed quality assurance plan will be developed which provides for inspection and certification by department at specified times during the manufacture and fabrication of such items. All costs for independent inspection or testing will be borne by the Contractor, and the Contractor shall be fully responsible to ensure that adequate provisions are made in his tendered rates to cover independent inspections and testing for the following equipments and machineries to be incorporated in the Permanent Works:

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Name of Equipment</th>
<th>Stages of inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pumps</td>
<td>1 Review of material test certificate for pump casing, bowls, shaft, impeller bearings, columns pipe etc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 Review of heat treatment certificate if any</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 Dynamic balancing or rotating parts / impeller</td>
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<tr>
<td></td>
<td></td>
<td>4 Examination of the shaft</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 Hydro test of casing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6 Performance test at 49Hz and 50Hz frequency including vibration measurement covering following tests i) Capacity in LPM / LPS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ii) Delivery Head in mtrs.</td>
</tr>
<tr>
<td>Sl. No</td>
<td>Name of Equipment</td>
<td>Stages of inspection</td>
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<tr>
<td>--------</td>
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<tr>
<td></td>
<td></td>
<td>iii) Efficiency at the specified duty.</td>
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<td></td>
<td></td>
<td>iv) Power absorbed by the pump at the specified duty.</td>
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<tr>
<td></td>
<td></td>
<td>v) N.P.S.H required.</td>
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<tr>
<td></td>
<td></td>
<td>vi) Maximum power required by the pump.</td>
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<tr>
<td></td>
<td></td>
<td>vii) Shut off Head of the pump.</td>
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<tr>
<td></td>
<td></td>
<td>viii) Discharge of the pump when only on pump is operated in the system.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ix) Delivery pressure when only on pump is operated in the system.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>x) Power absorbed by the pump when only one pump is operated in the system.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>xi) Efficiency of the pump when only one pump is operated in the system.</td>
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<tr>
<td></td>
<td></td>
<td>xii) Visual and dimensional check.</td>
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<tr>
<td></td>
<td></td>
<td>xiii) Strip test.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>xiv) Speed test at 49 Hz and 50 Hz frequency</td>
</tr>
<tr>
<td></td>
<td>Motors</td>
<td>1. Dynamic balancing of rotor and visual examination of rotor assembly.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Visual inspection and testing of stator assembly.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Review of Test Certificate for conductor, Stator Coils, shaft Bearings etc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Routine test no load x load test vibration measurement as per IS.</td>
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<tr>
<td></td>
<td></td>
<td>5. Verification of type test report.</td>
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<tr>
<td></td>
<td></td>
<td>6. Visual and dimensional check.</td>
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<tr>
<td></td>
<td>Switch Gear and Electrical Panels</td>
<td>1. Visual and dimensional check.</td>
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<tr>
<td></td>
<td></td>
<td>2. Verification of bill of materials.</td>
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<tr>
<td></td>
<td></td>
<td>3. Functional Test.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Verification of type test reports.</td>
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<tr>
<td></td>
<td></td>
<td>6. Voltage ratio, burden class, induced high voltage, applied high voltage test for potential transformers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7. Current ratio, burden, class of accuracy, test for current transformers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8. Rate symmetrical breaking capacity, rated making capacity, rated short time current, auxiliary voltage for release coils, Impulse with Standard voltage test for Switch Gear panels.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9. Test results of Relay provided.</td>
</tr>
<tr>
<td></td>
<td>Transformer</td>
<td>Visual inspection, dimensional check and verification of bill of materials.</td>
</tr>
<tr>
<td>Sl. No</td>
<td>Name of Equipment</td>
<td>Stages of inspection</td>
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</tr>
<tr>
<td>5.</td>
<td>Capacitor</td>
<td>All routine and type test as per IS:2834 such as sealing test, test for output / capacitance, Insulation resistance test between terminals. Containers and loss angle measurements, test for efficiency of discharge divide, test for dielectric loss angle, thermal stability test, self healing test, voltage test between terminals.</td>
</tr>
<tr>
<td>8.</td>
<td>Pipes &amp; Specials</td>
<td>1. Visual and dimensional check. 2. Review of chemical and physical test certificates as per the relevant Indian Standard specifications. 3. Hydrostatic pressure test as per the relevant Indian Standard specifications. 4. Ultrasonic testing of welded joints for MS pipes 5. Checking the integrity of epoxy lining for MS pipes at joints after laying and jointing pipes.</td>
</tr>
<tr>
<td>9.</td>
<td>Penstock Gate</td>
<td>1. Visual and dimensional check. 2. Review of chemical and physical test certificates as per the relevant Indian Standard specifications. 3. Hydrostatic pressure test as per the relevant Indian Standard specifications. 4. Checking the integrity of epoxy lining</td>
</tr>
<tr>
<td>10.</td>
<td>DG set</td>
<td>1. Visual check up. 2. All the manufactures test certificates shall be submitted. If department desires any test, contractor shall arrange to perform the same at no extra cost.</td>
</tr>
<tr>
<td>11.</td>
<td>Compressor/Blower</td>
<td>1. Visual check up. 2. All the manufactures test certificates shall be submitted. If department desires any test, contractor shall arrange to perform the same at no extra cost.</td>
</tr>
<tr>
<td>12.</td>
<td>Screening Equipment</td>
<td>1. Visual and dimensional check up. 2. All the manufactures test certificates shall be submitted. If</td>
</tr>
<tr>
<td>Sl. No</td>
<td>Name of Equipment</td>
<td>Stages of inspection</td>
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<td></td>
<td></td>
<td>department desires any test, contractor shall arrange to perform the same at no extra cost.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Oxygen transfer capacity.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. All the manufactures test certificates shall be submitted. If department desires any test, contractor shall arrange to perform the same at no extra cost.</td>
</tr>
</tbody>
</table>
| 15.    | Sedimentation Units | 1. Visual and dimensional check up.  
|        |                   | 2. All the manufactures test certificates shall be submitted. If department desires any test, contractor shall arrange to perform the same at no extra cost. |
|        |                   | Load test at 25% in excess of rated load.  
|        |                   | Test for Deflection  
|        |                   | Test for lifting speed. |
|        |                   | 2. speed for actuation  
|        |                   | 3. All the manufactures test certificates shall be submitted. If department desires any test, contractor shall arrange to perform the same at no extra cost. |
| 18.    | Motors and Reduction Gears | Visual and dimensional checkup.  
|        |                   | Test for speed  
|        |                   | All the manufactures test certificates shall be submitted. If department desires any test, contractor shall arrange to perform the same at no extra cost. |
| 19.    | PLC, Automation, Field equipments | Visual and dimensional checkup.  
|        |                   | Checking for suitability in terms of connecting, fitting, auxiliary voltage, necessary change over contracts.  
|        |                   | Test certificate of all equipment and performance of equipment after connecting all controllers at local level and at remote level through controller.  
|        |                   | Display in terms of appropriate units and satisfactory calibration. Any error shall be removed.  
|        |                   | Coding and addresses of all inputs and outputs.  
|        |                   | Graphical representation alarm generation. |

In addition to these the contractor shall carry out test of the other equipment in the presence of DEPARTMENT engineers and shall submit test certificates for approval.

2.3.1.3 GUARANTEE

i) The Contractor shall guarantee all plant and machinery and their equipments supplied under the Contract, including erection and commissioning works, to be suitable for the application for which it is designed, and against defects due to manufacture or poor workmanship for a period of 3 months from the date of satisfactory completion of the stipulated trial run period. The Contractor shall be responsible to replace, free of cost, the whole equipment or parts thereof.
which may be found defective during this period, and to ensure the proper working of the equipment during the guarantee period. In case the Contractor fails to repair or replace any defective Equipment & machinery and equipment or part(s) thereof within 30 days from the date of intimation of any defects by the Engineer-in-Charge, the same will be done by the department /Engineer-in-Charge at the Contractor's cost.

ii) If it becomes necessary for the Contractor to replace or renew any defective portion of the plant or equipment under this Sub-Clause, the plant and equipment, so replaced and the work so renewed shall be guaranteed for a further period of 6 months from the date of replacement or renewal. Only genuine spare parts are to be used under the supervision and with approval of Engineer – in-Charge.

CERTIFICATES AND DRAWINGS FOR ELECTRICAL INSTALLATIONS

The Contractor shall furnish all the necessary data, drawings, layouts and test certificates, etc., as may be required by the power distribution agency and the Electrical Inspectorate Authorities in respect of all electrical installations, and shall obtain any required approvals or clearances. Necessary assistance will be given by the department in this respect. It would be obligatory on the part of the Contractor to obtain such sanctions and approval of the electrical load from the concerned authorities.

2.3.1.5 INSTALLATION OF PLANTS & MACHINERIES

In case of all Electrical & Mechanical Equipment, plant & Machinery and fittings etc., the tendered rate shall include the costs of supplying, installation/erection, fixing in position, testing and commissioning etc. at the site of work. No extra charges shall be payable on this account by the department.

6 sets of completion drawings, complete set of equipment brochures, dimensional details, approved drawings, installation manuals, pre commissioning tests, commissioning tests required to be carried out, shall be kept & made available at site for inspection of department officers. These sets will be given to Engineer-in-charge before commencement of supply/erection of equipment.
GENERAL REQUIREMENTS

Material
All materials incorporated in the Work shall be the most suitable for the service conditions and duty concerned. They shall be new and of reputed make/approved quality, free from imperfections and selected for long life and minimum maintenance. Non-destructive tests, if called for in the Specification, shall be carried out. All submerged moving parts of the Plant, or shafts and spindles or faces etc. in contact with them shall be of corrosion resistant materials. All parts in direct contact 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 cause. All materials shall conform to the material standards as per BIS or any equivalent standard.

Workmanship
Workmanship and general finish shall be of first class quality and in accordance with best workshop practice. All welds shall be as per IS, BS, ASME standards. All tolerances and clearances shall be as per good and sound engineering practices. Should the Employer’s representative not consider any material acceptable, it shall be replaced.

Design Features
As far as practicable, all designs shall be as per latest concept and practices. The equipment shall be new, of robust design for a long reliable operating life. These shall be capable of 24 hours per day continuous operation for prolonged period in the climatic and working conditions prevailing at the site and with a minimum of maintenance. Particular attention shall be given to extra temperature and the rating of electrical and mechanical equipment, cooling systems and the choice of lubricants shall be for the temperatures as specified. Paints used shall be the manufacturers’ standard and shall be suitable for duty as described. The equipment shall be designed to provide easy access to and replacement of component parts which are subject to wear without the need to replace whole units. All parts in contact with water shall have a life from new to replacement for 15 years minimum and new to repair of not less than five years.

Design features shall include the protection of equipment against damage caused by vermin, dirt, dust and dampness and to reduce risk of fire. Equipment shall operate without undue vibration. Noise reduction measures shall be adopted such that levels of 75 dB (A) at 3 meters are not exceeded. Parts shall be designed to withstand the maximum stresses under the most severe conditions of normal service. Materials shall have a high resistance to change in their properties due to the passage of time, exposure to light, temperature and any other cause which may have a detrimental effect upon the performance or life of the Plant.

All rotating elements shall be dynamically and statically balanced.

All equipment shall have name plates specifying the makes, model, rating and other pertinent information.
**Lubrication**

The equipment shall be lubricated by long life lubricants such that working life is not less than 3000 operation hours or as recommended by equipment manufacturer. A complete schedule of recommended oils and other lubricants shall be furnished by the Contractor. The number of different types of lubricants shall be kept to a minimum. The schedule and the name of the supplier of the lubricants shall be submitted to the Employer’s representative for approval.

Lubricants shall be oil and grease. The Contractor shall indicate indigenously available equivalent lubricants, with complete specification. 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.

Where more than one special grease is required, a grease gun for each special type shall be supplied and permanently labeled.

**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 Employer’s representative. All indicating and operating devices shall have securely attached to them or marked upon them designations as to their functions and proper manner of use.

**Painting**

At Manufacturer’s Works

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 may not be filled in before testing at the manufacturer’s works. Parts subject 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 an approved de-watering 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 ground 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.

At Site

Immediately on arrival at the site, all items of Plant shall be examined for damage to the paint coat applied at the manufacturer’s works. Any damaged portions shall be cleaned down to the bare metal, all rust removed, and the paint coat made good with similar paint.

After erection, such equipment/items which are not finish painted shall be done so. Items that have been finish painted at the manufacturer’s works shall be touched up for any
damaged paint work. For finish painting, two coats of synthetic enamel conforming to IS: 2932 shall be applied. Dry film thickness of each coat shall be at least 25 microns.

The dry paint film thickness shall be measured by Elcometer or other instruments approved by the Employer’s representative. In order to obtain the dry film thickness specified, the Contractor shall ensure that the coverage rate given by the paint manufacturer will enable this thickness to be obtained. Strength of adhesion shall be measured with an adhesion tester and this value shall not be less than 10 kg/cm². Painted fabricated steel work which is to be stored prior to erection shall be kept clear of the ground and shall be laid out or stacked in an orderly manner that will ensure that no water or dirt can accumulate on the surface. Suitable packing shall be laid between the stacked materials. Where cover is provided, it shall be ventilated. Acceptable Makes:- Berger/ Shalimar/Asian/Woodlas Neroalc

**Galvanising**

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 gms/sq. m
b) Fasteners : 300 gms/sq. m

Galvanising 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 aluminum paint.

**Supports for Pipe Work & Valves**

All necessary supports, saddles, slings, fixing bolts & foundation bolts shall be provided to support the pipe work. Valve and other equipment mounted in the pipe work shall be supported independently of the pipes to which they connect.

All valves to be installed in straight lines shall be installed between the flanges with a dismantling joint or SS expansion bellow at one side of the valve. The dismantling joint must allow a minimum clearance of 20 mm. The pressure rating of the dismantling joint / expansion below shall be same as that of the valve.

**MECHANICAL & MANUAL COARSE SCREENS & CONVEYOR**

1. **Purpose & Scope:**

   Mechanized screens should be suitable for installation in Sewage pumping stations for removal of floating wastes coming along with sewage. These screens should be capable to screen out most of the medium and large floating material such as plastic bags, floating debris, weeds, paper wastes, clothes and rags etc. which are generally clogging the impellers of the pumps installed downstream of the screens.

   The operation of the screen shall be automatic. An ultrasonic type differential level controller shall be provided to sense the head loss through the bar and give the signal to the traveling raking mechanism to start its operation. The sensor will signal the raking mechanism to operate continuously till the head loss is reduced to a preset level.

   A complete electrical control system shall be supplied with each screen and shall be mounted independently near to the screen installation. The system shall provide for total automatic operation of the screen with the feedback from the level controller.
2. **General Material And Equipment Requirements:**

   **Fabrication and design features:**
   - Use power grinder to dull and produce smooth edges.
   - Use bolted field connections. Field welding will not be allowed.
   - Design all components for continuous 24 hours per day service.

   The screen shall be so constructed so as to mechanically remove the waste from the bottom most portion of the bar portion using a traveling type raking mechanism without shutting the water flow through the screen. The raking mechanism shall then travel up to the top of operating platform and automatically discharge the waste through a discharge chute.

   The screen shall have protection against overload conditions, which might damage the equipment.

   All screens shall be constructed and shipped as an integrated product comprising of frame structure and guides, rake and rake arm mechanism, dead plates, cog wheels, sprockets and chains, discharge chute, drive unit and cover apron.

   The screen shall be supplied factory assembled and duly tested at manufacturers works before dispatch. This integrated and factory assembled screen shall involve minimum dismantling and assembly at site for erection.

   Upon receipt at site these shall be installed resting on the channel floor and mechanically or chemically anchored to the parallel sidewalls of the channel (without making grooves in concrete or breaking open the concrete side walls and thereby weakening the civil structure) in a way that there are minimum chances of misalignment.

   All parts shall be designed to withstand the stresses that will be imposed upon them during handling, shipping, erection and operation.

   All stainless steel fabricated materials will be pickled and passivated before dispatch to remove ferrous contamination, if any.

3. **Specifications :**

   **Material of construction:**
   All parts of screen including fixed bars, raking mechanism, screen frame and guide rails, dead plate and discharge chute shall be constructed from stainless steel material SS304 for long life in aggressive sewage environment. Suitable measures should be taken to ensure long life of parts like bearing, chains, sprocket and cogwheels etc, which are not made from stainless steel material.

   **Drawings & Documents:**
   Drawings for the following shall be submitted for approval before taking up manufacturing of Screens:
   - General Arrangement drawing of screens.
   - Bill Of Material (BOM) & Wiring diagram of control panels.
   - Quality Assurance Plan.

   All drawings shall be submitted in 3 copies of which one will be returned duly commented / approved.

   Approval of manufacturer’s drawings shall not relieve the manufacturer of his responsibility for supplying equipment confirming to the Technical Specification laid herein for any mistakes, errors or omissions in his drawings.
Screen Construction:
The bars shall be designed to have a tear drop profile so that they are wider on the upstream side and narrower on the downstream side. This is required to ensure that choking of bars due to stones and other hard material does not take place. The tear drop profile shall be 12 mm wide in the front and 10mm wide at the back and the depth of bars should be at least 60 mm.
The bar rack shall be firmly anchored to the channel floor and supported by a dead plate at the top.
The face of bars towards the incoming water should be half round (dia 12 mm) to ensure minimum resistance to the flow and avoid turbulence and also to offer guide and support to the rake during its travel.
The rake shall be made of Ultra High Molecular Weight Poly Ethylene (UHMWPE) so as to avoid the Galling between rake and bars. Further to this the rake should be provided with rounded off cavity to match the bars with a view to avoid sharp corner contact between the rake and bars thereby minimizing wear and tear.
The rake arm shall ride on a cogwheel / roller in a single guide channel (min. thickness 5 mm in stainless steel) on each side of the rake and will be lifted away from the dead plate on the downward travel direction. Upon reaching the bottom of its travel the rake would be rotated / swung into the bar screen to remove the collected debris.
To effectively remove the debris from the bottom most part of the bar screen, the rake should engage with the bars from the start of its inwards rotating motion. To achieve this the fixed bars should be curved at the bottom and taken forward so as to enable the rake to engage from the start of its inwards rotating motion.
The rake arrangement shall be spring loaded to ensure that the rake is always pushed on to the dead plate.
The dead plate shall be minimum 3 mm thick in stainless steel shall be suitably braced to ensure rigidity and prevent caving / bending due to increased water flow in monsoon.
The sprocket for screen chains shall have chilled tooth bearing surfaces and the chain and sprocket shall be of the same material.
The cogwheel and chains should be so located that these generally remain out of the flow of water during normal plant operation. An exception to this would be allowed only in case when water depth is greater than 2 m.
The screen should have integrated scraper for discharging the screenings to discharge chute. The scraper / wiper shall be cushioned during travel to the rest position by a shock absorber.
The rake mechanism should be operated by an Electro brake motor and be suitable for automatic operation controlled by a level sensor and electric control cabinet. Torque switch should be provided to protect the screen from damages resulting from excessive torque.
The screen shall be provided with non-corrosive apron and enclosure at the top above the platform.
After fabrication and assembly the stainless steel parts and all welded joints are to be further cleaned by acid pickling and after that they should be passivated to remove any ferrous contamination that might have taken place during manufacturing / handling / movement of raw and fabricated material.
Level controller
The level controller shall be of ultrasonic differential type.

Electrical motor
The motor shall be of TEFC type with IP 55 protection and suitable for operation on
415V ± 10% and frequency of 50 Hz ± 5%.

Control Panel
The control panel shall have IP 65 protection, painted with epoxy paint and shall be
comprising of
Mushroom head emergency stop.
Overload relays for motor protection.
Circuitry to operate the screen with ultrasonic level sensor.
Selector switch to operate the screen in Auto, off and JOG mode.
Provision to run the screen on timer in case of failure of level sensor.

Shop Testing
The screen should be completely manufactured and offered for inspection at the plant of
the manufacture confirming the above mentioned eligibility criteria. A screen assembled
by a vendor and offered for inspection at the plant of a vendor / sub contractor shall not
be accepted. The screen shall be subjected to following tests at manufacturer’s premises
by third party inspection and / or HUDA representative(s):

  Dimensional Check: The overall dimension of the screen shall be conforming to the
approved drawings.

  Operational Test: The complete screen including its carriage, rake, drive system and
brace motor shall be mechanically operated and tested to verify interference free
movement and satisfactory operation.

Miscellaneous:
Any type of work, either supply and or erection of material / equipment which have
not been specifically mentioned in this specification, but are necessary to complete
the works for trouble free and efficient operation and guaranteed performance of the
entire plant system and equipment offered shall be deemed as included with in the
scope of this specification and shall be provided by tenderer with out any extra price
to purchaser.

The installation and commissioning of screens has to be done in the presence of
manufacturer’s representative(s) so as to avoid any possibility of misalignment and
faulty installation. Minimum two (2) working days of training has to be imparted to
the concerned department people by the manufacturer’s representative(s). Packing of
screens and allied accessories shall be transit worthy to avoid any possibility of
damage during the transportation to the site(s).

Acceptable Makes:- Jash / Shivpad/Johnson/Triveni/Voltas/Hubber
**Manual Bar screen**

The manual bar screen will be of opening not more than 40 mm for coarse screen and 20 mm for medium screen and inclination about 45° with respect to horizontal. Specifications for Manually raked screen shall be as under.

The trash screen shall be rectangular in shape. The screen shall be fabricated out of stainless steel SS 304 of not less than 10mm thick and 75 mm wide in section. The screen shall be rigidly fixed to the frame and provided with 2 sets of cleaning rakes.

**BELT CONVEYOR**

The conveyor shall be common to the mechanical and manual screens. The conveyor system shall be a combination of a horizontal conveyor and upward inclined conveyor (if required) and shall have a capacity to transfer the maximum screenings anticipated at the peak flow. The discharge elevation of the dropping conveyor system shall be as said in sub-section II.

The conveyor provided for discharge of screenings shall be inter-locked with all the screenings discharging on to the conveyor so that it operates when the screenings are discharged on to it and stops automatically after a time lag when the screen stops discharging the screenings on top the conveyor.

<table>
<thead>
<tr>
<th>Number</th>
<th>One</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conveyor type</td>
<td>Horizontal</td>
</tr>
<tr>
<td>Capacity</td>
<td>To handle screenings of peak flow of 33.75 MLD.</td>
</tr>
<tr>
<td>Speed</td>
<td>15 m / minute (maximum)</td>
</tr>
<tr>
<td>Type</td>
<td>Troughed</td>
</tr>
<tr>
<td>Belt</td>
<td>3 ply Z duck, 3 mm top, 1.5 mm bottom, rubber cover CR M –24</td>
</tr>
</tbody>
</table>

**MECHANICAL FINE SCREENS**

**GENERAL:**

Mechanically operated step Screen completely made of Stainless Steel having 6 mm clear spacing between the bars shall be provided in inlet screen channel for screening out floating materials such as plastic pouches, bags, rags, floating debris, weeds, paper wastes and other floating materials from the raw sewage coming from the pumping station / gravity mains.

The screen shall include discharge chute as required to discharge the screenings on the belt / screw conveyor without employing any external mechanism / rake mechanism. The screen shall be factory assembled & movement tested at plant before dispatch to site & shall only be installed at the site in factory assembled condition thereby avoiding chances of misalignments.

**SCOPE:**

Design, Supply, Installation, Testing & Commissioning of screening equipment consisting of following:

Mechanized step screen having 6mm spacing between bars and suitable for installation at an inclination of 40 degrees in channel.

Level sensing instrument connected to control panel for automatic operation of screen mechanism and allied accessories.

Local control panel installed near screen.

Belt/screw conveyor to discharge the screened material of the screen to the waste bin.
SPECIFICATION

Material of construction:
The fixed as well as movable bars, mechanism, support frame, fixings discharge chute shall be manufactured from stainless steel for long life in the aggressive sewage environment. No component of the screen assembly shall be made of carbon steel or any other material, which can get corroded in sewage environment.

Screen Construction
The step screen shall be a complete unit comprising of main frame with an integral mechanism containing movable bars located in between fixed bars with out engagement of external mechanism / rake mechanism for pulling out the screened material ensuring minimum movement of the mechanism. The mechanism comprising of movable bars located between fixed bars shall gradually move the screened material upward in the form of a mat and deliver on the up to the discharge chute. The fixed as well as movable bars shall contain a series of steps to prevent the screenings from falling back into the main flow. The mechanism shall be mechanically operated by Electro-motor or hydraulic system and shall be suitable for automatic operation controlled by a level sensor. The screen shall operate automatically when the upstream water level of the screen increases beyond a pre-set limit and it shall stop when the upstream level decreases to a preset low level due to upward travel of screened material. The fine bar screen shall be capable of being tilted out of the sewage flow up to horizontal position for the purpose of cleaning & maintenance. The base of the screen shall be fitted with a specially profiled stainless steel plate to direct any grit that may be present towards the screen and taken out along with other screened material thus reducing the possibility of building up of grit in front of the screen.

Level Controller
The level controller shall be upstream type Ultrasonic level switch.

Electrical Motor
The motor shall be TEFC type with IP 55 protection and shall be suitable for operation on 415V ± 10% and frequency of 50Hz ± 5%.

Control Panel
The Control Panel shall have IP 55 protection, painted with Epoxy paint and shall be comprising of
- Mushroom Head Emergency stop
- Overload relays for motor protection
- MCB’s, HRC Fuses and Glass Fuses
- Circuitry to operate the screen with level sensors.
- Selector Switch to operate the screen on JOG mode
TESTING

The Fine bar screen shall be Factory assembled and subjected to following tests at the manufacturer’s premises.

**Dimensional Check:** The overall dimensions of the screen shall be conforming to the approved drawings.

**Operational Test:** The complete screen including its mechanism, Electro-motor/hydraulic operating mechanism level probing system and control panel shall be integrated and mechanically operated to verify free movement and satisfactory working.

Acceptable Makes:- Jash / Shivpad/Johnson/Triveni/Voltas/Huber

**Mechanical grit separator**

The grit separator shall be square in size and twin unit construction. A Central drive mechanism of worm reduction type driven through helical gear and motor or by geared motor shall be mounted on the RCC platform spanning the tank. All exposed steel parts shall be sand blasted and painted with epoxy. The walkway shall have RCC posts and handrails of anodized aluminum. All wetted parts shall be in mild steel with epoxy coating. The epoxy coating shall be suitable for corrosion as well as abrasion of the grit. The drive shall be provided with electro-mechanical device, torque indicating arrangement and mechanical trip contacts with electrical overload relays. Flow regulating vanes shall be provided at the inlet side of the collection chamber and shall be of FRP. The vanes shall be adjusted as per the flow requirement. The weirs at the outlet of grit chamber shall be SS 304 with minimum 3-mm thickness or FRP with minimum thickness of 6 mm. The spacing of anchor bolts of SS 304 for the fixing of the weir shall not be more than 450 mm.

**Classifier Mechanism**

The classifier mechanism shall comprise of a screw driven by a suitable motor. The material of construction of the mechanism shall be SS 304 and the diameter shall be minimum 400 mm. The length of screw shall be such that the grit can be elevated up to the discharge end as in clause 2.4 section 4, sub-section II. SS puddle pipe shall be provided in the concrete trough at the discharge point of wet grit. An organic return pump with wetted parts in SS304 shall be provided.

Acceptable make for Detritor:- Hindustan Dorr Oliver / Jash / Voltas/ShivPad/Triveni.

**AIR BLOWERS FOR OXYGENATION**

The blowers shall be provided for providing adequate oxygen into the reactor tank for aeration. The air requirements shall be calculated for summer and winter as well as mixing power at 15 Ncum / minute per 1000 cum of tank volume and the higher duty installed. The summer sewage temperature shall be taken as 38 degrees C and that in winter at 10 degrees C. Provision shall be made in the design of diffuser density in plan such that if required, 40% of the air should be available for discharge in the first 15% of the tank volume. This flexibility shall be ensured.

The blowers shall be capable of developing the required total pressure at the rated capacity for continuous operation. The blowers shall be multistage Centrifugal blowers or Twin lobe type. There shall be maximum two blowers working for each compartment of aeration tank.
and one blower shall be a common standby. One number VFD drive shall be provided common for two blowers of each compartment. Directly coupled design shall be preferred. If Bidder quotes for motors with VFD motors shall be suitably derated. For Multistage centrifugal blowers dampers regulation by motorized linkage assembly may also be provided. The blowers shall be provided with suction air filter, silencer, dead weight pressure relief valve and pressure gauge and the air delivered shall be clean, dry and oil free. The blower noise level and velocity of vibration shall be within 90 dB(A) and less than 4.5mm/s at a distance of 1.86 m respectively. The blower shall be driven by squirrel cage induction motor

Acceptable Makes for Air Blower:- Kay Engg/ Swan Pneumatics/ Everest / Beta

Blower shall be of Twin Lobe type. The speed of the blowers shall be below 1500 rpm. The power rating of motor shall be at least 10% above the maximum power requirement by the blower. The kW of single blower shall not exceed 220 kW. The blowers shall be mounted at a level necessary to avoid back flow or siphoning of sewage into the blower. The accessories shall be complete with common base plate for blower and motor, suction and discharge connection, non return valve, safety valve, pulley and V- belt guard, eye bolts etc., The pulleys used shall be taper lock of Fenner make.

Material of construction:

<table>
<thead>
<tr>
<th>Casing</th>
<th>CI conforming to IS: 210 Gr FG 260</th>
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</thead>
<tbody>
<tr>
<td>Rotor</td>
<td>Alloy steel</td>
</tr>
<tr>
<td>Shaft</td>
<td>Carbon steel C40/EN 24/19</td>
</tr>
<tr>
<td>Timing gear</td>
<td>Cast alloy steel</td>
</tr>
<tr>
<td>Pulley and gear side plates and cover</td>
<td>CI conforming to IS 210 Gr FG 260</td>
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</tbody>
</table>

Parameter:

<table>
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<tr>
<th>Type</th>
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<tbody>
<tr>
<td>Discharge pressure</td>
<td>To suit</td>
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<tr>
<td>Power transmission</td>
<td>direct drive preferred</td>
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<tr>
<td>Cooling</td>
<td>Air cooled</td>
</tr>
<tr>
<td>Code</td>
<td>BS 1571</td>
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Tests

<table>
<thead>
<tr>
<th>No</th>
<th>Tests</th>
<th>Specs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hydrostatic tests</td>
<td>Twice the maximum working pressure</td>
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<tr>
<td>2</td>
<td>Performance test</td>
<td>As per BS : 1571</td>
</tr>
<tr>
<td>3</td>
<td>Strip test</td>
<td>Clearances with tolerance limit</td>
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<tr>
<td></td>
<td>Tests</td>
<td>Specs</td>
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<tr>
<td>4</td>
<td>Mechanical balancing</td>
<td>ISO 1940 Gr. 6.3 or better</td>
</tr>
<tr>
<td>5</td>
<td>Visual Inspection</td>
<td>Before painting</td>
</tr>
</tbody>
</table>
**DIFFUSED AERATION SYSTEM**
This comprises piping to diffusers and the diffusers.

*Type of diffuser system*
A fine bubble diffused aeration system shall be applied to both the selector zone and aeration tank for oxygenation. The number of diffuser elements can be varied by the bidder depending on the manufacturer selected, subject to the condition that sufficient design calculations are attached along with it and the manufacturer is a standard one having supplied the diffusers to various waste water treatment plants for at least two years.

*Diffuser Elements*
The diffuser elements shall be membrane type and resistant to such ingredients as hydrocarbons, oil and grease. This shall afford a high oxygen transfer rate coupled with a minimal pressure drop besides permitting simple erection onto the horizontal air manifold. They shall also permit easy retrieval above the liquid surface by lifting the air vertical header feeding the horizontal air manifold. They shall have minimal coupling / attachments to the air manifold and shall have self-cleaning properties while in action. Flat surfaces facing upwards as membrane surfaces shall not be accepted. The diffuser unit shall be of corrosion resistant material. The membrane diffusers shall permit connection to the air manifolds of circular or square cross section and the entire lot of diffusers shall be capable of discharging designed flow of air at an average flow (maximum of summer and winter requirement) with the nominal air flow per diffuser per element shall not exceed 60 Nm$^3$/h/m$^2$ of diffuser surface area when installed in the said aeration tanks.

The headers onto which the diffusers are fixed shall be of standard imported PVC pipe sections of suitable inner bore and shape with custom fixtures of the diffuser elements as directed by the membrane manufacturers. Alternative pipe materials shall be acceptable provided the same are a mandatory part of the diffuser supplier and have been in the supplier’s line of supply as original equipment. The headers shall also be procured from the equipment manufacturers who are the suppliers of the membrane diffusers. These headers shall have enough counterweight or alternative arrangement to surmount any buoyancy lift from the floor during air charging. The connection between the headers and the air piping from the compressor shall preferably permit a “quarter-turn” fitment and “quarter-turn” dismantling. This segment shall be assembled and installed above the water level and in the horizontal travel of the air piping. The coupling shall have a minimum of two neoprene washers to ensure against chance leakage of air. Alternatively flanged fittings of SS 304 material shall also be permissible. Each header shall travel downward from the air piping by aligning itself onto the sidewall of the aeration tank and thereafter travel horizontally onto the tank floor. Suitable mechanical provision for lifting the headers easily above the water level for maintenance without the need for draining the tank shall be provided for each header. Isolating valves of polypropylene shall be provided upstream of the coupling to cut off the flow through the specified header for purposes of attending to the diffuser header and also diffusers.

*Air Supply Piping*
The air piping from the blower to the basin header (above water) shall be of MS and pressure rated for the sewage depth plus frictional losses etc. These shall be fixed securely to the concrete surfaces in the horizontal plane and vertical plane so that they are not clamped
horizontally onto vertical sides of the walls. The clamping shall be so designed as to permit “in-situ” screw driven fittings. Breaking open concrete surfaces shall not be permitted.

Two spare drop pipes with diffuser elements shall be supplied by the Contractor one for each compartment. This will be used to replace the choked diffusers drop pipe or on preventive basis on rotation. The choked one will be attended to and used as spare drop pipe.
Acceptable Makes for Fine bubble diffuser Mechanism:- OTT / EDI USA

**Specifications for Epoxy Painting**

Zinc rich epoxy primer and epoxy paint of approved quality shall be used for external and internal painting. No primer shall be applied without prior approval from the Employer’s Representative. The max of zinc rich epoxy primer shall be prepared at work site not earlier than 15 minutes before applying the same on pipes and special surfaces. One coat of zinc rich epoxy primer of DFT 75 micron shall be applied along with two coats of epoxy paint DFT 40 micron and DFT 30 micron respectively. No thinner shall be added to ready mix paint without previous approval of the Employers’ representative and the finishing coats on top of the primer coat shall only be applied after allowing the film to cure for at-least 48hrs.

After application of zinc rich epoxy primer the surface should be cleaned by duster and inspected. If during inspection any portion is found rusting the same shall be removed by emery paper and coated with zinc rich epoxy primer. Mixed paint should be used within 3 to 4 hrs. of mixing and fresh mixing shall be done for every new application. Every successive coat of paint shall be given only after 48 hrs. of previous coat. Before applying the next coat the surface should be properly cleaned by duster.

**Specifications for Decanting Drive**

The decanting device shall be rotating moving arm devices of Stainless Steel with top mounted gear box, drive, scum guard, down comers, collection pipe, bearings. The following type of decanter assemblies are not acceptable,

- Rope driven decanters.
- Floating decanters.
- GRP products.
- Valve-arrangement.
- Telescopic type

The maximum design travel rate shall be 60 mm/min. with proven hydraulic discharge capacity of the decanter proportional to the selected basin area. Bidders to provide sample graphs of executed projects with such decanting speeds with decanters of min. same size (length)

There should be Maximum 1 decanter per basin

The hydraulic design based on design flow rates as given above shall not exceed flow speeds of 1.3 m/s

Flexible rubber hose kind of decanter sealing is not acceptable.

Each Decanter mechanism shall be inclusive of local control boxes with manual operation selection and function buttons, communication to main PLC by DH485 or Ethernet

The Cyclic Activated sludge process should be designed with the following data sheets for process, decanting drive and diffusers.
Specification cyclic activated sludge process.

- The biological treatment section comprising SBR/ cyclic activated sludge process has to be installed and equipped for the total average flow of 15MLD and peak factor of 2.25 (33.75MLD. – Peak flow).

- The complete biological system has to be designed for handling peak flow capacity.

- Two nos. (minimum) tanks with minimum volume of 4410 m3 for each shall be provided. In addition, 0.5m free board shall be provided to each tank. Maximum liquid depth of tank shall be restricted to 6.0m.

- Cyclic Activated Sludge Process / SBR Process basins will be constructed in M30 grade concrete and as per IS 3370. RCC staircase 1.2m wide is to be provided for access from the ground level to the operating platforms. All platforms and walkways shall be provided hand railings as per tender specifications. 1.2 m Plinth protection along periphery shall be provided as per technical specifications.

- The design criteria and modelling parameters for SBR shall be maintained as per Met Calf & Eddy norms and design criteria for other units shall be maintained as per CPHEEO.

- F/M ratio and MLSS shall be maintained as per CPHEEO norms.

- SBR/ Cyclic activated sludge cycle times shall be selected adequately by the bidder considering min. 12 hrs/day of aeration and not exceeding decanting of 2.6 m liquid depth at any time.

- The excess sludge produced shall be fully digested. Sludge production (including percipients) rate shall be about 0.6 – 0.8 kg / kg of BOD removed. The nitrification assumed shall be 90-96% and maximum power recovery from denitrification shall be not more than 50% of the power used for nitrification.

- In the SBR / cyclic activated sludge basins, NO filling during settling or decanting will be acceptable.

- All other accessories, whether specified or not, but required for completion of contract shall be in contractor’s scope.

Aeration System
The Aeration facility shall be planned for present units will be installed for 15MLD average flow with pean factor of 22.5 ( 33.75 MLD )

- Minimum installed aeration equipment design capacity per day per basin for 15MLD average flow with pean factor shall be (33.75 MLD) marked on the basis of 12 hrs aeration per day per basin. Minimum oxygen transfer capacity provided for 15MLD with pean factor of 22.5( 33.75 MLD.) average flow shall be marked on 12 hrs. per day aeration basis.

In case diffusers are used.
Only fine bubble membrane diffusers shall be acceptable with minimum membrane diffuser to floor coverage area of 5%. Diffusers shall be submerged fine bubble / fine pore, high transfer efficiency, low maintenance, non-buoyant type. Diffusers shall be tubular (membrane) type.

Material of construction for (entire under water system including accessories) shall be of non corrosive. Any support for under water system shall be of adjustable type and made of SS 304.
The air blower arrangement shall be capable of handling Total Water Level and Bottom Water Level operation conditions, controlled by process sensors such as DO, temperature and level.

Each set of blower shall include dedicated standby. One blower in each set shall operate on VFD and all other blowers including standby shall operate on soft starter. The blowers shall be positive displacement (roots) type, and head for blowers shall be decided on the basis of diffusers and maximum liquid depth in tank duly considering the losses governing point of delivery (diffusers) and the blowers. The number of standby blower shall be minimum 50% (fifty percent) of the number of working blowers. Blowers shall be complete with motor and accessories like base frame, anti vibratory pad, silencer, non return valve, air filter etc. as per requirements. Vibration due to operation of blowers should not damage the structures. Further, blowers shall have acoustic enclosure to ensure that the noise level at 3 m from blowers is below 80db. The blower room shall have sufficient ventilation, lighting and working space. The room will be equipped with sufficient capacity EOT (Min 2 T or 1.5 times the weight of blower, whichever is more) to facilitate removal of blower/motor etc. for repairs. The room will also have rolling shutter.

The blower shall be operated through PLC on variable frequency drives and capable to operate at different speeds as per requirement of the system.

The main air header/rising main shall be in MS as per relevant IS. The header / rising main shall be adequately supported at suitable intervals. The header shall have auto valves to facilitate switch over aeration cycle from one basin to other by PLC operation. The header shall supply air to basin at various locations through air supply pipes. Air supply pipe above water level shall be in MS and below water level it shall be in PVC as per relevant standards. All under water lateral pipes shall be of PVC. All other accessories, whether specified or not, but required for completion shall be in contractors scope.

**Blower details :-**

<table>
<thead>
<tr>
<th>MOC</th>
<th>CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Twin lobe roots type</td>
</tr>
<tr>
<td>Duty</td>
<td>Continuo’s not less than</td>
</tr>
<tr>
<td>Capacity of discharge</td>
<td>4000 m³/hr @ suitable head</td>
</tr>
<tr>
<td>No. of units</td>
<td>3 nos. (2W+1S)</td>
</tr>
</tbody>
</table>

All other accessories, whether specified or not, but required for completion shall be in contractors scope.

**Submersible Pumps for Raw sewage**

Raw sewage pumps shall pump sewage from wet well at sewage pumping station to inlet chamber of STP. Return sludge pumps shall pump the return sludge from the sump to the aeration tank. Pumps shall be submersible type of non-clog design. They shall be suitable for pumping soft solids of size 100 mm. Only pumps with maximum 960 rpm shall be provided. In addition to this, the pumps shall be fitted with a special tearing system on the
suction side for tearing soft solid material. The impeller shall be of a non-clog design with smooth passage and solid handling capability of 100 mm size. Maintenance-free anti-friction bearing, deep grooved permanently greased filled ball bearings shall be provided to take care of all the axial and radial forces at any point of operation. The pump installation design shall be such as to facilitate automatic installation and removal of the pumps without having to enter into the sewage pit. The motor shall be squirrel cage type, suitable for three phase supply continuous duty with class ‘F’ insulation. Motor shall have integral cable parts and the cable entries shall be sealed. The cables must be leak tight with respect to liquids and firmly attached to the terminal block. The motor shall be designed for non-overloading characteristics. There shall be thermal protection against overheating of the motor winding. The pump design shall ensure that seal does not come directly in contact with the liquid being pumped as well as cooling / lubrication by oil is provided. The moisture sensor of the tripping unit shall be located inside the oil chamber.

The pump unit shall be supplied along with the special duck foot bend, flanged elbow, lifting chain with shackles, enough guide wire / pipe, sufficient tough rubber sheeted water proof cable, as well as stainless steel foundation bolts and nuts. Alternatively pump unit can be with SS wire rope guiding system and pedestal cart integrated with the discharge head.

**Reverse Rotation**

The pump shall be designed to operate safely in the reverse direction of rotation, due to wastewater returning through the pump.

**Pump Construction**

**Pump Casing**

The pump casings shall be of cast iron and conform to IS: 210 Gr FG 260. The internal surfaces shall be free of rough spots. The casing shall have centre line discharge.

**Impellers**

The material of impellers shall be as specified and they shall be of the single vane type. They shall be dynamically balanced. The leading edge of the vanes shall be rounded and cut back to prevent rags, stringy material etc. from impinging on the impeller vanes.

**Pump Shaft**

The pump shaft shall be hard chrome plated alloy steel or stainless steel. The shaft shall be of one-piece construction.

**Pump Bearings**

Pump bearings shall be of the antifriction type. The bearings shall be able to take normal axial thrust loads due to unbalanced hydraulic loads on the impellers plus the weight of all rotating parts of the pumps. Pump bearings shall be designed with a minimum life of 40,000 hours. The bearings shall be grease lubricated for life and shall be maintenance free.
Guide Arrangement
The assembly may have C.I. pedestal, bracket, delivery bend, SS 316, guide rail pipe, upper guide rail holder, etc complete. The pedestal and bracket may provide automatic coupling between pump delivery and discharge bend. Alternatively, the guiding system can be with S.S. wire rope and the pedestal cast integrated with the discharge bend.

Mechanical Seals:
A double mechanical seal of approved type shall be provided to prevent pumped liquid entering into the motor winding. The seals shall be running in oil bath. The oil bath shall have moisture sensors to sense water leakage. The sensors shall be used for tripping the pump and also for alarm.

Pump Balance:
All rotating parts shall be accurately machined and shall be in rotational balance. Excessive vibration shall be sufficient cause for rejection of the equipment. The mass of the unit and its distribution shall be such that resonance at normal operating speeds is avoided. In any case the amplitude of vibration as measured at any point on the pumping unit shall not exceed the limits set forth in the latest edition of Indian Standards. At the operating speed, the ratio of relative speed to the critical speed of the unit or its components shall be less than 0.8 or more than 1.3.

Lifting chain
Each pump shall be provided with galvanized steel lifting chain of suitable capacity. One end of the chain shall be attached to the pump and the other end fixed near the upper bracket for guide rail / wire rope assembly, by means of GI D shackle. The chain shall have GI rings fixed at an interval of about 1 meter for engaging the hook of the chain pulley block.

Submersible Cable
Each pump shall be provided with submersible cables of equal length for power and control so that the pump positions can be interchanged with each other. The cable shall be terminated in a common weatherproof junction box.

Moisture Sensor
The moisture sensor shall be provided in the oil chamber to detect the failure of the mechanical seal.

Motor
The motor shall be integral part of the pump. The enclosure for motor shall be IP-68. Each phase of the motors shall be provided with thermistor. The motor winding shall be suitable for star delta/soft starter. The motor shall be designed for minimum 10 starts/stops per hour, irrespective of whether it is DOL start or otherwise. For other requirements refer subsection VI. The motor shall operate satisfactorily at all operating levels in wet well.

Materials of construction:
Pump casing : CI IS: 210 Gr FG 260
Discharge casing : CI IS: 210 Gr FG 260
Impeller : CI IS: 210 Gr FG 260
Shaft: SS AISI 431
Mechanical Seal: Silicon Carbide
Fasteners: SS AISI 304.

**Protective Coating:**
The pumps shall be epoxy painted.
Acceptable Makes of Sub. Pumps:- Kishor/ Kirloskar/ KSB/Aqua/ABS/Grundfos

**RETURN SLUDGE PUMPS**

Return sludge pumps shall pump the return sludge from the sump to the aeration tank. Pumps shall be submersible type of non-clog design. They shall be suitable for pumping soft solids of size 100 mm. Only pumps with maximum 960 rpm shall be provided. In addition to this, the pumps shall be fitted with a special tearing system on the suction side for tearing soft solid material. The impeller shall be of a non-clog design with smooth passage and solid handling capability of 100 mm size. Maintenance-free anti-friction bearing, deep grooved permanently greased filled ball bearings shall be provided to take care of all the axial and radial forces at any point of operation. The pump installation design shall be such as to facilitate automatic installation and removal of the pumps without having to enter into the sewage pit. The motor shall be squirrel cage type, suitable for three phase supply continuous duty with class ‘F’ insulation. Motor shall have integral cable parts and the cable entries shall be sealed. The cables must be leak tight with respect to liquids and firmly attached to the terminal block. The motor shall be designed for non-overloading characteristics. There shall be thermal protection against overheating of the motor winding. The pump design shall ensure that seal does not come directly in contact with the liquid being pumped as well as cooling/lubrication by oil is provided. The moisture sensor of the tripping unit shall be located inside the oil chamber.
The pump unit shall be supplied along with the special duck foot bend, flanged elbow, lifting chain with shackles, enough guide wire / pipe, sufficient tough rubber sheeted water proof cable, as well as stainless steel foundation bolts and nuts. Alternatively pump unit can be with SS wire rope guiding system and pedestal cart integrated with the discharge head.

**Reverse Rotation**
The pump shall be designed to operate safely in the reverse direction of rotation, due to wastewater returning through the pump.

**Pump Construction**

**Pump Casing**
The pump casings shall be of cast iron and conform to IS: 210 Gr FG 260. The internal surfaces shall be free of rough spots. The casing shall have centre line discharge.

**Impellers**
The material of impellers shall be as specified and they shall be of the single vane type. They shall be dynamically balanced. The leading edge of the vanes shall be rounded and cut back to prevent rags, stringy material etc. from impinging on the impeller vanes.

**Pump Shaft**
The pump shaft shall be hard chrome plated alloy steel or stainless steel. The shaft shall be of one-piece construction.

**Pump Bearings**
Pump bearings shall be of the antifriction type. The bearings shall be able to take normal axial thrust loads due to unbalanced hydraulic loads on the impellers plus the weight of all rotating parts of the pumps. Pump bearings shall be designed with a minimum life of 40,000 hours. The bearings shall be grease lubricated for life and shall be maintenance free.

**Guide Arrangement**
The assembly may have C.I. pedestal, bracket, delivery bend, SS 316, guide rail pipe, upper guide rail holder, etc complete. The pedestal and bracket may provide automatic coupling between pump delivery and discharge bend. Alternatively, the guiding system can be with S.S. wire rope and the pedestal cast integrated with the discharge bend.

**Mechanical Seals:**
A double mechanical seal of approved type shall be provided to prevent pumped liquid entering into the motor winding. The seals shall be running in oil bath. The oil bath shall have moisture sensors to sense water leakage. The sensors shall be used for tripping the pump and also for alarm.

**Pump Balance:**
All rotating parts shall be accurately machined and shall be in rotational balance. Excessive vibration shall be sufficient cause for rejection of the equipment. The mass of the unit and its distribution shall be such that resonance at normal operating speeds is avoided. In any case the amplitude of vibration as measured at any point on the pumping unit shall not exceed the limits set forth in the latest edition of Indian Standards. At the operating speed, the ratio of relative speed to the critical speed of the unit or its components shall be less than 0.8 or more than 1.3.

**Lifting chain**
Each pump shall be provided with galvanized steel lifting chain of suitable capacity. One end of the chain shall be attached to the pump and the other end fixed near the upper bracket for guide rail / wire rope assembly, by means of GI D shackle. The chain shall have GI rings fixed at an interval of about 1 meter for engaging the hook of the chain pulley block.

**Submersible Cable**
Each pump shall be provided with submersible cables of equal length for power and control so that the pump positions can be interchanged with each other. The cable shall be terminated in a common weatherproof junction box.

**Moisture Sensor**
The moisture sensor shall be provided in the oil chamber to detect the failure of the mechanical seal.

**Motor**
The motor shall be integral part of the pump. The enclosure for motor shall be IP-68. Each phase of the motors shall be provided with thermistor. The motor winding shall be suitable for star delta/soft starter. The motor shall be designed for minimum 10 starts/stops per hour, irrespective of whether it is DOL start or otherwise. For other requirements refer subsection VI. The motor shall operate satisfactorily at all operating levels in wet well.

**Materials of construction:**
- Pump casing : CI IS: 210 Gr FG 260
- Discharge casing : CI IS: 210 Gr FG 260
Impeller: CI IS: 210 Gr FG 260
Shaft: SS AISI 431
Mechanical Seal: Silicon Carbide
Fasteners: SS AISI 304.

Protective Coating:
The pumps shall be epoxy painted.
Acceptable Makes of Sub. Pumps:- Kishor/ Kirloskar/ KSB/Aqua/ABS/Grundfos

Parameters of Pump
Type: Submersible, Verticle Non clog
Quantity: 2 working
Capacity: As per bidder’s design
Head: Suitable to pump to sludge digester
Efficiency: Minimum 45 %
Pump speed: 960 rpm (maximum)
Ball passing size: 25 mm minimum
Material test certificate: Casing, Impeller, Shaft
Field Tests: Field performance tests required for satisfactory operation

Note:- The type, capacity & duties of return and excess sludge pumps shall be as proposed by the bidder. However, minimum 50% standby capacity shall be provided and the same set of pumps may be used for the pumping of excess sludge and return sludge.

EXCESS SLUDGE PUMP
The pump shall be use for pumping sludge to sludge sump.

Parameters of Pump
Type: Submersible Non clog
Quantity: 2 working
Capacity: As per bidder’s design
Head: To pump to inlet chamber before fine screen
Efficiency: Minimum 65 %
Pump speed: 960 rpm
Ball passing size: 25 mm minimum

HIGH PRESSURE PUMP
This pump is intended for flushing the sludge line of reactors, sludge thickener, Sludge thickener underflow pumps, Storm water drains etc., The pump shall be submersible type. The specification shall be same as that of specifications given in the clause 14 above.
Number: One
Capacity: As per bidder
Head: Minimum 40 MWC
Efficiency: Minimum 60 %
Pump speed: to suit
Ball passing size: 25 mm minimum

AGITATORS FOR SLUDGE STORAGE TANK
The equipment shall include drive motor, coupling, turbine impeller assembly, intermediate bearings, basket, walkway with handrails and such other fittings, devices or appurtenances necessary for a complete operating installation. 

Accepted Makes:- Fibre & Fibre/ Shivpad/Remi or equivalent

**Mounting Arrangement.**
The civil tank for the sludge storage will be provided with a minimum freeboard of 300 mm. The agitator drive unit shall be mounted on RCC platform spanning the tank. These shall be mounted above the freeboard elevation over a RCC bridge walkway with necessary cut out for agitator shaft. The walkway will be provided with hand railing in SS 304 and steel ladder with handrails. A portal shall be provided permanently in the platform required for the maintenance work of the agitator components.

**Drive Motor**
The drive motor shall not exceed an rpm of 1500 and shall be directly coupled with the gear reducer. It shall be wired for 415 volts, 50 cycles, and three-phase service. It shall be totally enclosed, fan cooled, and rated for severe chemical duty with a minimum service factor of 1: 1.15.

**Rotary Speed**
The rotary speed of the impeller shall not exceed 100 rpm so that the solids are not sheared.

**Direct Coupling & Torque**
The drive motor output shaft and the impeller rotary shaft shall be connected by a direct coupling using such couplings as “Lovejoy” type to avoid cumbersome erections and de-erections. The coupling shall be able to withstand continuous duty with occasional upward thrusts. The drive assembly for each agitator shall consist of a suitable drive motor, directly coupled to a helical gearbox. The gear reducer shall be of heavy duty, high efficiency type with a rugged housing and shall have a minimum service factor of 2.0 and suitable for 24 hours continuous service. The gear reducer shall have oil bath lubrication and dry well construction on the vertical output shaft to prevent leakage of lubricant. The casing of the gear reducer shall be of CI and the gears shall be hardened and ground for precision.

**Impeller Elements**
The circulating element of the each agitator will consist of a single, axial flow design, 4 inclined impeller having SS304 blades

**Mixing Power**
The minimum required mixing power should be provided at 8 watts per cum of tank contents.

**Fasteners & Anchor bolts**
All fasteners and anchor bolts shall be of such metallurgy that shall be compatible with the duty conditions shall be used.

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<tr>
<th>Parameters</th>
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<tbody>
<tr>
<td>Number</td>
<td>One</td>
</tr>
<tr>
<td>Type</td>
<td>Axial flow turbine</td>
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<tr>
<td>Material of construction</td>
<td>AISI SS304</td>
</tr>
<tr>
<td>Type of mounting</td>
<td>On RCC platform spanning the tank</td>
</tr>
<tr>
<td>Speed reduction</td>
<td>By belt drive or helical reduction gear</td>
</tr>
</tbody>
</table>

**CENTRIFUGE FEED PUMPS**
These pumps shall be used for pumping sludge to centrifuge. The pumps shall be designed to operate satisfactorily without detrimental surges, vibration, noise, or dynamic imbalance. Over the required head range, the head-capacity curve of the pump shall have a continuously rising head characteristic with decreasing capacity over the whole range of total head. The pump shall have the maximum efficiency at the specified duty point. The unit shall be designed to operate safely at the maximum speed attainable in the reverse direction of rotation due to sludge returning thro the pump at times when power supply of the motor is interrupted. The first critical speed of the pump set shall be at least 30% above the operating speed.

The pumps shall run smooth without undue noise and vibration. The velocity of vibration shall be within 4.5 mm/sec. The noise level shall be limited to 85 dBA at a distance of 1.86m.

All rotating parts shall be statically and dynamically balanced as per ISO standards.

A stationary coupling guard shall be provided for the coupling conforming to all relevant safety codes and regulations. Guards shall be designed for easy installation and removal. They shall be complete with necessary support accessories and fastener.

The pumping unit shall be provided with a common base plate. The base plate shall be of sufficient size and rigidity to maintain the pump and motor in proper alignment and position. The pump design shall be as per IS 6595 and pump performance shall be as per IS 9137.

The power rating of the pump motor shall be the larger of following

(i) 115% of power required by the pump at the duty point
(ii) 110% of maximum power required by the pump from zero discharge to the runoff point total head

Acceptable makes: - Roto Pumps / Ramo / Alpha Helical

<table>
<thead>
<tr>
<th>Material of Construction</th>
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<tbody>
<tr>
<td><strong>Type</strong></td>
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<tr>
<td><strong>MOC</strong></td>
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<tr>
<td><strong>Base plate</strong></td>
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<tr>
<td><strong>Fastener</strong></td>
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<table>
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<tr>
<th>Parameters of Pump</th>
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<tbody>
<tr>
<td><strong>Capacity</strong></td>
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<tr>
<td><strong>Head</strong></td>
</tr>
<tr>
<td><strong>Efficiency</strong></td>
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<tr>
<td><strong>Pump speed</strong></td>
</tr>
<tr>
<td><strong>Ball passing size</strong></td>
</tr>
<tr>
<td><strong>Applicable code</strong></td>
</tr>
<tr>
<td><strong>Performance</strong></td>
</tr>
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<tr>
<th>Testing</th>
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<tbody>
<tr>
<td><strong>Material test certificate</strong></td>
</tr>
<tr>
<td><strong>Hydrostatic test</strong></td>
</tr>
<tr>
<td><strong>Performance test</strong></td>
</tr>
</tbody>
</table>
Mechanical balancing: As per ISO 1940, Gr. 6.3 or better
Visual inspection: Pump shall be offered for visual inspection before shipment. The pump components shall not be painted before inspection
Field Tests: Field performance tests required for satisfactory operation

**Parameters**

- **Number**: 2 working + 1 standby.
- **Capacity**: To suit
- **Head**: Suitable to pump to Centrifuge
- **Duty**: Continuous
- **Speed reduction**: Through inline helical gear
- **Pump speed**: 200 rpm

**POLYELECTROLYTE TANK & AGITATORS**

The equipment shall include drive motor, direct coupling, impeller assembly, and such other fittings, devices or appurtenances necessary for a complete operating installation.

The Polyelectrolyte requirement has been estimated at 1.20 Kg / T of dry solids. The Polyelectrolyte solution is expected to be prepared with suitable commercial Polyelectrolyte. The strength of Polyelectrolyte solution shall be as recommended by the centrifuge manufacturer. The volume of the Polyelectrolyte solution tank shall be planned to hold at any time the requirement for 12 hours of feed solution of centrifuges in operation. The Contractor will provide two HDPE tanks. The agitator equipment for both the tanks shall be provided along with independent supports. The preparation of Polyelectrolyte solution tank shall commence one hour prior to exhaustion of supply of first tank.

The drive motor shall not exceed rpm of 1,500 and directly coupled with the gearbox. It shall be wired for 415 volts, 50 cycles, and three-phase service and shall be totally enclosed, fan cooled, rated for severe chemical duty with a minimum service factor of 1:1.5.

The rotary speed of the impeller shall not exceed 100 rpm.

The drive motor output shaft and the impeller rotary shaft shall be connected by a direct coupling using such couplings as “Lovejoy” type to avoid cumbersome erections and de-erections. The drive assembly for each agitator shall consist of a suitable drive motor, directly coupled to a helical gearbox. The Gear reducer shall be of heavy duty, high efficiency type with a rugged housing. It shall have a minimum service factor of 2.0 and suitable for 24 hours continuous service. The gear reducer shall have oil bath lubrication and dry well construction on the vertical output shaft to prevent leakage of the lubricant. The casing of the gear reducer shall be of CI. The gears shall be hardened and ground for precision.

The impellers of the each agitator will consist of a single, axial flow design. The inclined SS304 blades shall be bolted to the centre hub. The impeller assembly will be securely keyed to the shaft. Each impeller shaft shall be solid SS304 shaft of suitable diameter designed to resist the applied radial and axial thrust loads. Reinforced flanges at both ends will be used to attach the impeller at the bottom and to the rigid drive coupling at the top. All fasteners used in the assembly will be of SS304. The rotating shaft is best designed as a tubular structure for better torque resistance.

All fasteners and anchor bolts shall be of such metallurgy that they are compatible with the stipulated duty conditions shall be used.

**POLYELECTROLYTE DOSING PUMPS**
The Polyelectrolyte solution from the preparation tanks shall be pumped by the use of Polyelectrolyte solution dosing pumps to the Centrifuges. The pipe and the pipe fittings shall be HDPE and valves shall be Polypropylene. These pumps shall be capable of pumping the up to 0.5% Polyelectrolyte solution. There shall be three pumps of which two shall be working and the other standby at any time. Dosing pumps shall be of the duplex type diaphragm type hydraulically operated. These shall permit manual override and variable flow control at both sides of the chosen median duty point for the duty already stated herein. These shall be able to handle a flow variation of plus 25% of the required flow. The construction shall be totally enclosed and corrosion proof. The liquid end shall be in SS 316.

Acceptable Makes:- Swellore/ Asia LMI/ VK Pumps/ Shapootools

<table>
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<tr>
<th>Parameters</th>
<th>Details</th>
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<tbody>
<tr>
<td>Number of pumps</td>
<td>2 W + 1 S</td>
</tr>
<tr>
<td>Standby</td>
<td>minimum 50%</td>
</tr>
<tr>
<td>Capacity of each pump</td>
<td>to suit each centrifuge requirement</td>
</tr>
<tr>
<td>Material of construction of wetted parts</td>
<td>AISI SS 304</td>
</tr>
</tbody>
</table>

Note: Bidder may offer progressive cavity pumps also with mechanical variator, to suit the requirement of the centrifuges in operation. The specification shall be as per clause 18 above.

**CENTRIFUGES**

Centrifuge shall be capable of handling sludge consisting of minimum 8% solids by weight. The dewatered cake shall be based on minimum consistency of 28% by weight dry solids. The centrifuge shall be solid bowl centrifuge of co-current/countercurrent design, as decided by the bidder. The centrifuge shall have sufficient clarifying length and differential RPM so that separation of solids is effective. The centrifuge shall have central lubrication system. The centrifuge shall have adjustable weir plate, so that its pond depth can be raised. The centrifuge and its accessories shall be mounted on a common base frame so that entire assembly can be installed on an elevated structure.

Suitable drive with V-belt arrangement and turbo-coupling shall be provided along with overload protection device. The wetted parts of Centrifuge shall be stainless steel, 304. The tungsten carbide lined conveyor liner across surface, feed chamber and solid discharge outlet shall be provided. Differential speed and bowl speed should be adjusted by changing the pulleys; differential speed may be adjustable by use of epicyclic-gear. The bowl shall be protected with flexible connections so that vibrations are not transmitted to other equipment. The base frame shall be in epoxy painted steel construction and provided with anti-vibration pads. All steps necessary to prevent transmission of structure borne noise shall be taken. The drive motor shall be of 1450 rpm. Interlocking with centrifuge feed pump, polyelectrolyte dosing pump shall be provided. The noise level shall be 88 dB (A) measured at 1 m distance under dry run. The vibration level shall be below 50 micron measured at pillow blocks under dry run condition. Adequate sound proof shall be carried out for the housing the centrifuges to ensure that the noise level at 5 m distance from the enclosure is less than 75 dB (A).

A hoist shall be provided above centrifuge for maintenance purpose. The hoist shall be such that it shall be possible to erect or de-erect the centrifuge while one centrifuge is in operation.

Acceptable Makes:- Humboldt Wedag/ Penwalt/Alfa Laval/Miller

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Details</th>
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<tbody>
<tr>
<td>Number of Centrifuges</td>
<td>2 working + 1 standby</td>
</tr>
</tbody>
</table>
Type                                      Horizontal,  
Capacity of each unit                        to suit 50% requirement of digested sludge  
Number of working hours/day                  18 hours (maximum)  
Mixing arrangement of Polyelectrolyte and sludge: online-mixing

DISINFECTION SYSTEM
Chlorination System:

General

(a) Chlorine diffusers shall be supplied and installed at the dosing point.
(b) Treated sewage, of quality BOD 20mg/l and suspended solids 30mg/l, shall be dosed with chlorine gas at suitable concentrations so that effluent from the chlorine contact tank shall not have more than 5 mg/l residual chlorine.

Chlorinators

(a) Vacuum type chlorinators shall be supplied with one duty and one stand by unit.
(b) Chlorinators shall be free-standing, floor-mounted, and shall have a turn down ratio of 10:1 over the full range of works operation.
(c) The dosing rate shall be manually set and each chlorinator shall be equipped with a 0 to 10mg/l scale and a manual dose setter over the complete range.
(d) Mal-operation of the duty chlorination system shall be indicated in the chlorination room and the central MMI. The change to the standby system shall be carried out automatically in the event of duty chlorinator failure.

Dosing Pumps

(a) Dosing pumps (1 working + 1 standby) shall be installed.
(b) The dosing pumps shall draw their supply from treated sewage line.
(c) The pumps shall be placed inside the chlorination room and shall be made from material resistant to corrosion by chlorine.

Injectors

Two injectors shall be provided, each serving a duty/standby pair of chlorinators. The injectors shall be located in the chlorination room.

Chlorine
Chlorine shall be supplied as liquid from nominal 1 tonne chlorine toner.

**The Toner Room**

(a) Storage shall be provided for chlorine tonners sufficient for at least one month’s usage at normal rate of withdrawal.

(b) The system shall be designed to prevent freezing of the liquid chlorine at the maximum rate of withdrawal.

(c) Tonners on line, tonners on standby and full and empty tonners shall be stored separately in the tonner room.

(d) Four sets of tonner rollers shall be provided. Tonners not in use shall be stored on concrete cradles.

(e) A 2 tonne overhead single girder electric traveling crane shall be provided in the chlorine tonner room for the following functions:
   i) offloading (and reloading) of tonner from trucks;
   ii) handling of tonners within the storage area.

(f) The system shall serve the tonner store width over the entire length including the loading/unloading area.

(g) The hoist and traverse speeds shall be as follows;
   (i) Long traverse speed : 5m/min
   (ii) Cross traverse speed: not more than 5m/min
   (iii) Slow lifting speed : 1m/min
   (iv) High lifting speed : 5m/min

(h) The container lifting beam shall be specifically designed for handling chlorine containers and equipped with necessary shackles and hooks.

(i) Operation of crane system shall be from the floor level using independent push button pendent controls operating at a 230 volt 50Hz AC supply.

(j) Two lifting beams shall be provided (a duty and a spare) and a one tonner weighed to be suspended from the crane hoist.

(k) When the pressure in the duty chlorine tonner falls to less than 1kg/cm² the automatic change over device shall operate to isolate the empty tonner and to bring the full standby tonner on line.

(l) A pit and alkali absorption systems shall be provided to contain and neutralize chlorine in the event of leak. The system shall comprise a pit located in the tonner storage room and accessible by the overhead crane system. The pit shall be surrounded with removable guard railing. The pit shall be kept full with a neutralizing solution of lime. The pit shall be capable of holding side by side two chlorine tonners. A provision shall be made to drain the pit.

(m) Special consideration shall be given to any floor drainage system in the tonner building; adequate shall be provided to ensure that chlorine gas cannot escape. All leader tubes carrying cables or pipes out of the building shall be sealed at either end to prevent any chlorine gas leaking out.

**Chlorination Room**

(a) The chlorination room shall be constructed adjacent to the tonner room but with no interconnecting door or other form of access.

(b) Gas lines from the tonner room into the chlorination room shall run in ducts to be sealed after installation and prior to commissioning.
Chlorine Leak Detectors
(a) Not less than three chlorine gas leak detectors shall be provided each, with a single detector cell. At least two sensors shall be located in the chlorine tonner storage room and at least one sensor in the chlorination room.
(b) The chlorine leak detectors in the tonner room shall be mounted at each end of the tonner room.
(c) The chlorine leak detectors shall have two adjustable alarm levels sensitive to chlorine concentrations above 1mg/m³. The range of adjustment of alarm levels shall facilitate selection of the following alarms:
   (i) low level 2mg/m³
   (ii) High level 4mg/m³
(d) The low level alarm shall:
   (i) initiate a local audible and visual alarm;
   (ii) Start the ventilation fans in the tonner and chlorination rooms;
   (iii) Raise an alarm at the local control panel and the central MMI
(e) The low level alarm shall:
   (i) initiate local audible and visual alarm;
   (ii) Initiate audible and visual alarms outside the buildings (the alarms shall be sufficiently loud to be heard in all buildings at STP);
   (iii) Raise an alarm at the local control panel and at the central MMI;
   (iv) shut down the chlorination systems;
   (v) Stop the tonner room and chlorination room exhaust fans.
(f) The chlorine detectors shall have self-checking circuitry and detector failure alarms shall be provided at the local control panel and central MMI.
(g) Detector failure alarms shall not be combined with the leak alarms.
(h) Statutory warning notices relating to the storage and handling of chlorine shall be provided. The signs shall be pictorial and provided in Marathi and English.

Ventilation System
a) Each area where chlorine is stored or used as gas or liquid shall be provided with a forced ventilation system.
b) Air intakes shall be sized to allow uniform ventilation and positioned to prevent possible recirculation.
c) Exhaust air shall be ducted from low level and discharged at high rates.
d) An air change rate of four per hour under normal condition and a minimum of twenty changes of air per hour under shall be used in the event that a chlorine leak is detected.
e) Exhaust fans shall be heavy duty industrial pattern manufactured from chlorine resistant materials.
f) Ductwork shall be manufactured from U- PVC extruded sheets or circular sections.
g) Duct shall be designed in accordance with relevant Indian standard specifications.
h) Fan controls shall be linked to the leak detection system.
i) Hardwired fan controls shall be provided shall be manually controlled. An override shall be provided to operate the fans in the event of a chlorine leak alarm.
j) Fan controls shall be grouped in an enclosure outside the ventilated area and shall include the following:
   (i) Fan off/ on
   (ii) Fan running/ failed indication lights;
   (iii) Low and high gas leakage indication alarm light.
Chlorine Residual Test Kit

(a) Chlorine residual test Kit shall be provided for monitoring of the residual free chlorine at plant outlet.

Safety Equipments

(a) Materials and equipment necessary to ensure the safety of personnel operating the chlorination plant and others shall be provided.
(b) The equipment shall include:
   (i) two sets of approved self-contained breathing apparatus, each comprising an air set, carrying harness, face mask and valves and ancillary equipment. Each set shall be provided with three 1200 liter capacity, 140mm diameter air tonners;
   (ii) Two sets of approved positive airline breathing apparatus, each comprising body harness, face masks and valves and 30 m of airline. One air trolley, comprising wheeled frame with two air tonners, control manifold, airline hose and hose winding drum. Two spare tonners suitable for changeover shall be provided;
   (iii) one portable electric motor driven air compressor for recharging air tonners, complete with quick-release air hose couplings;
   (iv) two ‘instant action’ resuscitators;
   (v) Four sets of safety clothing in various sizes, each comprising PVC overalls, Wellington boots with steel toe caps, goggles, gloves and safety helmets.
(c) Each set of safety equipment shall be mounted in a glass-fronted, non-locking PVC coated steel cabinet in approved locations on the outside of the building.
(d) Two emergency showers shall be provided and shall be installed outside on either side of the tonner room.
(e) Each shower shall be operated automatically by a quick acting hand or foot valve.
(f) Four eyebaths shall be supplied. Two eyebaths shall be adjacent to each of the showers.
(g) Water for showers, etc., shall be drawn from the service water supply.
(h) A telephone will be provided close by outside the building for emergencies.

Chlorination Power and Control

A combined MCC and control panel shall be provided and located in a suitable location protected from the weather and effects of the process. The control panel shall provide facilities for:
   (i) display status and values associated with the chlorination systems;
   (ii) Duty Pump selection
   annunciate alarms associated with the chlorination systems;
   Operator adjustment of process set points.

The chlorination system shall operate using a fixed manually set dose rate. The quantity of chlorine dosed will therefore be adjusted in direct proportion to the process flow at the dosing point.

The chlorine residual monitors to be provided shall be used for monitoring and alarm purpose only.

Chlorination system shall be provided in the chlorine house. The chlorinator and chlorine cylinder shall be arranged in chlorine house with partition. Doorways to the room shall be
shown as outward opening. Suitable storage for filled / empty drums should be provided. It shall have sufficient ventilation as per the latest norms for safety purpose with necessary lifting arrangements etc. complete. The chlorination room should be having RCC jali for dust protection as well as for proper ventilation.

**Design Basis**

**Design flow** : 15 MLD

**Number of Units** : 2 nos.

**Type** : Vacuum

**Chlorine Dosing** : 5 mg/lit max.

**Accessories** : 5 Nos. Chlorine toners duly filled up & certified by the Explosive Department, Residual chlorine analyzers & chlorine leak detector and absorption system.

Acceptable makes : Pennwalt / Metito / Industrial Device

The chlorinated effluent shall be conveyed to the adjacent stream or shall be used for recycling within the plant premises through closed RCC conduit or DI pipes.

**VALVES**

**General**

Valves shall be as per internationally recognized standards. Flanges shall be machined on faces and edges to ISO 7005, IS 6392. Valves shall be flanged type. For sluice / gate calves, back seat arrangement shall be provided. Valves buried or installed in underground chambers, where access to a hand wheel would be impracticable, shall be operated by means of an extension spindle and / or keys. Valves shall be suitable for frequent operation as well as operation after long periods of idleness in either the open or closed position. The valve stem, thrust washers, screws, nuts and all other components exposed to the water shall be of a corrosion resistant grade of stainless steel. All valves parts shall be in general of the material of construction best suited for the proposed application. The inspection category is detailed in subsection VII.

Acceptable Makes for BF valves:- Kirloskar/ Fouress/ Audco/ Intervalves/ R& D Multiples / Crane Process / BDK

Acceptable Makes for Ball Valves:- Fouress/ Audco / Crane / BDK

**Sluice Valves**

The gate face rings shall be securely pegged over their full circumference. Valves of 450 mm and above shall be provided with a thrust bearing arrangement for ease of operation. They shall also have renewable channel and shoe linings. The gap between the shoe and channel shall be limited to 1.5mm. Alternatively, valve of diameter 450mm and above may be provided with a gear arrangement for ease of operation. The operation gear of all valves shall be such that they can be opened and closed by one man against an unbalanced head 15% in excess of the maximum specified rating. Valve and gearing shall be such as to permit manual operation in a reasonable time and not to exceed a required rim pull of 80 N. All hand wheels
shall be arranged to turn in a clockwise direction for opening and counter clockwise for closing. These directions shall be indicated on the hand wheels. All valves shall be rated for not less than PN 1.0.

All valve doors when fully closed, will ensure door faces are riding on body seat ring by at least 50% of width of seat ring providing sufficient allowance for wear. Valves of diameter 450 mm and above shall be provided with a drain and air plug.

Acceptable Makes: Fouress/ Kirloskar/ Aodco/ IVC / Jash

**Material of Construction**

<table>
<thead>
<tr>
<th>Component</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body, Bonnet, Wedge</td>
<td>CI conforming to IS 210 Gr FG 260</td>
</tr>
<tr>
<td>Spindle</td>
<td></td>
</tr>
<tr>
<td>Drain and Air Plug</td>
<td>IS 318 Gr LTBZ</td>
</tr>
<tr>
<td>Seat Ring, Wedge Ring</td>
<td>SS ASTM A743 CF8</td>
</tr>
<tr>
<td>Back seat Bush</td>
<td>Bronze IS: 318 Gr LTB 2</td>
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<tr>
<td>Gland Packing</td>
<td>Graphide Asbestos</td>
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</table>

**Parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Rising spindle</td>
</tr>
<tr>
<td>Nominal pressure</td>
<td>2 times working pressure in pipeline</td>
</tr>
<tr>
<td>Nature of operation</td>
<td>Horizontal / vertical</td>
</tr>
<tr>
<td>Applicable code</td>
<td>IS 14846</td>
</tr>
<tr>
<td>Tests:</td>
<td>Acceptance tests as per IS 14846</td>
</tr>
</tbody>
</table>

**Knife Gate Valves**

Knife gate valves shall be suitable for use at suction and delivery side of pumps in a sewage pumping station. The valve should be provided with gate made of stainless steel and the gate should have beveled knife edge at the bottom to cut through and easily enter in the solids settled in the bottom and ensure positive shut-off / closure in sewage environment. The valve should be bonnet-less and suitable for face to face flange connections in between pipelines. It should be suitable for uni-directional application.

The valve body should be of Cast Iron Gr. FG 260. The body shall be designed to withstand 6 bar pressure.

The valve shall be provided with replaceable type flexible sealing seals to offer drop tight shut off. The seals should be made of EPDM rubber and should be held in place by an easily removable type seal retainer ring. The seal retainer ring should be designed in a manner so that the flow of the fluid should be away from the sealing perimeter and towards the center of the valve.

The valve housing should have integral as cast tapered lugs provided for pushing the gate towards the flexible rubber seal only at the verge of closure with a view to avoid seal
wear and achieve drop tight shut off. The surface of the gate coming in contact with the seal should be polished & buffed.

The valve shall be provided with sufficient ply of stuffing seals in the in built stuffing box to seal the rear opening. The stuffing box should have internal tappers for pushing the seals on to the gate. The seals should be of non-asbestos PTFE to reduce the friction and offer higher life. Provision shall be made to enable tighten the stuffing seals by means of a pusher arrangement to minimize the leakage through the back of the valve. Replacement of stuffing seals should be done in installed condition of the valve.

The spindle should be double start threaded and non-rising type for compact & safe operation. The gate movement area should be covered by protection shields. Gate opening indicating arrangement should be provided to find out the extent of gate opening/closing.

Acceptable Makes.

Flange drilling suitable to mount between flanges as per IS 1538 -1993.

- Body: Cast Iron FG 260 as per IS 210
- Knife gate: AISI:304 Gr. ASTM A240
- Retainer ring: SS:304 ASTM A351 Gr. CF:8
- Inlet Seal: EPDM
- Spindle: AISI:410 Gr. ASTM A276
- Spindle Nut: Cast Iron Gr. FG 200 as per IS 210
- Stuffing plate: Cast Steel ASTM A216 Gr. WCB
- Stuffing seal: Synthetic yarn with PTFE

Factory Tests:
Body test: The valves shall be hydrostatically pressure tested at specified pressure without any visible leakage.

Seat test: The valve shall be hydrostatically pressure tested for seat leakage at 2.8 bar for no visible leakage.

Reflux Valves
Reflux valve shall possess high speed closing characteristics and be designed for minimum slam conditions while closing. External counterweights are not acceptable. Dual plate check valves shall conform to API 594 and API 598. They shall have metal to metal sealing. The spring action shall optimize the equal closing rates of each plate, especially when the friction coefficients are uneven due to one plate resting upon another. The plates shall not drag on the seat while opening. The plates shall not vibrate under full or partial flow condition. The pressure drop in the valve at design flow shall be limited to 0.4 mWC.

Acceptable Makes:- H. Sarkar/ Fouress/ IVC/ Kirloskar / BDK / Crane / Intervalve

Material of construction
- Body CI conforming IS 210 Gr FG 220
- Plate SS AISI 316
- Spring SS AISI 316
- Seal SS AISI 304
### Parameters

<table>
<thead>
<tr>
<th><strong>Type</strong></th>
<th>Dual Plate.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nominal pressure</strong></td>
<td>Twice the pressure in pipeline</td>
</tr>
<tr>
<td><strong>Nature of operation</strong></td>
<td>Automatic</td>
</tr>
<tr>
<td><strong>Closure characteristic</strong></td>
<td>Non slamming</td>
</tr>
<tr>
<td><strong>Applicable code</strong></td>
<td>API 594</td>
</tr>
<tr>
<td><strong>Tests</strong></td>
<td>Acceptance tests as per API 598</td>
</tr>
</tbody>
</table>

### Pipe Work

In general, the colour code for piping shall be blue for potable water, white for air, red for gas and as received colour from manufacturer for all other sewage pipes. The pipe works for the plant involves procuring, supply, laying and jointing of suitable size electrically welded steel, cast iron, ductile iron, u PVC, RCC and PS CC pipes along with matching specials etc. as required. All yard piping inside the plant shall be cast iron or ductile iron. All pipe work and fittings shall be a class rating in excess of the maximum pressure attained in service including any surge pressure. The pipe work installation shall be so arranged to offer ease of dismantling and removal of pumps or major items of equipment. CI/DI Piping above ground level shall be only flange jointed and adequately provided with structural/ masonry supports. Stainless steel AISI 304 expansion bellows which can take radial and axial misalignment of minimum one percent of the valve nominal size and tie bolts shall be provided. All pipe work shall be adequately supported with purpose-made fittings. When passing through walls, pipe work shall incorporate a puddle flange. Flange adapters and union shall be fitted in pipe work runs, wherever necessary, to permit the simple disconnection of flanges, valves and equipment. The Contractor 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 suitably removed until immediately prior to connections adjacent pipes, valves or pumps. All small-bore 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 Employer’s representative. All underground-buried mild steel piping unless found otherwise necessary, shall be protected by the application of hot coal tar enamel and fiberglass wrapping. The coating shall consist of one coal tar primer one coat, wrapping of fiber glass one more coat of enamel and the final wrap of enamel impregnated fiber glass. However, all water supply plumbing pipelines shall be of UPVC class 4 thick-walled inside the premises in concealed piping. They shall be GI class B in external locations and either anchored externally with SS AISI fasteners or appropriately buried below the ground with a sand cushion of 20 cm all round. All sanitary piping shall be of UPVC class 4 suitably buried below the ground with a sand cushion of 20 cm all round. Changes in direction on the ground shall be achieved with inspection chambers of 45 cm x 45 cm and heavy-duty CI/Steel reinforced fiberglass chamber covers. Acceptable Makes for CS pipes:- Jindle tubes/ SAIL/ TATA- TISCO / Saw / Zenith

### Sludge Pipings

All the sludge piping shall be designed for frictional losses using a Hazen William “C” value of 45 because of the different characteristics of sludge as compared to clear fluids. The minimum size for gravity lines/pipes shall be 200 mm diameter as well as for suction of pumps. The minimum delivery piping for pumps shall be 80 mm. Velocities in the delivery lines shall be 1.5 to 2.0 m/s. All sludge lines should have provisions for flushing by means of
40 to 60 mm hose connectors positioned in inbuilt “Y” junctions in the form of specials. The minimum cover for buried pipelines shall be 1m.

**C I Pipes**
The C I pipes and specials their laying and jointing and their dimensions shall conform to IS 1536, IS 1538 and IS 3114 with their latest revisions. The quality of cast iron shall meet grade 15 of IS 210 and be free from flaws, air bubbles, cracks, sand holes and other defects and shall be truly cylindrical and of uniform thickness. The methods for sampling of C.I. pipes and fittings shall conform to IS 11606. Pipework outside the buildings shall use Tyton ring joints and inside, double flanged joints. All underground pipes shall be provided with granular bedding. Thrust blocks wherever required in the opinion of the Employer’s representative shall be provided in accordance with relevant specifications of the BIS

Acceptable Makes:- Electrosteel

**Tests:**
Following tests shall be carried out on the C.I. pipes:

(i) **Mechanical Tests**
    as specified in I.S. 1536 during manufacture of the pipes.

(ii) **Hydrostatic tests at works**
    The pipes shall be tested hydrostatically at the pressure specified in Table 1 for spigot and socket pipe and as per Table 2.0 for flanged pipes of IS 1536. The pressure shall be applied internally and shall be steadily maintained for a period of minimum 10 seconds and the pipes shall be moderately struck with a 700 gm hammer. The pipes shall withstand the pressure test and shall not show any sign of leakage, sweating, cracks or fracturing or other defects.

(iii) **Testing at site**
    The following site tests shall be carried out after a new pipe is laid, jointed and partially backfilled.
    (a) **Pressure test**
        The pressure test at a field test pressure specified in clause 7.2.1 of IS 3114 shall be carried out. Pipes and joints shall be absolutely water tight under the test. The procedure for testing shall be as per clause 7.2.1 of IS 3114.
    (b) **Leakage test**
        The leakage test shall be conducted as per clause 7.3 of IS 3114 and the leakage should be within the specified allowance as calculated using formula given in clause 7.3.2 of IS 3114.
    (c) **Water required for any type of testing shall be arranged by the Contractor, at his own cost.**
    (d) **Markings:**
        The following markings on the pipe shall be cast, stamped or indelibly painted-
        1. Manufacturer’s name or identification mark
        2. The nominal diameter
        3. Class reference
        4. Mass of pipe
5. The I.S. Code reference
6. The year of manufacture

The marking shall be done outside the socket or towards the end of barrels of the pipe. The coating on the pipes, both internally and externally shall be provided as per clause 15.0 of IS 1536.

**Galvanized Iron pipe**

The procurement, supplying, laying, jointing and testing at works and site of Galvanized Iron (G.I.) pipes and fittings shall be in accordance with IS 1239 (Part I and II) and its latest revisions. The general requirements relating to the supply of mild steel tubes shall conform to IS 1387. The sulphur and phosphorus requirements in steel shall not exceed 0.05 percent each. The galvanizing of the pipes shall be as specified in IS 4736. The zinc coating shall be uniform adherent, reasonably smooth and free from imperfections. The pipes shall be galvanized before screwing. All screwed pipes and sockets shall have pipe threads conforming to the requirements of IS 554. Gauging in accordance with IS 8999 shall be considered as an adequate test for conformity of threads of IS 554. Screwed tubes shall have taper threads while the sockets shall have parallel threads. The specifications for G.I. pipes shall be generally in accordance with Clause 15.4 of standard specifications. The tolerances on the length of pipes shall follow clause 11.0 of IS 1239 (Part I). The fittings for G.I. pipes shall be of mild steel tubular or wrought steel fittings conforming to I.S. 1239 (Part II). The laying of G.I. pipes and fittings shall follow the relevant I S code of practice. These pipes shall be used for drinking water supply for the office and laboratory buildings. The pipes shall be painted with two coats of anticorrosive bitumastic paint.

**Testing of G.I. pipes**

Hydrostatic test shall be carried out at works at a pressure of 5 M Pa, maintained for at least 3 sec and shall not show any leakage in the pipe. The tensile strength of length or strip cut from selected tubes, when tested in accordance with IS 1894 shall be at least 320 N / mm2. The elongation percentage shall be as per clause 14.1.1 of IS 1239 (Part I). The bend test shall also be carried out as per clause 14.2 of IS 1239. The G.I. pipes and fittings shall be tested at site, after they are laid and jointed as per clause 15.4.11 of standard specifications.

**HDPE Pipes: (Medium Density Poly Ethylene Pipe)**

The International standard specifies the required properties of pipes made from poly ethylene (PE). Confirming to ISO 4427:1996.

**PHYSICAL PROPERTIES.**

**Thermal stability**

When determined in accordance with ISO/TR 10837, the induction time for materials PE 63, PE 80 & PE 100 shall be either at least 20 minutes. When tested at 200° C, or an equivalent period when tested at 210° C provided the equivalence is supported by a clear correlation between results obtained at 200° C or 210° C respectively. In case of dispute, the test temperature shall be 200° C.

**Specification & Designation.**

The compound shall be designated by the material type (e.q. PE 80) conforming to the applicable level of minimum required strength. (MRS) specified in Table below.
The design stress $S$ of a pipe shall be obtained by applying a design coefficient $C$ of not less than 1.25 to the value for the material.

**Dimensions**
The dimensions of pipes shall be measured in accordance with ISO 3126.
The tolerances on the outside diameters shall be in accordance with ISO 11922-1 as
Grade A for normal tolerance (NT pipes)
Grade B for close tolerance (CT pipes)

**Length of pipe.**
The length of straight pipes & coils shall be not less than that agreed between supplier and user.

**Finishes.**
All internal surfaces of the pipes should be regular and smooth.
The shape of the finished ends should be fixed by the manufacturer to suit the type of joint used.

**Specials for MDPE pipes:-**
The specials should be manufactured from MDPE/Hard plastic, polyacetal split rings for positive grip and should sustain maximum working pressure 16 bar at 20° C. should be available in sizes 20mm (1/2”), 25 mm (3/4”).
The fittings 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.

**Unplasticized Poly Vinyl Chloride (uPVC) Pipes**
The latest versions of Indian standards and codes of practice shall be adhered to for the design, manufacturing, inspection, factory testing, packing, handling, and transportation, laying, and jointing of the UPVC pipes. The rubber rings shall be vulcanized from Ethylene Propylene (EPDM) confirming to IS 5382. The UPVC pipes shall be of minimum 4 kg/sq. cm and as per IS 4985 and the pipes for plumbing works in office building shall be SWR (Type B) as per IS 13592, with electrometric sealing rubber ring joints. The method of sampling of rubber rings should be in accordance with IS 5382. The material from which the pipes are made shall consist substantially of unplasticized polyvinyl chloride conforming to IS 10151, to which only those additives shall be added that are absolutely needed to facilitate the manufacture of the polymer and the production of sound, durable pipes of good surface finish, mechanical strength and opacity. The total quantity of additives like plasticizers, stabilizers, lubricants and fillers shall not exceed more than 7.0%. The bulk density of UPVC pipes shall be 1.39 to 1.44 g/cm³. The PVC resin of suspension grade K-66/K-67 shall be used for extrusion of UPVC pipe. The UPVC fittings shall be fabricated from Class 4 UPVC as per IS 4985.
Acceptable Makes:- Finolex/ Kirti/ Jain Irrigation/ Supreme

**Tests on Material:**
Following in house tests shall be carried out on the raw material:
(i) Grade (K-value)
Acceptance Test on Pipes:
The acceptance test shall be conducted in accordance with IS 4985 and in presence of the Engineer’s representative–
(i) Visual and dimensional check
(ii) Reversion test
(iii) Vicat softening test
(iv) Ash Content
(v) Bulk density
(vi) Resistance to external blows
(vii) Internal hydrostatic pressure test for pipes and joints
(viii) Opacity

Marking on Pipe:
Each pipe shall be clearly marked as indicated below:
(i) Manufacturer’s name and trade mark
(ii) Outside diameter (OD) in mm
(iii) Class of pipe and pressure rating
(iv) Month and year of manufacturing
(v) Length of pipe
(vi) Marking of insert depth of spigot

Marking on rubber ring:
Each sealing ring shall be permanently marked with
(i) The manufacturer’s name or trade mark.
(ii) The month and year of manufacture
(iii) Diameter of pipe for which the ring is suitable.
(iv) Type of rubber material

Tests on rubber ring:
Following tests shall be conducted on rubber rings conformity:
(i) Hardness
(ii) Tensile strength
(iii) Elongation at break
(iv) Compression set
(v) Accelerated ageing
(vi) Water Absorption
(vii) Stress relaxation

Ductile Iron Pipes
The DI pipes shall be centrifugally cast (spun) for Water and Sewage and confirming to IS 8329-2000. The pipes used shall be both gasket joints and flanged joints. The minimum class of pipe to be used shall be class K-9 conforming to IS 8329. In general, pipes inside the buildings and below the structures shall be jointed as double-flanged pipes and those outside the building can be either EPDM gasket in accordance with IS 5382 and manufactured by the
The pipes shall be supplied in standard lengths of 5.5m and 6.00m length with suitably rounded chamfered ends. Any change in the stipulated lengths will be approved by the Engineer’s representative. The flanged joints shall confirm to the Clause 6.2 of IS 8329. The pipe supply will also include one rubber gasket for each flange. Acceptable Makes:- Electrosteel/ Kesorem/ LANCO/Jindal SAW

**Inspection and Testing:**
The pipes shall be subjected to following tests for acceptance:
(i) Visual and dimensional check as per clause 13 and 15 of IS 8329.
(ii) Mechanical tests as per clause 10 of IS 8329.
(iii) Hydrostatic test as per clause 11 of IS 8329.
(iv) The test reports for the rubber gaskets shall be as per acceptance tests of the IS 5382 and in accordance to clause 3.8

The sampling shall be as per the provisions of the IS 8329.

**Markings**
All pipes shall be marked as per clause 18 of IS 8329 and shown as below:
(i) Manufacturer name / stamp
(ii) Nominal diameter
(iii) Class reference
(iv) A white ring line showing length of insertion at spigot end.

**Packing and Transport**
The pipes should be preferably transported by road from the factory and stored as per the manufacturer’s specifications to protect them from damage.

**Specials for DI Pipes**
The DI specials shall be manufactured and tested in accordance with IS 9523 or BS 4772. The mechanical test and hydrostatic test shall confirm to clause 9 and clause 10 respectively of IS 9523. The tolerances on dimensions shall be as per IS 9523. The D.I. fitting of Kejriwal Casting/Kiswok Make.

**Supply**
All the DI fittings shall be supplied with rubber rings for each socket. The rubber ring shall conform to IS 12820 and IS 5382. Flanged fittings shall be supplied with one rubber gasket per flange and the required number of nuts and bolts.

**Sluice Gates**
The construction of sluice gates shall be in accordance with the specification and generally as per AWWA C 501 or IS 13349. The sluice gates shall be capable of performing the duties set in the specification without undue wear or deterioration. They shall be constructed so that maintenance is kept to a minimum. All parts of sluice gate, including mechanism components shall be designed for the heads specified with a minimum safety factor of five. All sluice gates shall be of the raising spindle type.

All sluice gates shall be manually operated. Motorised gates, if provided by the Contractor, the actuator specs be got approved from the Employer’s representative. Acceptable Makes:- Jash/ IVC/ Kirloskar
**Constructional features**
The sluice gates shall be standard design of manufacturer’s and of robust construction. The special features shall be as follows

**Frame:**
The frames shall be of ample section and cast in one piece. All surface forming joints and bearings shall be machined. The frame shall be of the flange back type and shall be machined on the rear face to bolt directly to the machined face of the wall thimble.

**Guide:**
The guide shall be bolted to the frame or cast integrally with it and shall be machined on all bearing and contact faces. The length of the guide shall be such that it should support the gate upon the horizontal line of stem nut pocket. Arrangements shall be such that it should support the gate upon the horizontal line of stem nut pocket. Arrangements shall be made to prevent lateral movement of bolted on guides. They shall be capable of taking the entire thrust produced by water pressure and wedging action. Wedges or wedge facings shall be attached to the guides at point where, in the closed position, they will make full contact with the wedging surface on the slides.

**Seating Faces**
The seating faces shall be of full width, solid section. They shall be secured firmly by means of counter sunk fixings in finished grooves in the frame and slide faces in such a way as to ensure that they will remain permanently in place as well as free from distortion and loosening during the life of the sluice gates.

**Wedging devices**
Sluice gates shall be equipped with adjustable side, top and bottom wedging devices required providing contact between the slide and frame facing when the gate is closed position. All faces shall be machined accurately to give maximum contact and wedging action. Wedges shall be fully adjustable with suitable adjusting screws and lock nuts and so designed that they will remain in the fixed position after adjustment.

**Gate slides**
The slide shall be with strengthening ribs where required and reinforced section to receive the seating faces. The slide shall have tongues on each side extending its full length and tongues shall be machined accurately on contact surfaces. Surfaces of the slide that in come in contact with the seat facing and wedges shall be machined accurately. The maximum allowable clearances between the slide and slide gate shall be 1.6 mm. An integrally cast stem nut pocket with reinforced ribs shall be provided above the central line of the slide.

**Stem nut and Lift nut**
A gate shall be provided with lower fixed stem nuts for connecting the stem to the slide and revolving lift nut located in the lifting mechanism in the head stock. They shall be of ample design to endure the thrust developed during gate operating under maximum gate operating condition loads in opening and closing direction. The stem nut and slide shall be constructed to prevent turning of the stem nut in the pocket in the slide. The stem nut shall be threaded and keyed or threaded and pinned to the stem.

**Stem**
The operating stem shall be designed for a tensile strength to withstand 90 kg effort on the crank and for a critical buckling compressive load assuming a 36 kg effort on the crank. The threads of the stem be machine cut or rolled and of the square or acme type. The number of threads per inch shall be such as to work most effectively with the lift mechanism used. The top of the stem be provided with a stop collar. Stem shall be provided with polycarbonate cover fixed to the headstock.

**Stem coupling**
The coupling shall be threaded and keyed or threaded and bolted and shall be of greater strength than the stem.

**Stem guide**
Stem guides shall be cast, with bushings and mounted on cast brackets. Guides shall be adjustable in two directions and shall be so constructed that when properly spaced they shall hold the stem in alignment. The number of stem guides shall be such that the unsupported length of stem shall not exceed one hundred times its diameter.

**Lifting Mechanism**
Sluice gates shall be operated through a suitable lifting mechanism, which shall incorporate gearing if required. The lifting mechanism shall be suitable for operation by one man under all conditions. The lifting mechanism shall incorporate a strong locking device suitable for use with a padlock or padlock and chain. The manual operation shall be of the hand wheel crank operated type and shall have a lift nut threaded to fit the operating stem. The crank shall be removable. Ball or roller thrust bearings shall be provided above and below flange on the lift nut to take the load developed in opening and closing the gate with torque of 14 kg-m on the crank. Fittings shall be provided to lubricate gears and bearing. The design of the lift mechanism of the hand operated gates shall be such that the slide can be operated with torque is not more than 7 kg-m on the operator after the slide is unseated from wedges based on the operating head. The maximum crank radius shall be 380 mm.

**Gears and bearings**
All gears and bearings shall be enclosed in cast iron housing with labyrinth seals. The lifting mechanism shall be of cast iron pedestal, machined and drilled to receive the gear housing and suitable for bolting to the operating floor. The gates shall close with clockwise rotation of the crank. The direction of rotation to close the gates shall be indicated on the lift mechanism. A suitable means shall be provided for lubricating the stem threads directly adjacent to the lift nut. An inspection cover shall be provided to access the lift nut and gearing.

**Fasteners**
All anchor bolts, assembly bolts, screw, nuts etc., shall be of ample section to safely withstand the forces created by the operation of the gate.

**Wall thimbles**
The wall thimbles shall be made of cast iron and shall be supplied along with the gate. The wall thimbles shall provide a rigid mounting and designed to prevent warping of the gate frame during installation. The cross section of the thimble shall have the shape of the letter ‘F’. The front, or mounting flange, shall be machined and shall be attached to the thimble with bolts and studs. The depth of the wall thimbles shall not be less than 300mm. To permit entrapped air to escape as the thimbles are being encased in the concrete, holes not less than
35 mm diameter at not more than 600 mm span, shall be cast or drilled in each entrapment zone formed by the reinforcing ribs or flange and water stop.

### Material of Construction

Acceptable Makes:-

- **Frame, Guide, Thimble, Stem**
  - C I conforming to IS 210 Gr 260

- **Guide Bracket, Wedges,**
  - Bronze conforming to IS 318 Gr LTB 2

- **Door Sealing faces**
  - SS AISI 431

- **Spindle**
  - Natural or synthetic rubber conforming to IS: 1855

- **Anchor bolts**
  - SS conforming to IS 6603

- **Hand wheel**
  - Cast iron

- **Stem cover**
  - Polycarbonate transparent tube.

### Parameters

- **Type**
  - Rectangular rising spindle

- **Size**
  - As per requirement

- **Applicable code**
  - IS 13349

- **Class**
  - 1

- **Maximum seating head**
  - As per contractors design

- **Unseating head**
  - As per contractors design

- **Maximum distances between gates centre line and operating platform**
  - As per contractors design.

- **Tests**
  - Seat clearance check, moving tests, leakage tests and Hydrostatic tests as per IS 13349/ AWWA C 501 shall be conducted at Manufacturer’s works in accordance with the Inspection category.

### OPEN CHANNEL GATES

The manufacture of open channel gates shall be in accordance with the manufacturer’s standard.

- All open channel gates shall be of the rising spindle type.
- All open channel gates shall be manually operated.
- Open channel gates shall be tested as per manufacturer’s standard.

The open channel gates for pumping stations shall be CI sluice gates. All other gates shall be aluminum gates.

The material of construction shall be as follows.

<table>
<thead>
<tr>
<th>Components</th>
<th>Material</th>
<th>Specification</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gate frame, shutter,</td>
<td>Cast Iron</td>
<td>IS: 210 – 1993</td>
<td>FG: 260</td>
</tr>
<tr>
<td>Headstock, Flush bottom seal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>support bar, Stop nut.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sealing faces/ Seat facings</td>
<td>Stainless Steel</td>
<td>ASTM A276</td>
<td>AISI: 304, 316</td>
</tr>
<tr>
<td>Component</td>
<td>Material</td>
<td>Specification</td>
<td>Grade</td>
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<td>Resilient rubber seal</td>
<td>Natural Rubber EPDM</td>
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<td>AISI: 304, 316</td>
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<td>Seal retainer bar</td>
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<td>ASTM A276</td>
<td>AISI: 304, 316</td>
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<tr>
<td>Stem / Spindle</td>
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<tr>
<td>Operating Nut/ Stem Nut</td>
<td>Leaded Tin Bronze</td>
<td>IS: 318 – 1981</td>
<td>LTB 1, LTB 2</td>
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</tr>
<tr>
<td>Yoke</td>
<td>Mild Steel</td>
<td>IS: 2062 – 1992</td>
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</table>

**OPEN CHANNEL ALUMINIUM Gates**

The construction of Aluminum open channel gate shall be in accordance with the specifications mentioned hereunder. The open channel gate 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. The open channel gate shall be rising spindle type.

**DETAILS OF ALUMINIUM OPEN CHANNEL GATE.**

1. **Shape of water way**: Square / Rectangular.
2. **Size (W x H) in mm**: mm x mm.
3. **Mounting**: Suitable for mounting in between two parallel walls of an open channel.
4. **Type**: Self contained type gate with headstock mounted on the yoke of the gate frame.
5. **Top water level**: 200 mm less than gate height.
6. **Type of head**: Seating as well as Unseating.
7. **Distance between channel bed/invert of gate opening to top of operating platform**: meters.
8. **Method of operation**: Manually operated suitable for opening with maximum 18 kgs effort by a single person with maximum diameter of Hand wheel/crank being 750mm.
9. **Specific Construction Requirement for gate**: Gate frame shall be manufactured of non-corrosion 6061-T6 high strength extruded aluminum section weighing minimum of 5 Kg/m. Frame guides shall be made of UHMWPE to prevent metal to metal rubbing between frame and shutter. The shutter shall be made of same composition as the frame and sufficiently reinforced to restrict deflection to less than 1/360 of span under the design head. All parts of shutter shall have minimum thickness of 6mm. The complete gate assembly shall be given a coating of...
suitable epoxy lacquer.

10. Stem: Rising type unless otherwise specified.
11. Type of closure: Flush Bottom closure.
12. Sealing: Only at two vertical and bottom sides of gate aperture due to open channel installation.
13. Seal seat clearance: With the slide in the closed position shall not exceed 0.10mm.
15. Polycarbonat (UV resistant) transparent Pipe hood cover to cover the threaded portion of spindle and with additional mechanical stop nut on threaded stem.
16. Indicate number of hand wheel revolutions required to fully open the gate.
17. Approved Gate Makes: JASH / IVC
18. MATERIAL OF CONSTRUCTION:

<table>
<thead>
<tr>
<th>PART</th>
<th>MATERIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Gate frame, shutter/Door</td>
<td>Aluminium Alloy 6061-T6</td>
</tr>
<tr>
<td>b) Side Guides</td>
<td>Ultra High Molecular weight polyethylene</td>
</tr>
<tr>
<td>c) Seating faces</td>
<td>Aluminum</td>
</tr>
<tr>
<td>d) Rubber Seals</td>
<td>EPDM Rubber</td>
</tr>
<tr>
<td>e) Rubber seal retainer bar</td>
<td>Stainless Steel AISI-304</td>
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<tr>
<td>f) Drive Nut</td>
<td>Ledged Tin Bronze to Is : 318 LTB-2</td>
</tr>
<tr>
<td>g) Assembly bolts, nuts and</td>
<td>Stainless Steel AISI-304</td>
</tr>
<tr>
<td>fasteners</td>
<td></td>
</tr>
<tr>
<td>h) Stem &amp; connecting pin</td>
<td>Stainless Steel AISI-304</td>
</tr>
<tr>
<td>i) Yoke</td>
<td>Mild Steel to IS : 2062</td>
</tr>
<tr>
<td>j) Headstock</td>
<td>Cast Iron</td>
</tr>
<tr>
<td>k) Pipehood</td>
<td>Transparent Polycarbonate</td>
</tr>
</tbody>
</table>
19. PAINTING:

a) Paint for gate assembly: Epoxy primer and finish paint.
b) Paint for yoke and headstock: Epoxy primer and finish paint. Minimum coating thickness to be 150 microns.

20. SHOP TESTING: Following shop tests at manufacturer site will be conducted as per procedure mentioned hereunder.

a) Movement Test: Movement test should be conducted in assembled condition using stems & headstock. The gate should be operated once from full close to full open and back to full close condition with a max. force of 135 Newton-meter on the crank or hand wheel.
b) Dimensional Check: Important Dimensions shall be checked with reference to approved GA drawing.
c) Seat clearance check: With the gate in closed condition 0.1 mm thick feeler gauge should not pass through the sealing faces.
d) Material Test Certificates: Material test certificates for important components such as Frame, Side guides, Shutter, Rubber seals & Fasteners to be furnished at the time of inspection.

Fire Extinguishers
The Contractor shall provide 3 Kg CO2 fire extinguishers of suitable capacity and numbers for the treatment plant at the following locations after consultation with the Employer’s representative. These shall be provided as adhoc at the start itself and replaced fully up to date before handing over of the work. However for providing fire extinguishers in sub station, PMCC/MCC and control rooms, please refer to sub-section VI
Laboratory - 1
Blower room - 2
Near Gas holder (to be installed in future) - 1
Near Sludge digesters - 5
These shall be installed in a fashion such that their use is facilitated in case of fire emergency.

**First Aid kits**
The first aid kit shall consists of all materials, medicines necessary for treatment of cuts, wounds, burns etc., These shall be provided in addition to requirement mentioned in subsection VI as adhoc at the start itself and replaced fully up to date before handing over of the work
Laboratory
Rest room
Security room
Plant in charge room

**Emergency Lamps**
The Contractor shall provide for lamps with autonomy of 5 hours continuous service. The units shall be DC 6V and shall be rechargeable from any 5A plugs. They shall be continuously chargeable without damage to the battery at the following locations
Security room
Laboratory
Toilets
Vehicle parking area
Work shop
PMCC rooms, Control room, substation room and all rooms with starter panel
Portable lamp (1 No.) for use of operator to open the by pass gate in the event of power failure during night time.

**Exhaust fans**
The fans shall be as per IS 2312 and the blades shall of mild steel dynamically balanced to avoid noise and vibration. The blade and its carriers shall be securely fastened to avoid loosening in operation and shall have a SS AISI guard as a grill inside and a 10 sq mm mesh screen to safeguard birds from getting sucked in. The duty of the fans shall be calculated to ensure 3 to 10 air changes per hour in the command area depending on requirement. These shall be provided at the following locations
• Laboratory
• Rooms located with starter panel
• PMCC room
• Workshop
• Security room
• Toilets
Acceptable Makes:- Bajaj/ Crompton Greaves/ GE/ Khaitan

**Materials of Construction**
Casing: M S as per IS 2062
Impeller: Cast Aluminium
Test: As per IS 2312

**Chain Pulley Blocks**

Geared Chain Pulley Blocks shall be adopted. The monorail and trolley and the chain pulley block shall be provided for lifting the blowers and submersible pumps. The trolley and chain pulley block shall be hand driven. The capacity of the trolley and the chain pulley block shall be for the maximum weight to be lifted during erection and maintenance of the equipment but should not be less than 1 tonne. The traveling trolley shall run on the lower flange of the rolled steel joist. The trolley shall have two wheels on both sides of the joist web. The trolley wheels shall be single flanged with treads machined to match the flange of the beam. The wheels shall be of carbon steel casting conforming to IS 1030. The trolley shall have an arrangement for the fixing chain pulley block and sling. Pushing the load shall move the trolley. Suitable arrangement shall be provided on the joist to prevent over traveling. The chain pulley block shall have frame housing gears load sheave, brake unit, hand chain wheel and load chain wheel shall have hooks on both sides, one fixed with traveling and other for the load. The frame shall be of welded construction.

The gears shall be of spur type incorporating high grade hardened carbon steel pinion and heat treated carbon steel wheels. The width of the gear shall be adequately sized for long life. The driving pinion shall be integrated with the driving shaft. The load hook (bottom hook) shall rotate on the ball bearing. The chain shall be electrically welded, accurately calibrated, pitched and polished. The length of the load chain shall be sufficient for taking out the blower/pumps from their location. The hand chain wheel shall be provided with roller type guardings to prevent slipping the chain. The hand chain wheel shall hang to cleat of the hook. The braking shall be automatic, the screw and friction disc type and shall offer no resistance. The load shall be sustained in any position of lift when effort for hoisting or lowering is removed. Each chain pulley block shall be supplied with one set of 1 tonne sling with galvanized D-shackles and clamps. The slings shall be about 3 m long. The monorail shall be ‘I’ section. The exposed mild steel surfaces shall be enamel painted. The fasteners shall be GI or Cadmium plated. The chain pulley block shall be tested for 150% overload through a length of lift which will be ensure that every part of the block mechanism and every teeth of gears come under load.


**Valve Actuators**

**General**

All actuators shall be motorized type and local controls shall be protected by a lockable cover.

Each actuator shall be adequately sized to suit the application and be continuously rated to suit the modulating control required. The gearbox shall be oil or grease filled, and capable of installation in any position. All operating spindles, gears and head stocks shall be provided with adequate points for lubrication.

The valve actuator shall be capable of producing not less than 1½ times the required valve torque considering valve spindle jamming and shall be suitable for at least 5 continuous operation.

The actuator starters shall be integrally housed with the actuator in robustly constructed and totally enclosed weatherproof housing. The motor starter shall be capable of starting the motor under the most severe conditions. The entire electrical system shall be tropicalised.
The starter housing shall be fitted with contacts and terminals for power supply, remote control and remote positional indication, and shall also be fitted with internal heaters so as to provide protection against damage due to condensation. Heaters shall be suitable for single phase operation. The heaters shall be switched “ON” when the starters are “OFF” and shall be switched “OFF” when the starters are “ON”.

Each actuator shall be equipped as follows:

(a) AC electric motor with engage/disengage clutch mechanism of the dry type.
(b) Reduction gear unit (with thrust bearing if required)
(c) Torque switch mechanism
(d) Limit switch mechanism
(e) Geared hand wheel for manual operation of valve.
(f) Valve position indicator – open/closed
(g) Auto-Manual lever with suitable locking arrangement
(h) Valve position transmitter
(i) Reversing contactor starter complete with overload relays of suitable range and adequately rated control fuses
(j) Actuator with integral starter shall have selection between local/remote operation
(k) Local control switch/push buttons
(l) 415 V/110 V AC control transformer
(m) A white lamp for supervision of main supply to be provided locally.
(n) A potential free contact shall be provided to annunciate over-load trip/main supply failure on remote panel
(o) Provision for local as well as remote operation

Special Features

(a) Two (2) nos. interposing relays for matching the control voltage of remote commands.
(b) The motor shall be specially designed for valve operation, combining low inertia with a high torque and with linear characteristics.
(c) All motor actuators shall be provided with visible local valve position indicators mounted on the actuator assembly itself.
(d) The torque switch shall function to stop the motor on closing or opening of the valve, on actuation by the torque when the valve disc is restricted in its attempt to open or close. A minimum of two (2) torque switches, one for closing direction and one for opening direction shall be provided.
(e) The non-adjustable limit switches shall stop the motor and give indication when the disc has attained the fully open or close position. Provision shall be made for indication of stuck or jammed valve.
(f) All wiring connections from the various switches shall be brought out on to separate terminal box mounted on the valve, having liberal space for wiring and making connection.
(g) The terminal box shall be suitable for outdoor use and shall be weather-proof and dust tight.

3.0 - SPECIFICATIONS
(ELECTRICAL AND INSTRUMENTATION WORKS)

3.1- GENERAL SPECIFICATION

REQUIREMENT FOR OTHER ELECTRICAL ITMES:
Painting:

APPLICATION OF SHOP COATINGS:

a) Rust in the sheet steel, structural steel used for fabrication shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly hot water and drying. A lightweight zinc coating to class C as per relevant IS shall be applied. After phosphating thorough rinsing shall be carried out with clean water, followed by final rinsing with dilute dichromate solution and drying. After pre treatment, powder coats of thickness not less than 50 microns shall be applied.

b) Paint shade for all electrical equipment shall be 692 (smoke grey shade) and 631 (admiralty grey) for indoor and outdoor equipment respectively. Unless specifically instructed interior portions of all housings shall be painted with white colour. Paint shade references are as per relevant IS.

Sheet Metal Work:

Sheet steel used for fabrication of these or similar items shall be cold rolled sheet of 2 mm or hot rolled sheet of 2.75 mm.

All cubicles, panels, cabinets, kiosks and boards shall comprise rigid welded structural frames made of pressed and formed sheet steel thickness of not less than 2 mm cold rolled or 2.75 mm hot rolled. The frames shall be enclosed by steel sheets thickness of at least 2 mm cold rolled or 2.75 mm hot rolled, smoothly finished and free from flaws. Stiffeners shall be provided wherever necessary.

All doors, panels, removable covers, gland plates, etc. shall be gasketed all round the perimeter. Locking arrangement for doors / removable covers/ panels shall be hand operated type requiring no tools for locking or unlocking. Padlocking facilities where required shall be provided in addition to above along with padlocks and duplicate keys.

All doors shall be removable and supported by strong hinges of the disappearing or internal type and braced in such a manner as to ensure freedom from sagging, bending and general discretion of panel of hinged parts. The hinges should be in such a fashion that door once hooked in upper hinge automatically slides in the bottom hinge. Suitable compartment shall be made for mounting switch gear and compartment shall be fully isolated from other compartment.

SWITCHGEARS:

LV Switchgears, Circuit Breakers, SFU, MCCB’s, MCB’s RCCB:

LV Switchgears:

415 V switch gear shall comprise separate, segregated modules for each circuit in compartmentalized fashion. More than one module may not be arranged in the same
compartmentalised section. Medium voltage switchgear circuits controlled by circuit breakers shall be of drawout type. It shall not be possible to obtain access to an adjacent cubicle when any door is opened. Each door shall be interlocked and all line terminals, bus bar chambers & back covers must be shrouded between each vertical riser and there should be proper barriers. Not more than one air circuit breaker shall be mounted in one vertical bay.

Bus bars and cableways in 415 V switch gear shall run in separate segregated compartments and again these should be isolated from equipment chamber making minimum form 3B construction.

Instruments, relays and control devices shall be mounted flush on hinged door of the metering compartment located in the front portion of the cubicles.

Circuit Breakers:

a. **General:**
The circuit breaker shall be air break type with draw out design confirming to the relevant Indian standards. All the circuit breakers of the panel will be mounted in separate cubicles and will be of same make to maintain the uniformity.

The breakers will be draw out type and will be mounted on a rigid steel frame moving on horizontal ball, telescopic slides offering minimum of friction. The system will have horizontal, self aligning, isolating pairs of moving and stationary power and control contacts. The unit will have three horizontal positions corresponding to:

b. **Plugged In Position:**
Here both the Power and control contacts are in make position and the breaker gets mechanically locked in this position. The breaker can go in ON position only after being locked in this position.

c. **Test Position:**
Here the power contacts get isolated where as the control contacts can be kept in make status. The breaker can be mechanically locked in this position and make ON and OFF for testing purposes.

d. **Withdrawn Position:**
In this position the power and control connections are in isolated status and the moving portion of the breaker can be dismantled from the panel. An isolating shutter or set of shutters is to be provided for the automatic coverage of live power and control fixed isolating contacts in the withdrawn position.

All the breakers with remote closing arrangement will have a spring charging motor of single phase 230 V and a closing coil. In case of power failure the spring charging can be done manually with the help of button or lever. The circuit breaker should switch on only when the spring is charged fully which should be able to store energy for one closing and one tripping operation. The spring will also get fully charged when the breaker is in closed position. In this case the spring should store enough energy to make first tripping, one re-closing and the second tripping.
The breaker will have quick making trip free closing mechanism. The operation of the mechanism will be independent of the speed of the closing lever or the duration of the closing signal.

The breaker will have following indications distinctly notable from outside.

- Electrical indication of breaker ON status.
- Electrical indication of breaker OFF status.
- Electrical indication of trip circuit healthy.

All breakers will have switching ON and OFF time of less than 4 cycles and will have the following interlocks for the safe operation of the equipment:

- Breaker to ON only when mechanically locked in any of the three horizontal isolation position.
- When the Breaker is in "Plugged in" position it will go to ON position only with the front door closed.

The breakers will be provided with 6 Nos each of type NO and NC auxiliary contacts rated for 10 Amps AC at 415 V and 6 Amps DC at 48 V. These contacts are in addition to the ones already in use for the operation of the breaker and will be required for subsequent interlocks incorporated in near future.

Whenever requested mechanical positive interlocks will be provided between the operation of different breakers with the help of individually unique and suitable Castle Key Locks.

**Isolators Switches, Fuse Units & Fuses:**

These items shall conform to the latest IS13947 and following specifications:

a. The isolators and switch fuse units (SFU) will be three pole or four pole air break double isolating type capable of making and breaking the current as detailed below with out any abnormal deterioration in the life of equipment and without endangering the safety of the operators. Wherever isolable neutral is specified, neutral is terminated / isolated separately. Wherever switched neutral is specified, four pole switches will be used. All switches will be fully shrouded and a proper barrier plate will be used between phases.

b. In case of isolator/SFU supplying heater, lighting loads etc., the current is of 125% of full load current connected.

c. In case where the switch is supplying current to a group of motors this capacity of the isolator/SFU will be equal to full load current of all motors plus the locked rotor stator current of the largest motor of the group.
d. In case of the load being capacitors this capacity of the isolator/SFU is equal to 225% of the capacitor current.

e. In case of the DBs, SFU panel etc. the isolator/SFU will be mounted on the component plate of the module and the operating handle will be brought out for front access to enable the operation. The operation of the isolator/SFU will be interlocked with the isolator/ SFU in ON and OFF positions will be provided. Clear indications of ON and OFF positions of the handle will be shown on the front door for confusion free evaluation of the status of the isolator/SFU.

f. The operating mechanism of the isolator/SFU will be quick make, quick break type and it's speed of operations will be independent of the speed of the operating handle.

g. The isolator/SFU will be able to carry short-circuit current 1 for 10 cycles before the fault is cleared by the local/ remote fuses/breaker.

h. The SFU will have three fuses one in each phase to provide safety against high currents. The fuses will be only High rupturing capacity (HRC) type. The fuses should be capable of clearing the fault current on short circuited with out damaging the isolator/ switch and without endangering the safety of the operator and the adjacent equipment.

i. All the control fuses and the power fuses will be HRC type with current rupturing capacity of more than 41 KA at 440 V AC. No wire fuses or any other kind of fuses shall be used in the supply of electrical equipments for this project.

j. Shall have very high mechanical life e.g. 10000 operations for 800A.

k. Manufacturer to confirm that equipments have been tested as per IS13947.

**Contactor Type Motor Starters:**

Motor starter / contactor shall be of the electromagnetic type rated for uninterrupted duty. Contactors of DOL and star / delta starters shall be suitable for class AC 3 utilisation category and contactor for reversing starters shall be of AC 4 category. Contactors used for star / delta and forward / reverse shall be electrically interlocked. Main contacts of the contactors shall be silver faced. Operating coils shall be suitable for operation on 230V, 1 Phase, 50 Hz supply. Each contactor shall have minimum 2 Nos + 2 NC auxiliary contacts for interlocking and control circuits. Contactors shall have very high electrical & mechanical life and size shall confirm to only type II coordination. At least one spare 1 NO + 1 NC shall be provided for future use after using all control contacts for interlocking, control circuit in PLC/ DDC logics, indication and controls.

**Overload Relay:**

All the power load relays used for the protection of three phase induction / synchronous motors will be three elements, ambient temperature compensated, positive acting, manual reset, as well as auto reset from panel front, heavy duty, separately mounted, bimetallic thermal type relays with one change over contact rated
for 6 amps at 415 V AC. The resetting of the relay will be done by a push button located on the front door with the help of movement transfer by a flexible shaft in flexible cable outer between the push actuator and the relay reset point. The relay shall have single phasing prevention feature and shall be as per latest amended relevant IS. If due to PLC logic, more changeover NO/NC contacts are required then either relay shall have more changeover contacts or basic changeover (along with the relay) shall be multiplied to obtain extra contacts. The rating of these contacts should be rated for at least 2 times the current requirement.

For the equipment having higher inertia special arrangements will be made to short circuit the relay with or without resistance, with the help of a contactor and a timer. The shorting contactor will open after lapse of a preset time (Set on the timer) after the starting.

The adjustment range of the over load relay shall cover 70% and 110% of the full load currents of the motor it is protecting.

All motors of 100 H.P. and above shall have additional protection of earth leakage through core balance current transformers and winding temperatures shall be displayed. For these motors of 100 H.P. and above, the numeric type micro-processor based relays shall be used in place of conventional thermostatic overload relays.

**Moulded Case Circuit Breaker**

Moulded Case Circuit Breakers shall comply with IS-13947 and have a category of duty P2. They shall be of the low energy let through type incorporating positive ion quenching in order to ensure rapid arc quenching i.e. shall be of extra current limiting feature. It shall have provision of adding either one shunt trip or under voltage along with two changeover contacts at any stage.

The operating face plate shall have three positive positions ‘ON’, ‘OFF’ and ‘TRIPPED’ and this shall be used with front extended rotary handle. All contacts shall have phase barrier and extended links for aluminum suitability.

Tripping characteristic shall be of ambient temperature compensated and selected according to application, i.e. distribution, generation or motor duty. The size of MCCB shall be selected after taking necessary derating into account inside panel compartment. It shall have variable over current setting and variable short circuit setting.

**Miniature Circuit Breaker:**

Miniature circuit breaker ( MCB ) shall have 10 KA breaking capacity. If fault withstand capacity of MCB is less than that of the switchboard, backup HRC fuse or motor protection circuit breaker shall be fitted. MCB shall confirm to latest IS 8828 : 1996 and shall have lower watt losses and shall be rated for 10 KA and type ‘C’ Curve shall be used.

**Residual Current Circuit Breaker**

Residual current circuit breaker shall be current operated and comply with IS 12640 or BS 4293. The tripping current shall be selected dependent on location within the
supply network and the calculated loop impedances. It shall operate to trip all phases including the neutral.

**Unless otherwise specified the following sensitivities shall be applied:**

- Individual ring mains, ring main group or socket outlets 30mA
- Small consumer boards incorporating no other RCCB protection 30mA
- Small consumer boards incorporating RCCB protection on outgoing way 100mA
- Large consumer board incoming RCCB shall be at least 300 mA

The residual current circuit breaker shall be capable of withstanding the likely fault current at the point of installation.

**Bus Bars:**

Switchgears shall be provided with three phase or three phase and neutral bus bars. Bus bars shall be of aluminum and shall be insulated with close fitting fiber reinforced plastic sleeve. PVC sleeve shall be acceptable for LV switchgear. Insulating sleeves shall have R, Y, B, colour bands at suitable intervals for identification of phases and shall withstand 90 °C temperature. Bus bar used shall be Al 91E with minimum 55% conductivity. Bus bar will be designed for 500V with neutral bus bar size shall be half of phase. Bus bar sizes will be uniform through out horizontal run and again uniform on the vertical run. No reduction of bus bar size is permissible either in horizontal or vertical run and uniform life of busbar shall be adopted.

All bus bar joints and bus tap joints shall be plated. Bus bar joints shall be of the bolted type and shall be insulated with moulded caps. To provide a tight seal between adjacent cubicles, bus bars shall be taken through seal off bushings or insulating blocks.

Bus bars shall be adequately supported on insulators capable of withstanding dynamic stresses due to short circuit. The short circuit rating of bus bars shall not be less than that of the associated switchgear and bus bar ratings shall be worked out after taking deratings of ambient temperature and enclosure. Bus bar temperature shall not rise beyond 85º C. Bus bar temperature rise calculations, short circuit calculations along with SMC support distance shall be submitted at detailed engineering stage for approval alongwith temperature rise and minimum size of busbar selected. Similar calculations must be submitted for earth bus.

**Interlocks:**

Interlocks for LV circuit breakers shall comply with the following requirements:
a) It shall not be possible to plug in or isolate a closed circuit breaker. Attempted isolation of a closed circuit breaker from switchgear cubicle / module shall trip the circuit breaker.

b) It shall not be possible to close a circuit breaker unless it is in “service”, “test”, or “isolated” position.

c) Isolating devices, if provided shall be interlocked with breakers to prevent their making or breaking current.

d) It shall not be possible to close the circuit breaker in service position, without completing the auxiliary circuits between fixed and moving portions.

e) Where key interlocking is employed tripping of a closed circuit breaker shall occur if any attempt is made to remove the trapped key from the mechanism.

Test Operation Facilities:
A separate test position of the breaker shall be provided in the cubicle / module. It shall be possible to test the breaker in this position with all interlocks in the circuit.

Safety Shutters:
Switchgear cubicles shall be provided with safety shutters operated automatically by the movement of the circuit breaker carriage to cover the stationary isolated contacts when the breaker is withdrawn.

Switchgear Control Components, Devices and Other Features:
All individual components of control equipment associated with any item of pumping station shall be contained in a single control cubicle or panel.

All instruments, relays, switches, lamps, push buttons and the like shall be arranged on the cubical in a neat, functional and logical manner. The arrangement shall be subject to department approval.

Similar items shall be of the same type, style pattern or appearance throughout. Control and changeover selection switches for various functions shall be of the same type but with a handle of different shape for each specific function.

Instruments, control devices and relays mounted on different panel sections but having similar functions shall be located in a physically similar position. Such equipment shall be mounted at a operating height not exceeding 1800 mm and not less than 300 mm operating height above floor level.

Indicating Meters:
All indicating meters shall be digital type complete with inter-facing devices.

a) Display : 4-1/2 Digits, 7 segments red coloured LED
b) Accuracy : ± 1%
c) Inputs : From current transformer/voltage transformer as required.
d) Dimension of digits : 12.75 mm (Minimum)
e) Sampling rate : 4 samples/sec

**Indicating Lights:**
Indicator lights shall be not less than 20mm diameter and shall be panel mounted types with metal bodies adequately fastened so that the lamps shall be capable of replacement from the apparatus without disturbance to the lamp holder or panel wiring. Lamp holders shall be keyed into panels to prevent rotation. Lens colours shall comply with BS EN 60037 as follows:

- Power on: White*
- Running: Green
- Tripped/ alarm: Red
- Status (open, closed, etc): Blue
- Ready to start: Blue
- Warning (no imminent danger): Amber

Note: *white may be used where doubt as to which other colour to use.

The Lights shall be under-run to give long life either by use of a resistor to limit voltage to 90% normal value or by using higher voltage lamps.

The indicating lamps on control panel shall be cluster of LED’s.

**Pushbuttons:**
Colours of push buttons shall generally comply with IS 6875, BSEN 60947, 60037 or IEC 60073 and in particular shall be as follows:

- Stop, emergency stop: Red
- Start: Green
- Jogging/ inching: Black
- Reset (when not also acting as a stop): Blue
- Lamp test: Blue
- Override/ alarm accept: Yellow

**Control Transformers:**
Unless otherwise specified all control circuit supplies for contactor starters shall be obtained from a 230V, 50 Hz integral control transformer contained in the breaker or starter cubicle. In the case of motor control centers and composite boards comprising circuit breakers and starters one or more master control circuit transformers shall be provided for each section of busbars in the switchgear to feed a group of outgoing starters and / or outgoing breakers via bus wires in the board. Each control transformer shall be busbar connected and be provided with isolation facilities, and primary and secondary HRC fuses. Transformers shall be of the double wound pattern and be provided with earth screen between primary and secondary windings. One end of the secondary winding shall be earthed through a link. Each control transformer will have 100% standby and a manual change over arrangement between two control transformers.

L.T Current Transformers (CTs):
The current transformers to be used in the L.T. Electrical panels shall be low tension, ring/ rectangular type resin cast current transformer with the requisite currents ratio having secondary of the current transformers. For guidance the protective current transformers shall have an accuracy class 5P and an accuracy limit factor greater than 10. Low reactance current transformer shall be used for protection. Selection will be based on the following information:

a) For energy measuring : 1.0 class of accuracy.
b) For other metering : 1.5 class of accuracy.
c) For protection : 5P10 class of accuracy.

The current transformers to be selected for this panel will have at least 20% extra VA capacity available over the normal conventional meter capacity based on the following details:

- For ammeters conventional : 3 VA.
- For current coils of KW & KWH : 5 VA
- For current coils of PF.KVAR meters : 5 VA
- For all recorders conventional : 5 VA
- For normal wiring : 2 VA
- For current coil of protection relays : 10 VA.

The VA rating shall be calculated keeping 30% spare capacity and under no circumstances the VA rating of the CT's will be less than 15 VA. In case of low currents a primary wound CT will be chosen or a higher size ring type CT with 2 or 3 or 4 or 5 turns of primary conductor may be used to get the VA rating at required current ratio.

Terminal Blocks:
Terminal boards or block shall be of barrier pattern, stud type having covers of transparent insulating material.

All terminal blocks shall bear a permanent identification number and letter. Terminal blocks shall be of 650 V grade, 10A rated.

Dropping type shorting links shall be provided on terminal block for CT secondary shorting. Terminals used in conjunction with current transformer shall have facilities for shorting out of the output to enable removal of instrumentation.

Terminal blocks shall be of the screw clamp, rail mounted type to IS: 13947, VDE 0611 : Part 1 for connection of copper conductors up to 1000V.

The terminals used shall be suitable for the type of wire to be terminated and current carrying capacity.

Each terminal rail and each individual terminal shall be indelibly marked with a unique number corresponding to the schematic numbering system.

No more than two cables shall be terminated per clamp. Cross connections shall be used to link adjacent terminals where multiple wire connections are required.

Earth terminals shall be coloured green/yellow and shall clamp to the fixing rail in order to provide earth continuity.

Terminals of different sizes and for different voltage terminations shall be partitioned.

Where unisolated external voltages may be present, terminals shall be screened and a warning label fitted.

Terminals used in conjunction with current transformers shall have facilities for shorting out of the output to enable removal of instrumentation.

In any terminal arrangement adequate space shall be provided for the neat and logical termination of the incoming wiring. Terminal rails shall have provision for the installation of at least 10% additional terminals.

Terminals within cubicles and enclosures shall not be obscured and shall be easily accessed for installation and testing purposes, without removal of equipment.

**Anti Condensation Heaters/ Panel Internal Illumination:**

Each vertical section of MV switchgear shall incorporate wiring for supplies to anti condensation heaters. The wires will be energised from a single phase supply obtained from a separate distribution board. The heater circuit shall be controlled by a rotary type ON/ OFF switch, HRC fuse or MCB mounted inside the panel and adjustable type
thermostat. Multitier cubicles shall have cubicle heater and thermostat for each vertical panel section.

The heaters shall be located in cable alleys where such alleys are available or shall be located in the bottom portion.

Panels / panel sections shall be provided with fluorescent lamp lighting fixtures of 20W rating protected by HRC fuse and a switch or a MCB located inside the panel.

**Safety Arrangements:**

All terminals, connections, relays and other components which may be “Live” when front access doors are open shall be adequately screened / shrouded.

**Auxiliary Switches:**

Auxiliary switches/ devices shall be supplied as required for indication, protection, metering, controls, interlocking and supervisory purposes. They shall be readily accessible and enclosed in transparent dust proof cover.

**Panel Internal Wiring:**

Inside switchgears, motor control centres, annunciation panels, etc the wiring for control, signaling, protection and instruments shall be done with PVC insulated copper conductors of minimum 1.5 sq. mm size. Wiring for CT circuits shall be with 2.75 sq.mm copper conductor. The insulation grade for these control wires shall be 1100 V. Inter panel wiring shall be enclosed in PVC wire ducts.

Wiring for three phase circuits shall be colour coded red, yellow and blue for identification of relevant phases. For single phase AC circuits white coloured wires shall be used for phase conductor and black coloured for neutral conductor. Grey coloured wires shall be used for DC circuits and green coloured wires for earth connections.

Circuits in which the operating voltage exceeds 110V shall be physically segregated from all other wiring. All wiring shall be neatly and securely fixed by insulated cleats or run in insulated wiring troughs. Wiring shall be so arranged that access to any apparatus or connection point is not impeded.

Wiring carrying low-level DC signals shall be segregated from AC circuits and screened if recommended by the manufacture of associated equipment/ instruments. Spare contacts available on relays / devices etc shall be wired up to terminal blocks.

Wires shall be joined or tied between terminal points.

Each wire shall be identified at both ends by yellow colour PVC ferrules marked with black letters/ numbers. The letters/ numbers used for marking on ferrules shall correspond with the appropriate wiring diagram. Trip circuit wires shall be distinguished by an additional red colour. Ferrules of other colours, if used, shall be subject to departments approval.
Wiring termination shall be made with solder less crimping type tinned copper lugs. Insulated sleeves shall be provided at all termination.

**Main and Auxiliary Bus Bars:**

Bus bars shall be of uniform cross section throughout the length and made of high conductivity hard drawn conforming to IS 613.

**Safety**

Access to any enclosure shall be possible only when the circuit isolator is open and unless connections within the enclosure are isolated or fully shrouded against accidental contact.

Where a test facility exists for use with the enclosure door open all live contacts shall be shrouded to prevent accidental contact.

Isolators shall be pad lockable in the ‘OFF’ position. It shall not be possible to open the assembly door when the isolator is in the ‘ON’ position.

**Short Circuit**

The short circuit rating of the assemblies shall be suitable for the point of installation in the system. Where possible short circuit protective devices shall be coordinated to ensure that a fault in any outgoing branch does not operate the assembly incoming protection device.

**Earthing**

Assemblies shall be provided with earthing facilities as follows.

For small single compartment assemblies an earth stud shall be provided.

For large single compartment or multi-compartment assemblies a clearly marked continuous Alum./ GI earth bar of minimum 40mm x 5mm shall run the entire length of the assembly and shall be provided with terminals for connections to the metal cladding or armouring of all incoming and outgoing cables. The earth bus size shall be generally 10% of phase size subjected to meeting short circuit conditions and minimum size for any panel shall be 40x5mm.

The temperature rise of the busbar and connections under fault conditions shall not cause damage to the connections of any equipment to which they may be connected. The earth fault calculations shall be submitted along with detailed engineering.

No earth terminal bolts or studs shall be less than 8mm diameter.

An earth bond of minimum size 4 sq.mm. shall be made to all enclosure doors.

**Labels**
The assembly as a whole and each compartment shall be clearly and unambiguously identified.

The labels shall be engraved letters and numbers filled black on a white background.

Warning labels shall be engraved and filled black on a yellow background.

Labels shall be affixed with non-corrosive rivets or screws.

Internal labels shall be used to identify all components and terminal strips. They shall be of plastic in construction and shall be affixed adjacent to the component to which they appertain.

3.2 Internal Wiring Arrangement:

3.2.1. Internal Power Distribution

The internal power distribution arrangement for each assembly shall comprise of an MCB distribution board arrangement for each voltage present. Separate switches on these board shall be dedicated to individual circuits in order to ease fault finding and to localize faults.

Separate MCB’s shall typically be provided for supplies to:

**For 240 V AC**
- Power supplies
- CPU and input modules
- PLC output modules
- Transformers
- Rectifiers
- Each instrumentation loop
- Panel Lighting
- Panel cooling
- Anti-condensation heating
- Internal socket outlets

**For 24V DC**
- DDC input/ Output circuit and modules

Where specified auxiliary contacts shall be fitted to each MCB to indicate a trip.

The power supply for the 240V AC distribution board shall be derived from a UPS and voltage stabilizer providing immunity from mains voltage disturbances.

The 24V DC power shall be derived from a stabilized reliable voltage power supply.

3.2.2. Arrangement of Internal Components
Internal components shall be laid out in a logical manner in order to provide freedom of access to terminations and to allow removal of any component without interference to adjacent components.

Particular attention shall be paid to the location of heat dissipating equipment such as power supplies etc. in order that they do not have a detrimental effect on adjacent cabling or components.

Where necessary forced ventilation shall be provided by extraction fans mounted in the sides or access doors of the assembly as appropriate. Unless otherwise specified disposable filters shall be provided at the inlet grills. These shall be externally serviceable without affecting the operation of the assembly.

An over-temperature alarm signal shall be provided by the volt free contacts.

3.2.3. Terminal Arrangements

Cable entering and leaving an assembly shall do so via suitably positioned terminals.

Terminals shall be arranged in function groups as follows:

- Supply outputs to field devices
- Signal inputs from field devices
- Control output to starter section
- Signal inputs from starter sections
- Signal inputs to telemetry
- Signal outputs form telemetry

Within each group terminal shall be arranged in subgroups as follows:

- Voltage
  - Energised with panel door open
  - De-energised with panel door open
- Digital signal
- Analogue signal

Terminals for circuits at voltages greater than 24V that are not de-energised when the assembly door is open shall be screened and labelled accordingly. Wiring for different voltage like A.C. And D.C. shall be carried out by different colour and in case any components/voltage is live even if incomer of the panel is off then it should be labeled along with warning sign and orange colour wire should be used for this type of wiring.

Incoming and outgoing cables to intrinsically safe barriers shall connect to the barriers via knife terminals.

3.2.4 Lighting:
Each cubicle of an assembly shall be provided with an internal switched fluorescent luminaire. It shall be positioned to illuminate all internal areas of the assembly cubicle.

3.3 Motor Control Gear And Control Panel Assembly Control Facilities

Unless otherwise specified assemblies shall contain dedicated sections for motor drive, starters, common control, instrumentation, lamp test.

3.4 Motor Drive Starters

All starter modules shall be self-contained. The drives shall have manual and automatic control features selectable by manually positioning a starter mounted automatic/off/manual selector switch.

Facilities may also be provided for manual control to be carried out locally or remotely. If this facility is provided a remote/local selector switch shall be provided on the starter. In this instance a remote start/stop station is located adjacent to the drive. This station is only active when the starter is selected ‘manual’ and ‘remote’.

Control in manual mode shall comprise safety controls only.

Control in automatic mode shall comprise safety controls and process controls.

- Safety controls shall comprise controls necessary for the safe operation and protection of the drive in order to protect the drive itself and/or personnel. Typically these shall comprise flow check switches, run dry protection, overrun devices, torque switches, overload, over temperature, high pressure, emergency stop devices etc. These devices shall be hard wired direct to the starter and shall be independent of any PLC/DDC controls that may exist.

- Process controls typically interact with the drive via a PLC/DDC or hard wired logic. Typically these shall comprise controls for duty rotation, auto standby, level and flow control, sequencing, start up/shut down procedures, scheduling etc.

Section of manual control shall enable local drive start/stop controls at the starter itself or remote manual controls if fitted. In this mode the starter shall operate independent of process controls. All safety controls shall be operative.

Selection of automatic control shall deactivate local and remote manual controls. In this mode the starter shall respond to the dictates of process and safety controls.

For starters module of motors rated for 100 H.P. and above, they shall have (besides above protection) numeric type microprocessor relay along with temperature scanner for windings. There should be minimum two thermocouples/PT 100 devices for each winding. These should be wired from motor to starter.

3.5 Common Control Section
This section shall house:

Safety controls which are related to drive groups rather than specific drives. Typically these shall comprise run dry protection (when used in a common sump), group emergency stop control, etc.

Process controls facilities. These facilities shall typically be provided by a PLC. However, unless otherwise specified, hard wired logic will be acceptable for simple control schemes comprising less than twenty control relays.

Lightning protection barriers, if fitted, shall be installed at the base of the section adequately segregated from all other unrelated devices.

The common controls section may also provide facilities for the marshalling of starter module status, alarm and remote control signals in order to facilitate the use of multi core cable connections to remote locations.

The interior of the common control section shall be accessible without isolation of any drive or circuit. Therefore all voltages in excess of 24V shall be screened to prevent access.

Each circuit shall be individually protected by an MCB such that maintenance work can be carried out with the minimum of interference to running pumping station.

The front face of the common control section shall typically be fitted with pumping station controls, status indication and alarm annunciation facilities.

Alarm annunciation facilities shall show drive group faults, non-drive related faults and drive common fault alarms, Specific drive related faults shall be indicated at the drive module itself i.e. the common controls fault annunciator may indicate a fault on drive A but starter module A shall indicate precisely what the fault is.

3.6 Instrumentation
This section shall house equipment associated with field and panel mounted instrumentation. Lighting protection barriers, if fitted, shall be installed at the base of the section adequately, segregated from all other unrelated devices.

Each circuit shall be protected by an MCB such that maintenance work can be carried out with the minimum of interference to running pumping station.
3.7 **Lamp Test**  
Facilities shall be provided to test all lamps on an assembly. This shall comprise a common lamp test section. Operation of the lamp test circuit shall energise a relay in each section of the assembly in order to light each lamp and annunciator. The lamp test circuit shall pass through auxiliary contacts on section isolators if fitted. A short time delay shall ensure that the lamp test supply is retained to allow visual checking of all lamps.

On small assemblies, less than ten starters, individual lamp test buttons on each section shall be acceptable unless otherwise specified.

3.8 **Emergency Stop Circuitry**

Each drive or group of drives shall provide with an emergency stop facility which shall comprise a red coloured, mushroom headed, stay-put-twist to release push button.

The emergency stop device shall be located adjacent to the drive or drive group to which it relates and shall be clearly labeled.

Individual drive emergency stop devices shall be wired directly into the drive starter contactor circuit.

3.9 **Local Control Station**

These shall be of heavy duty construction and with the smaller sizes designed for mounting on or near the pumping station to be controlled.

The bottom face shall be arranged to accept with adequate space for the use of spanners, gland terminations for the number of cables required. Cables shall enter from the top generally.

Terminals provided for interconnections shall be easily accessible and marked with identification numbers/ letters corresponding with the associated diagrams.

Indicator lamps shall be not less than 20mm diameter and have projecting lenses with a wide angle of vision.

Pushbuttons and selector switches shall be of heavy duty, oil tight type of matching design. Legend plates shall be provided to identify equipment to be controlled and the purpose of each operating or indicating device.

Pendant type control for cranes, hoists, etc. shall be of moulded neoprene or equivalent heavy flexible, high impact strength materials, with a long moulded-in cable strengthening sleeve, to minimize the possibility of cable fracture at the bending point. The enclosure shall be coloured in safety yellow.
3.10 HV Switchgear Components:

3.10.1 Circuit Breakers:
Circuit breakers shall be ring main unit type. In case where SF 6 circuit breakers are used, shall be puffer type or self extinguishing type with rotating arc of dead tank and single pressure design. SF 6 pressure/ destiny monitoring switch/ contacts shall be provided.

The short circuit fault level of HT Panel shall be obtained from nearest power distribution agency grid station and shall be taken as minimum 350 MVA.

Vacuum breakers shall have completely sealed interrupting units for interruption of arc inside the vacuum. All breakers shall be provided with contact wear gauge and should be able to measure snatch gap below the interruptible vacuum bottle. It shall be possible to isolate easily the vacuum interrupted unit from the breaker operating mechanism for testing of the interrupter.

Vacuum breakers shall have completely sealed interrupting units for interruption of arc inside the vacuum. All breakers shall be provided with contact wear gauge and should be able to measure snatch gap below the interruptible vacuum bottle. It shall be possible to isolate easily the vacuum interrupted unit from the breaker operating mechanism for testing of the interrupter.

Circuit breakers shall be complete with surge arrestors ( if the breaker design necessities the same ) to provide protection to the equipment controlled by the breaker, against switching surges. However for motor starting application surge suppressors shall be provided.

Circuit breakers shall be fully rated for the specified ambient conditions.

3.10.2 Operating Mechanism for Circuit Breakers:
The circuit breakers shall be operated by a motor operator spring charging type mechanism. The motor operated spring charges mechanism shall be completed with motor, opening spring, closing spring and all accessories to make the mechanism a complete operating unit.

The tripping spring shall be charged by the closing action to enable quick tripping. Closing of the circuit breaker shall automatically initiate recharging of the spring to enable the mechanism to be ready for the next closing stroke. It shall be possible to manually charge the springs in an emergency. Transfer from motor to manual charging shall automatically disconnect the charging motor. The charging mechanism shall be provided with mechanical indicators to show ‘ charged ’ and ‘ discharged ‘ conditions of the spring. Failure of any spring, vibration or mechanical shock shall not cause tripping or closing of the circuit breaker. The operating mechanism shall be designed to release the spring to close the circuit breaker only by a deliberate action.

Only one closing operation of the circuit breaker mechanism shall result from each closing impulse ( manual / electrical), even though the breaker trips while the control device ( manual / electrical ) is being held in the ‘ close ‘ position.
The circuit breaker mechanism shall make one complete closing operation, once the control switch has been operated and the first device in the control circuit has responded, even though the control switch is released before the closing operation is complete, subject to the condition that there is no counter-impulse for tripping.

Spring of motor operated spring charged mechanisms should not discharge until they are fully charged, and the charging means are disconnected. All switch gear compartment like circuit breaker compartment busbar chamber, CT& cable box compartment should be provided with pressure relief flap. Metallic safety shutters should be provided for busbar spouts and circuit spouts be interlinked with movement of circuit breakers.

All operating mechanisms shall be provided with ON/OFF mechanical indicators.

A local manual trip device shall be provided on the operating indicators.

3.10.3. Isolators & earth switches:

Unless otherwise specified isolators and earth switches shall be off-load and fixed type. For vertical isolation type switch gear integral earthing facility for busbar side (for incomer breaker) or circuit side (for outgoing breaker) shall be provided by breaker transfer position principle. For horizontal isolation type switch gear earthing should be provided by integral earthing switch or earthing truck for busbar and circuit side.

Mechanical and electrical interlocks shall be provided where applicable to ensure that the isolators cannot be operated unless the associated breakers are open.

3.10.4. Circuit Earthing Facility:

It shall be possible to connect each circuit of the switchgear to earth, either through earthing switches or though trunk mounted earthing devices.

Earthing switches shall be mechanically interlocked with the associated breaker/isolator to prevent earthing of live circuit.

Necessary NO and NC auxiliary contacts shall be provided on each earth switch for interlocking with the respective circuit breaker.

3.10.5. Relays:

All relays shall be numeric type microprocessor type. Relays shall be equipped with operation indicator LED’s for visual indication. On three phase relays with separate phase elements, each phase element shall have separate indicator with phase identification clearly marked. Output elements of over current, earth fault & other relays shall operate through master tripping electro-mechanical relay.
All relays shall be suitable for flush mounting, with only the dust tight covers projecting from the front of the panel. All relays shall be accessible for setting and resetting from the front. Access to setting devices shall be possible only after the front covers of the relays are removed. Resetting facilities shall however be accessible external to the relay case.

All protective relays except auxiliary relays shall be of the drawout type. Where it is not possible to provide protective relays of the drawout pattern due to non manufacturing range, fixed type relays with facilities for plugging in a portable test plug shall be provided. Necessary test plugs shall be furnished along with the relays.

All relays shall be provided with positive action flag indicators visible from the front.

No control relay except under voltage relays, which would trip a circuit breaker when deenergised, shall be used.

Auxiliary relays shall be rated to operate satisfactorily between 80% and 110% of the rated voltage. Tripping relays shall be rated to operate satisfactorily between 50% and 110% of the rated voltage. The successful bidder shall prepare coordination chart of all relays with the help of graphic chart and shall submit it for approval. The successful bidder has to ensure that only immediate relay trips first.

3.10.6. Current Transformers (CTs):

All current transformers shall have a short time current rating of not less than that of the switchgear in which they are incorporated. CTs shall be resin cast type and shall have class 1.0. Rating of CT’s shall be worked out in such a way that 30% spare VA capacity is available.

Duplicate rating labels shall be fitted on the exterior of the mounting chambers suitably located to enable reading without the removal of cover or metal sheeting forming part of the structure of the switchboards.

3.10.7. Voltage Transformers (VTs): 

Voltage transformers shall be supplied where required. They shall have a winding ratio to give voltage between lines of 110V on the secondary. They shall have a rated burden, at the stated accuracy, in accordance with the requirements of all connected instruments, meters and relays and of any instruments or meter to which they may be connected via test blocks.

The primary circuit shall be protected by HRC fuses having a short circuit rating of not less than that of the Switchgear. The connection between the fuses and the switchgear primary conductors shall be capable of withstanding the short time current of the switchgear.
The secondary circuit shall be protected by HRC fuses mounted as closely as possible to the secondary terminals. The fuses shall have safe access for replacement without the necessity for complete isolation of the switchgear.

Windings for metering circuit shall have accuracy class 1.0 and those for protective circuits shall have accuracy class 5 P10.

VT shall shae continuous over voltage factor of 1.2 and short time over voltage factor 1.5 for 30 seconds for effectively earthed system and in case of resistively earthed system or non-effectively earthed system, the short time over voltage factor shall be 1.9 for 30 secs.

3.11 Switch Tripping Unit (Batteries, Battery Chargers and DC Distribution Boards)

3.11.1 General

Switch tripping unit shall comprise battery, charger and DC distribution board housed in a common sheet steel enclosure. The enclosure shall be of cold rolled cold annealed (CRCA) and thickness shall not be less than 2mm. Enclosure shall be of indoor, floor standing, totally enclosed, dust, damp and vermin proof of adequate strength and rigidity. Degree of protection shall be IP-42.

The equipment shall be so housed in the cabinet as to facilitate easy inspection and maintenance. To prevent accident all live parts inside the cabinet shall as far as possible be adequately insulated to avoid contact during maintenance.

All external fasteners shall be cadmium plated/ zinc passivated to withstand the atmosphere conditions. The cabinet shall be complete with all necessary wiring, cable glands and sockets for incoming and outgoing circuits and suitable circuit label/inscriptions made of non-rusting metal, 3 ply lamicoid or engraved PVC. Two earthing terminals shall be provided to earth the cabinet.

All the steel works of the cabinet shall be painted after suitable pretreatment with anti-rust paint and special finishing paint. The internal surface shall be painted in white and the external surface in dark admiralty grey colour.

3.11.2. Battery

Batteries shall be of high performance 30V DC lead acid SMF conforming to relevant IS. The battery calculations shall be attached with the bid.

Batteries shall be suitably sized to supply the control requirements of HT and LT breakers and Annunciations wherever required.
Batteries shall have cells housed in translucent, high impact plastic containers. The containers shall be fitted with vented filler pumps. High and low electrolyte levels shall be permanently marked on the container.

Cell terminals shall be of bolted type. The terminal polarity shall be permanently marked.

Battery cells shall be arranged so that each is accessible for test and inspection. Cells shall be arranged in single steps, double tier rack formation and shall be not less than 300mm above floor level.

Batteries shall be supplied complete with all necessary connections. The connections between tiers and cells and disconnection links and fuses shall be of the multi-stranded plastic insulated type.

The battery rack shall be made of mild steel painted with alkali resistant paints and shall be supplied in knocked down condition which could be bolted and assembled at site. The batteries shall rest on treated wooden planks inside battery racks.

3.11.3. Battery Charger

Battery Charger shall conform to relevant IS code. The charger shall be a float cum boost charger suitable for rating lead acid cells upto 1.85V per cell and also capable of quick charging the battery upto 2.2V / cell. The charger should be able to supply continuous DC load during boost charging with 10% margin.

3.11.4. Terminal Arrangement

The Battery and Battery Charger shall have terminals suitable for connecting PVC insulated, armoured aluminum cables. Approved type of terminal lugs and screwed type glands for the entry of cables in the panels shall be provided.

3.11.5. Accessories

Each battery shall be complete with all accessories and devices including but not limited to the following:

- Battery stands
- Set of inter-cell, inter-row and inter-bank connectors and number plates as required for the complete installation.

One number each of the following accessories shall be supplied with each battery unit.

- I-centre zero cell testing voltmeter to IS: 1248 scaled 3-0-3 volts/
- Plastic filling bottle
Insulated box spanner
Insulated tommy bar
End lugs
Bellavee washers
Lugged inter row cable
Vent caps

Battery Charger and DCDB shall be provided with the following Components.

- Double pole rotary switch for AC input
- HRC fuses with fittings for the above
- Pilot lamp to indicate the equipment ON condition
- Variac to give step less control of DC output voltage from 0-48V.
- Double wound, impregnated, naturally air cooled single phase mains transformer with taps.
- Single phase, full wave bridge connected, silicon controlled rectifiers. Stack with RC net work for each SCR for surge suppression.
- Filter circuit to reduce the ripple content to 3% RMS
- Moving coil ammeter of suitable range and size to measure the DC output current
- Moving coil voltmeter of suitable range and size to measure the DC output voltage.
- HRC fuses with fittings for DC output
- Voltage dropping diode with selector switch and contactor
- Cable connection from battery to charger
- Cubicle internal light operated from a 240V, single phase, AC system with on-off switch.
- Battery earth leakage relay comprising of solid state sensing/ triggering circuit with electromagnetic relay with center zero millimeter isolating switch and fuse.
- Space heater suitable for operation on 240V, 1 phase, 50 hz, A.C system with ON-OFF switch.
- Local auto/visual annunciations for the following faulty conditions shall be provided for:
  - Mains fuse failure
  - Rectifier fuse failure
  - Capacitor fuse failure
  - D.C output overload
  - Rectifier control supply failure

**DCDB**

- Incoming feeder for DCDB comprising 1 No. double pole on/ off rotary switch and 2 Nos HRC cartridge fuses of suitable rating.
- Required number of outgoing feeders each comprising 1 No. double pole on/off rotary switch and 2 Nos. HRC fuses of suitable rating
3.11.6. DC Power Supply:

The Power supplies will operate from 240V AC, and produce a 24V and 48V DC output voltage at full load current.

- **Voltage regulation**: 0.02% for ± 10% mains voltage variation
- **Load regulation**: 0.3% form zero to full load conditions
- **Triple at full load**: <1 mV rms

The power supply shall incorporate an over voltage protection circuit, the components of which shall be independent of the voltage regulating circuit.

The protection circuit shall operate within 50ms of an over voltage occurring and shall cause rupturing of the mains input or output fuses.

Automatic reset of the over voltage protection circuit is not permitted.

3.12 Motors

The bidder shall strictly adhere to following condition while selection of motor:

i. Motors of 3000 rpm are not acceptable. In turn the bidder shall not consider pumps/ drives of 3000 rpm/ 2900 rpm. 2 pole motor shall not be considered anywhere in the project. **Main Pump motor shall have speed less than 1000 rpm.**

ii. Bidder shall take in general 15% additional safety factor while selecting the motor's KW. Bidder while selecting motor size shall take 25% safety margin for motors upto 5 KW and 15% safety margin for motors rated above 5 KW. Safety margin is defined as safety on top of EKW required by pump plus efficiency of motor.

iii. All the motor shall be provided with class F insulation and with temperature rise limit of B class above ambient temperature when operating at full load.

iv. All the motors shall have overloading capacity as per latest revision of IS.

v. The noise level during the operation of the pump sets/ drive shall not exceed 85 dBA at a distance of 1.86 m from the pump/drive.

vi. The mechanical vibration limits shall be as required by BS 4675: Part 1 to class III, subclass B or better. Vibration measurements on the drive and non drive end of motor bearing, pump bearing housing and base plates shall not exceed 2.8 mm/sec. RMS within ± 10% rated head, while the limit is 4.5 mm/sec RMS for balanced portion from shut off to maximum flow. The above indicated vibrations shall be measured at the manufacturer’s works during testing. For the purpose of guarantees, the site tests shall govern.

vii. All motor shall be on LT system. However, the motors above 75 KW shall be of slip ring type.
Flameproof motors shall be considered in all gas handling areas. If any other area is considered hazardous by process requirement, then bidder shall provide flameproof motors for the same also. All switchgears of these motors placed in hazardous area shall also be flameproof type. Degree of protection of motors shall be as per BIS codes subjected to minimum as detailed below:

a  IP-54: Applicable for indoor installation in safe area.
b  IP-54: Applicable for outdoor installation in safe area.
C  IP-55/flp: Suitable for hazardous area.
d  IP-23: Suitable for indoor installation in safe area of motor rated more than 150 KW

3.13 Lighting Fixtures:
3.13.1. Luminaires

a. Luminaires shall be designed for continuous trouble-free operation without reduction in lamp life or without deterioration of materials and internal wiring. Outdoor fitting shall be weather-proof and rain proof type confirming to minimum IP-54 protection.
b. The luminaries shall be designed so as to facilitate easy maintenance including cleaning, replacement of lamps/ starters etc.
c. Connections between different components shall be made in such a way that they will not work loose by small vibration.
d. All luminaries shall be supplied complete with lamps suitable for operation on a supply voltage and the variation in supply voltage and frequency indicated in the department’s Requirement.
e. Fluorescent type, metal halide and sodium vapour type luminaries shall be complete with accessories like lamps, ballasts, power factor improvement capacitors, starters, re-wireable fuse and fuse base. These shall be mounted as far as possible in the luminaire housing only. If these cannot be accommodated integral with the Luminaires then a separate metal enclosed control gear box shall be included to accommodate the control accessories together with a terminal block suitable for loop-in, loop-out connections. Outdoor type fixtures shall be provided with outdoor type weather-proof box. No mercury vapour lamps shall be used indoor & outdoor. Mainly sodium vapour lamps shall be used outdoor.
f. Fluorescent type Luminaires with single or double lamp shall be provided with electronic ballasts and these luminaire shall be used upto maximum height of five meters.
g. Each luminaire shall have a terminal block suitable for loop-in loop-out and T-off connection by 250/ 400V, 1 core, PVC insulated copper/ aluminum conductor wires up to 4 sq.mm. in size. In outdoor areas the termination at the luminaire shall be suitable for 1100V, PVC insulated, copper/ aluminum conductor, armoured cables of sizes upto 6 sq.mm. alum. conductor or suitably sizes cable as per design. Terminals shall be of stud of clamp type. The internal wiring shall be by means of insulated copper wire of minimum 1.5
sq.mm. size and terminated on the terminal block. Terminal blocks shall be mounted with minimum two fixing screws.

h. Mounted facility and conduit knock-outs for the luminaries shall be provided.

i. Earthing

- Each Luminaire and control gear box shall be provided with an earthing terminal.
- 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

j. Painting/ Finish

All surfaces of the luminaire control gear housing accessories shall be thoroughly cleared and degreased. It shall be free from scale, rust, sharp edges and burrs.

The luminaire housing shall be stove-enameded/ epoxy stove-enameded - vitreous enameded or anodized as indicated under various types of fittings.

k. Flame proof luminaries shall be considered in all gas handling and other hazardous areas along with its control gear.

3.13.2. Decorative Luminaire

**Fluorescent Luminaires** shall be provided as per following guide lines:

a. These luminaries shall be generally indoor type provided with cold rolled cold annealed (CRCA) sheet steel channel/ rail cum reflector housing complete with all electrical control accessories mounted on it. The finish shall be stove enameded.

b. Decorative fluorescent type luminaries shall be provided with aluminum louvers providing minimum glare at work station.

c. Luminaires shall be suitable for the number of lamps of specified wattage, direct mounting on ceiling/ wall/ column pendant mounting or for recess mounting in false ceiling.

d. Decorative luminaries with mirror optic reflectors shall be of the wide angle dispersion type. Where these luminaries are mounted in control rooms and computer rooms, clip-on type adjustable reflectors which can be attached onto the tube shall be provided to direct the light output in the desired direction. This is mainly to reduce reflection of the light source form TV/ monitor screens.

e. Luminaires mounted recessed in false ceiling shall be with reflector housing and spring loaded fixing arrangement for the diffuser/ louver frame. It shall be possible to have access to the lamp and other accessories from below.
3.13.3  Industrial Luminaires

**Fluorescent Luminaires** shall be provided as per following guidelines:

a. The luminaire shall be provided with CRCA sheet steel mounting rail with reflector of minimum 22 SWG thickness and complete with all control accessories mounted on it. The finish shall be vitreous enameled.

b. Luminaires shall be suitable for the number of lamps of specified wattage, direct mounting on ceiling/ wall/ column/ pendent mounting.

c. The distribution of light shall be such that at least 80% of the total luminous flux from the luminaire shall be in the lower hemisphere.

d. The luminous output of the luminaire with reflector shall not be less than 75% irrespective of type of reflector used.

e. Luminaires for use in areas where chlorine is stored or dosed shall be fully enclosed to IP-65 and have a luminaire body constructed of GRP or some other non-metallic material resistant to attack by chlorine.

3.13.4.  Incandescent/ Metal Halide / Sodium Vapour Luminaires

3.13.4.1. Bulk head Luminare

The Luminare shall be robust construction, with cast aluminum/ vitreous enameled housing, heat and shock resistant prismatic or clear glass cover fixed with neoprene gaskets for sealing. For mechanical protection to the glass cover, round steel wire guard with vitreous enameled finish shall be provided.

The Luminare shall be suitable for incandescent lamp up to 150 watts, for direct mounting to ceiling/ walls/ column and used for general purpose indoor lighting.

3.13.4.2. High and Medium Bay Luminaires

- High medium bay luminaries shall be with cast aluminum housing, anodized aluminum mirror polished reflector canopy with eye bolt for suspension, cooling fins and glass cover.

- The luminaire shall be suitable for metal halide up to 1000W and sodium vapour lamps up to 400 watts. The control gear accessories shall be mounted integral with the luminaire.

- High bay luminaries shall be used when the mounting height is above 8 meters while medium bay luminaries shall be used when the mounting height is around 5 to 8 meters.
3.13.4.3. Flood Light Luminaire

a. General purpose flood Light Luminaire

Flood Light luminaries shall be of weather proof construction with cast aluminum housing, anodized aluminum mirror polished reflector, heat resistant, toughened glass cover and necessary neoprene gaskets to prevent ingress of dust.

The housing shall be supported on a cast iron base and capable of being swiveled in both horizontal and vertical directions and locked in any desired position.

For focusing purposes, knobs, shall be provided alongwith sector plate indicating the angle in degrees between 0-90 degrees, in vertical direction.

The luminaires shall be suitable for single and dual metal halide or sodium vapour lamps up to 400 watts. When metal halide or sodium vapour lamp specified, the same shall be mounted in a separate sheet metal enclosed/ cast aluminum weather proof control gear box.

The luminaire shall be provided with cable gland on the canopy in down ward direction for cable connection.

It shall be possible to adjust the lamp position to achieve wide beam, medium beam or narrow beam.

It shall be possible to replace the lamp from the canopy without opening the front glass.

b. Outdoor Lantern Luminaires Post top Lantern

vii. Post top lantern Luminaires shall be generally outdoor weather proof type of illumination of walkways, gate posts, gardens or in front of office area only.

viii. The luminare shall have cast aluminum spigot of 50/60 diameter finished with corrosion proof paint for mounting, opal acrylic or high density polyethylene (HDP) diffuser bowl, complete with integral mounted control gear, neoprene gaskets, earthing terminal etc.

3.13.4.4. Street Lighting Luminaires

a. Fluorescent Luminaires :

Street lighting fluorescent luminaire shall be outdoor weather proof type for illumination of secondary roads, walkways, peripheral lighting of buildings etc.

The luminaire shall be of semi-cut off or non-cut off type, CRCA sheet steel housing, vitreous enamelled, plain or corrugated clear acrylic cover, complete with integral mounted control gear, neoprene gaskets, side pipe entry or top suspension type.

The outdoor luminaire shall have IP 55 enclosure.
b. Sodium vapour luminaries

Street light sodium vapour luminaries shall be outdoor weather proof type for illumination of main roads, traffic islands etc. The Luminaire shall be of semi-cut off with cast aluminum housing, acrylic or prismatic cover, polished aluminum reflectors, complete with integral mounted control gear, neoprene gaskets and with near pipe entry. The luminaire shall be suitable for 1 x 150W/ 1 x 250W / 2 x 150W / 2 x 250W sodium vapour lamp and for mounting heights up to 9 meters from natural ground level.

c. Emergency Light Luminaires

☐ Emergency light of installite luminaire shall be indoor type for providing emergency light during failure of normal AC supply.
☐ The luminaire shall be with CRCA sheet steel enclosure, complete with metallised mirror reflector, leak proof re-chargeable battery rated for two hour discharge, battery charger, charger-on lamp, push button switches, automatic changeover switch/ relay, two meter length cord with plug, mounting pads and other accessories required for satisfactory operation of the luminaire.
☐ The luminaire shall be suitable for connection to 240V, 50 Hz single phase supply. On failure of normal A.C supply the luminaire shall pick-up automatically and on restoration of A.C supply the luminaire shall switch off automatically. The luminaire shall be suitable for incandescent lamp up to 40W or fluorescent lamp up to 20 watts.

3.13.4.5. Accessories For Luminaires

a. Reflector

The reflectors shall be made of CRCA sheet/ aluminum/ silvered glass/ chromium plated sheet copper as indicated for above mentioned luminaries. The thickness of steel/ aluminum shall comply with relevant standards. Reflectors made of steel shall have vitreous enameled finished. Aluminum used for reflector shall be anodized/ epoxy stove enameled/ mirror polished. The finish for the reflector shall be as indicated for above mentioned fittings. Reflectors shall be free from scratches or blisters and shall have smooth and glossy surface. Reflectors shall be readily removable from the housing for cleaning and maintenance without disturbing the lamps and without the use of tools. They shall be securely fixed to the housing by means of positive fastening device of captive type.

b. lamp/ Starter Holders

Lamp holders shall have low contact resistance, shall be resistant to wear and shall be suitable for operation at the specified temperature without deterioration in insulation value. They shall hold the lamps in position under normal condition of shock and vibration met wit under normal installation and use.
Lamp holders for the fluorescent lamps shall be of the spring loaded bi-pin rotor type. Live parts of the lamps holder shall not be exposed during insertion or removal of lamp or after the lamp has been taken out. The lamp holder contacts shall provide adequate pressure on the lamp cap pins when the lamp is in working position.

Lamp holders for incandescent, mercury vapour and sodium vapur lamps shall be of Edison Screw (E.S.) type.

The starter holder shall be so designed that they are mechanically robust and free from any operational difficulties. They shall be capable of withstanding the shocks met within normal transit, installation and use.

c. Ballasts (Electronic)

The ballasts shall be designed to have a long service life, low power loss & high power factor. Ballasts shall be mounted using self locking, anti-vibration fixings and shall be easy to remove without demounting the fittings. They shall be in dust tight, non combustible enclosures.

Separate electronic ballast for each lamp shall be provided in case of multi lamp luminaries, except in the case of 2 x 20W luminaries. Electronic ballast shall have very high power factor (more than 0.95) and harmonic distortion shall be less than 10%.

Voltage variation of ballast shall be between 140-320V.

d Lamps

Incandescent lamp

General Lighting Service (GLS shall be tungsten filament incandescent type. The filament shall be coiled coil type rated for 230/250V, single phase A.C. Lamps shall be with Edison Screw type metal lamp caps. Lamps shall milky white for diffused, soft, glare free lighting and rated up to 100 watts.

Fluorescent Lamps

Fluorescent lamps shall be low pressure metal halide type with low wattage consumption and high efficiency and longer burning life (above 2500 hours). Lamps shall be of white light type suitable for operation on 240V, single phase A.C in standard lengths of 2, 4 and 5 feet and ratings upto 65 watts. Lamps shall be provided with features to avoid blackening of lamp ends.

High intensity discharge lamp

These lamps include high pressure metal halide lamps and high pressure sodium vapour lamps.

High pressure metal halide lamp shall be with quartz discharge tube, internal coated shall, quick restrike time (of within 8 minutes) and with burning life (above 10000 hours) in standard ratings up to 400 watts.
High pressure sodium vapour lamp shall be with polycrystalline translucent, coated discharge tube, coated shell, quick restrike time (of within 5 minutes) and with burning life (above 10,000 hours) in standard rating up to 400 watts.

3.13.5. Lighting System Equipment

Main Lighting Distribution Boards and Lighting Panels (AC & DC)

Construction Features

Boards and panels shall be sheet steel enclosed and shall be fully dust and vermin proof, providing a degree of protection of IP-52. Outdoor panels shall in addition be completely weather-proof with a sloping canopy for protection against rain and providing a degree of protection of IP-55. The sheet steel used for frame shall be cold rolled of 2.0mm thick or 2.75 mm hot rolled and all frame enclosures, doors, covers along with partitions will be of same thickness.

All boards and panels shall be provided with hinged doors for access to equipment. Doors shall be gasketted all round with neoprene gaskets. For the main floor mounted distribution boards with the switch fuse units arranged in tier formation, the hinged door of each unit shall be interlocked so as to prevent opening of the door when the switch is ON and to prevent closing of the switch with door not fully closed. However, a device for by-passing the door interlock shall be provided to enable the operation of the switch with the door open, when necessary, for examination/maintenance. For wall mounting 1-phase ways lighting panels wherever provided with MCBs, arranged latched front door shall be provided with key-locking facility and slotted bakelite sheet shall be provided inside. Only the MCBs operating knobs or the fuse cap covers shall project out of the bakelite sheet slots for safe operation and neat appearance. Incomer to lighting panels shall be provided with TPN MCB with RCCB. Lighting panels shall be manufactured with 1.6 mm cold rolled sheet.

All accessible live connections/metal shall be shrouded and it shall be possible to change individual fuses, switches, MCBs from the front of the board panels without danger contact with live metal.

For floor mounting type distribution boards, adequately sized mounting channel shall be supplied and for wall/column/structure mounting type panels suitable mounting straps shall be provided.

Adequate interior cabling space and suitable removable cable entry plates shall be provided for top/bottom entry of cables through glands and or conduits as required. Necessary number of glands to suit the specified cable sizes shall be provided. Cable glands shall be screwed on type and made of brass.

Two earthing terminals shall be provided.
All sheet steel parts shall be undergo rust-proofing process which should include degrading de-scaling and a recognized phosphating process. The steel works shall be then painted with two coats of Zinc-chromate primer and two coats of final stove-enameded finish paint of specified colours.

3.13..6. 415V, 3 Phase Switch Socket Outlets (Receptacles):

Switch socket outlets shall be suitable for operation on 3 phase, 4 wire, 50 Hz supply system. The switches and sockets shall conform to relevant standards. These units shall be housed in epoxy painted sheet steel boxes and shall be suitable for outdoor installation. The units shall be fed from power distribution boards / switchgear etc. located in relevant areas.

3.13.7. Receptacles (Lighting and Small Power):

Decorative and industrial type receptacle (receptacle means a combination of a socket and a switch) units of approved make with switches shall be supplied. The units shall be suitable for mounting flush or within painted sheet steel boxes. Decorative receptacles shall be 5A / 15A rated with 5 pin sockets and 15A switches. Industrial receptacles shall be of 20A rating along with MCB.

3.14 Ceiling Fans & Exhaust Fans:

Ceiling fans shall be provided in areas such as offices, stores etc. Adequate ventilation arrangements shall be made for enclosed areas where ceilings fans are not proposed to be installed or cannot be provided.

Power supply for the ceiling fans shall be derived from lighting circuits. Ceiling fans shall be complete with all accessories. Regulators shall be electronic type. Heavy duty exhaust fans shall be installed in plant rooms as to achieve a 20 air changes per hour.

3.15 Samples:

Contractor shall be required to obtain department approval for samples of items such as lighting fixtures of each type, ceiling fans, switch socket outlets of each type and rating, light/fan control switch of each type and rating, push buttons, conduits of various sizes, junction boxes, cable trays, wires and earthing conductor to be used for lighting system etc. before commencement of installation work.

3.16 DRAWINGS:

Following minimum data / information shall be made available on contractors drawing:

a). Single line diagrams for AC and DC system.

i). All equipment with rating.

ii). Cable details for all circuits.
iii). Details of relays and major components related associated with each circuit.

iv). Bus bar details makes of equipment/ components.

v). Relevant reference drawings.

b). General arrangement drawings (equipment, cabling, earthing, lighting, lightning protection etc.).

i). Dimensional layout drawing composite layout of these items.

ii). Plans and sections as required to show access space/ clearances etc.

iii). Civil foundation details, details of cutouts, openings, supporting/ mounting details etc.

iv). Bill of material, identification of components / rooms / area etc.

3.17. INSPECTION OF EQUIPMENT:

a) All equipment shall be offered for inspection by the contractor. Inspections shall be carried out at the works of relevant manufacturers in the presence of DEPARTMENT representative. Routine type and acceptance tests as applicable shall be carried out during inspection. Tests and test procedures detailed in relevant standards shall be adopted.

b) All measuring/ test instruments used for such tests shall be calibrated and certified by an approved independent testing authority. Supporting calibration certificates shall be provided. The DEPARTMENT representative reserves the right to impound any instrument immediately after test for independent testing. A certificate shall be provided by the contractor prior to carrying out every test showing the readings obtained, calculations and full of the calibration certificates referred to. On the day of testing, calibration validity shall not have expired.

c). Items of equipment/system not covered by standards shall be tested in accordance with the details and programmed agreed between the employer and contractor.

d). If during or after testing any item of equipment/systems fails to achieve its intended duty or otherwise prove defective it shall be modified or altered as necessary, retested and reinspected as required by the DEPARTMENT.
e). No equipment / system is to be delivered to site without inspection having been carried out or officially waived in writing by DEPARTMENT representative.

3.18 INSTALLATION WORK:

Equipment shall be installed in a neat, workman like manner so that it is level, plumb, square and properly aligned and oriented. Tolerance shall be as established in the manufactures drawing or as stipulated by DEPARTMENT. No equipment shall be permanently bolted down to foundation of structure until the alignment has been checked and found acceptable by DEPARTMENT.

Manufacturer’s drawings, instructions and recommendation shall be correctly followed in handling, setting, testing and commissioning of equipment.

Contractor shall be required to obtain approval of DEPARTMENT in respect of sample installations at commencement of any installation activity, these may include but be not limited to activities such as mounting of lighting fixtures/switch socket/switches/junction boxes etc., cable terminations, fixing of supports for cables/conduits etc., alignment/routes of cable/conduits/cable trays etc. More details in this regard shall be finalized with the contractor at site.
3.19 INSTRUMENTATION

3.19.1 Flow Measuring System
Flow measuring system shall consist of flow sensor/ transducers, flow computer and flow transmitter.

Flow transducers shall be rugged in construction and shall be suitable for continuous operation. Flow transducers shall have waterproof construction and shall be suitable for installation in underground/above ground pipeline.

To avoid the effects of disturbances in the velocity profile, a straight and uninterrupted run, upstream as well as downstream from the location of the flow sensor shall be provided in accordance with the requirements of the flow meter manufacturer.

The flow transmitter shall be suitable for field or panel mounting and shall accept an input from the flow sensor. It shall process the input signal and provide 4-20 mA dc output proportional to flow rate. The flow range shall be adjustable.

A zero span adjustment facility shall be provided for flow transmitter and indicator.

Flow measurement shall not be affected by physical properties of sewage viz., temperature, pressure, viscosity, density etc., within given limits. Contractor shall provide compensating electronic circuits if required. The overall accuracy of flow measuring systems shall be at least ±1.0% of the measured value unless otherwise stated.

3.19.2 Electromagnetic Flow meter
Full bore electromagnetic flow meter shall consist of flow sensors (i.e. flow tube), transmitter and remote flow indicator cum integrator.

The flow meter shall have flanged connection and shall be inserted in the sludge line.

The flow computer/ transmitter shall be microprocessor based and shall have diagnosis facility.

Remote flow indicator cum integrator shall be provided on the control panel.

To ensure full electromagnetic compatibility the flow tube flanges and transmitter housing shall be connected earth.
3.19.3 Open Channel Flow Meter

Open channel flow measuring system shall consist of level transducer, flow computer and flow transmitter. The level of the fluid in the flume shall be measured by the ultrasonic level transducer. The level measured shall be used along with the physical characteristics of the flume to compute the flow rate.

The level transducer shall be suitable for flange or bracket mounting as required and shall be environmentally protected as per IP65. It shall have ambient temperature compensation and adjustable datum setting facilities.

The design and application of ultrasonic level meter shall take into account the channel construction, the material size, shape, environment, process fluid or material, the presence of foam granules, size etc.

The installation shall avoid any degradation of performance from spurious reflections, absorption, sound velocity variations, sensor detection area, temperature fluctuation, specific gravity changes and condensation. For application where spurious reflections are unavoidable the control unit shall be provided with facilities for spurious reflection rejection.

The structure required for supporting the level sensor, platform, railings etc. shall be in the Contractor’s scope.

3.19.4 Level Measuring System

3.19.4.1 Ultrasonic Level Meters

Ultrasonic level measuring devices applied for liquid level measurement shall comprise a transducer, control unit and remote indicator.

The transducer shall be suitable for flange or bracket mounting as required and shall be environmentally protected to IP 65.

The design and application of ultrasonic level meters shall take into account the vessel or channel construction, the material, size, shape, environment, process fluid or material, the presence of foam granules, size etc.

The installation shall avoid any degradation of performance from spurious reflections, absorption, sound velocity variations, sensor detection area, temperature fluctuations, specific gravity changes and condensation. For applications where spurious reflections are unavoidable the control unit shall be provided with facilities for spurious reflection rejection.
If turbulence exists, shielding, stilling tubes or other measures shall be provided to avoid effects on the measurement.

### 3.19.4.2 Conductivity Level Switches

The electrodes used for conductivity level switches shall be stainless steel. Single electrode systems (one electrode per holder) shall be used (except where their use is impractical) with insulated electrodes such that only the tip of each electrode is exposed to the liquid at the operating level.

Relay or control units operating with level electrodes shall have adjustable sensitivity. Electrodes for use in fluids of low or variable conductivity shall be fitted with conductivity discs.

Where relay or control units are not mounted in control panel, they shall be provided with surface mounting enclosures with a degree of protection to IP-54 for indoor locations or IP 65 for outdoor location.

### 3.19.4.3 Ultrasonic Differential Level Measuring System

The ultrasonic type differential level measuring system shall consist of ultrasonic type level sensors on upstream and downstream of screens, differential level computer / transmitter and indicator.

The flow computer / transmitter shall be microprocessor based and shall have facility for programming (i.e. adjustment of set points).

The ultrasonic transducer shall be suitable for flange or bracket mounting as required and shall be environmentally protected as per IP-65. It shall have ambient temperature compensation and adjustable datum setting facilities.

### 3.19.5 Pressure Gauges

Pressure gauges shall comply with BS 1780. Snubber shall be provided where the gauge is subjected to pressure pulsations and / or vibrations. The internal parts of pressure gauge shall be of stainless steel material. In chloride applications the diaphragm shall be silver or tantalum for other fluids an appropriate diaphragm material shall be used. The pressure gauges shall be provided with diaphragm seal arrangement.

The minimum diameter for round pressure gauges shall be 150mm unless specified otherwise or where the gauge forms part of a standard item of equipment.

The accuracy of pressure gauges shall be ±1% over the operating range.

The zero and span of pressure gauges shall not change by more than ±0.1% of the span per (Degree C) changes in ambient temperature.
3.19.6 Surge Protection Devices

Surge protection devices (SPDs) shall be suitable for withstanding the surge arising out of high energy static discharge / lighting strikes and protect the instrument to which it is connected against damage. SPDs shall provide protection through the use of quick acting semiconductors like Tranzorb, zener diodes, varistors and an automatic disconnect and reset circuit. SPDs shall be passive and shall require negligible power for operation. During the occurrence of a surge it shall clamp on the allowable voltage and pass the excess voltage to the ground. The SPD shall be self resetting to minimize the down time of the measurement loop.

SPDs shall be provided to protect devices transmitting and receiving analogue and digital signals derived from field devices located outdoors.

The surge protection device shall be rated for surge rating of 10kA.

3.19.7 Cabinets for Field Instruments

Wall mounted cabinets shall be provided for enclosing transducer unit and associated accessories which are mounted outside the main control panel. The cabinet shall be of die-cast aluminum, field provided not less than IP-55 protection and shall be lockable. The cabinet shall have facilities for earthing. A steel plate shall be provided inside the cabinet for mounting instrument and accessories.

3.19.8 Alarm System

Alarms shall be initiated by the opening or closing of volt-free contacts which shall remain unchanged throughout the periods in which the alarm conditions exit. Alarm Circuits shall be capable of conversion from open-healthy to open-alarm or vice versa by a simple modification after installation requiring no additional parts or special equipment.

Each alarm shall initiate the operation of both visual and audible devices.

Audible devices in the same room or area shall have distinguishable sounds and adjustable sound levels.

3.19.9 Matrix Type alarm Annunciators
The alarm annunciator shall be microprocessor based, modular, split type unit with alarm windows mounted on the front door and electronic modules inside the panel. The weather protection class for alarm annunciator shall be IP-54 of IS 13947, Part-I.

Each alarm shall initiate a visible and audible indication of the specified condition. Unless otherwise specified, alarm indicators shall be grouped together in annunciator units each having at least 20% spare ways. Alarm indicator lamps (Cluster LED type) and shall have transparent screens engraved with legends approved by the employer’s Representative. The legend area of each indication shall not exceed 40mm high and 75mm wide.

When any alarm condition occurs, a condition device common to an alarm annunciator system shall sound and the appropriate indicator shall flash on and off. The flashing rate shall not be less than 2 Hz and shall not exceed 5 Hz. On pressing an accept pushbutton, the audible device shall be silenced and the flashing light shall become steady. The alarm indicator shall remain illuminated until the alarm condition ceases and a reset pushbutton has been operated.

The operation or acceptance of one alarm shall not inhibit the operation of the audible device or the flashing of the appropriate alarm indicator if a further alarm condition occurs. At unmanned locations alarms operated on two or more annunciators shall require acceptance at each annunciator.

Alarms shall be accepted automatically and the appropriate audible device silenced after an adjustable period of 1 to 5 minutes.

An integral ‘test’ pushbutton shall be provided to illuminate each lamp in the appropriate group and to operate the audible device but shall not cause a spurious alarm condition on any other annunciator.

Alarm circuitry shall be arranged so that spurious or transient alarm states persisting for less than 0.5 seconds do not initiate any action.

Alarm annunciator / indicator legends or labels shall be arranged with three lines of text as follows:

<table>
<thead>
<tr>
<th>Topline</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle Line</td>
<td>Parameter</td>
</tr>
<tr>
<td>Bottom Line</td>
<td>Status</td>
</tr>
</tbody>
</table>

  e.g. reservoir 1
  level high & level low
3.19.10 Direct Digital Controllers

3.19.10.1 Design and Construction Requirements:

Standalone DDC panels shall be microprocessor-based, multi-tasking, multi-user, real-time digital control processors. Each standalone DDC panel shall consist of modular hardware with plug-in enclosed processors, communication controllers, power supplies, and input/output modules with connectivity to the Network Controller through a RS485 or Ethernet communication bus.

The DDC’s should be application specific and should be located as near as possible to the controlled equipment reducing cabling runs. The DDC’s should be able to control the equipment connected to it on a standalone mode so that in case of failure of the first tier network the DDC’s will be able to perform the minimum control functions assigned to it. The DDC’s should have a inbuilt display on its facia with keypad to access all the information being monitored by the DDC.

3.19.10.2 Programming:

All the DDCs should be equipped with electrically erasable PROMs and the control software for the DDC can be downloaded through the central operator workstation. It should additionally provide a serial port for downloading and reconfiguring of software through a laptop locally. The control logic for the DDCs should be programmed through a user-friendly graphic programming language with control algorithms like PID loops, ladder logic, sequencers etc inbuilt into the software.

3.19.10.3 Input/Output point types:

Each DDC panel shall support the following types of point inputs and outputs:

**Analog inputs** shall monitor the following analog signals:

- 4-20 mA Sensors
- 0-10 VDC Sensors
- 1000ohm RTDs

**Binary inputs** shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input “bouncing.”

**Counter inputs** shall monitor dry contact pulses with an input resolution of one HZ minimum.

**Analog outputs** shall provide the following control outputs:

- 4.20 mA – Sink or Source
- 0-10 VDC

**Binary outputs** shall provide SPDT output contacts rated for 2 amps at 24 VAC and
they shall not activate main contactors of starter thus avoiding burdening of relays.

3.19.11 Uninterruptible Power Supply (UPS)

The UPS shall be floor mounted, self contained and metal clad and shall be suitable for operating on a non linear load.

It shall be front door accessible.
The UPS system shall be true ON-Line.

The ON LINE UPS shall be incorporating a six-pulse rectifier and pulse width modulation inverter technology with 100% microprocessor control with built in static and manual bypass switch.

The UPS shall incorporate a DC under voltage trip circuit to electrically trip the UPS in order to protect the battery.

The noise level of the unit shall not exceed 60dB (A) at 1m from the UPS cabinet. The output of the inverter shall be a sine wave having less than 5% THD for linear loads and less than 4% to 50% non linear load. It shall be suitable for load power factor 0.8 lag.

The unit shall have dynamic response such that a 100% step load causes an output voltage transient of less than ±4% with a recovery time of less than 4 ms.

For three phase output units the output voltage shall not vary by more than ±1% for an unbalance for 10%.
The load crest factor shall not be less than 3:1.

The efficiency at full load and 0.8 power factor shall be greater than 88%.

Indicators to indicate:

- UPS status
- UPS alarm conditions

The UPS shall provide a volt free contact output to indicate:
  - Warning, i.e low battery capacity
  - Fault
  - Static bypass in use.

The UPS shall have an overload capacity of 150% for 30 seconds and shall be protected in the event of a short circuit of the output.

The batteries shall be housed, either within the UPS enclosure or within a separate matching battery cubicle suitable for location adjacent to the UPS.

The batteries shall be maintenance free lead acid type sealed for life.
Terminals shall be shrouded to prevent accidental contact. The battery enclosure shall be corrosion resistant and ventilated to prevent the build up of gases.

Warning notices shall be provided for wall mounting to warn of the presence of charge gases.

The battery supply of the UPS shall be via a fused load break switch dis-connector circuit breaker.

The battery recharge time to 90% of full charge shall be approximately ten times the discharge time at full load.

The UPS battery shall have a back up of 30 minutes at full load and supported with inverter of suitable capacity.

3.19.12 Air Conditioning / Air Handling / Cooling and Ventilation / Exhaust :

The bidder shall design and provide AC / Air cooling / Ventilation and exhaust system as per the norms, regulations, statutory and process design requirement. The control room shall be provided with air conditioning of required capacity. All plant rooms shall be provided with push pull ventilation with air intake through a fan filter unit and exhaust with propeller fans. The design of supply air capacity should be based on 20 air changes per hour or heat load with inside temperature limited to a maximum of 5° C above ambient temperature. The equipment shall comprise of air intake louver, panel type filter, centrifugal air supply fan, GI ducting, Grills, propeller fans and their gravity louvers.

3.19.13 Testing / Inspection :

3.19.13.1 Tests on cables

Check details are in accordance with the specifications.
Check for physical damage.
Continuity Check, meggar test for insulation Connections.
No dark visible marks of armouring onto external surface.

3.19.13.2 Tests on electrical installation

Check all closing, tripping, supervision and interlocking of control devices.
Check operation of all alarm circuits.
Check CT polarities, give primary & secondary injection.
Carry out relay calibration
3.19.13.3 Test on complete control system

On completion, the functioning of the complete system shall be tested to demonstrate its correct operation in accordance with the Specification.

For control system testing, the contractor may provide temporary means to simulate operating conditions, but the system will not be finally accepted until correct operation has been demonstrated to the satisfaction of the Engineer when all the pumps are operating.

The system shall be shown to operate correctly whatever the selection of duty and standby equipment may be.

Conditions to be tested shall include:

- Normal automatic operation.
- Normal manual operation
- Emergency manual operation

3.19.13.4 Commissioning Tests

Correct operation of controllers shall be verified by observing that the final control element moves in the proper direction to correct the process variable as compared to the set point. All logic sequences shall be verified to operate in accordance with the specifications.

All defects and malfunctions disclosed by test shall be corrected immediately. New parts and materials shall be used as required and approved and tests shall be repeated.

A report certifying completion of validation of each instrument system indicating calibration values, verification that the system performs as per requirements and any provisional settings made to devices shall be provided. A format for commissioning checklist to be provided for approval before performing the commissioning tests.

3.19.13.5 Final Operational Testing and Acceptance

Upon completion of instrument calibration and system validation, all systems shall be tested under process conditions.

The testing shall include, but not limited to all specified operational modes, taking
process variables to their limits (simulated or process) to verify all alarms, failures, interlocks and operational interlocks between systems and/ or mechanical equipment.

Any defects or malfunctions shall be immediately corrected using approved methods and materials and the tests shall then be repeated.

Upon completion of final operational testing, a report shall be submitted, indicating that the total control system provided meets all the functional requirements specified herein. This report shall be made in the format approved by the Engineer. The Engineer shall certify this report and it shall constitute final acceptance of the control system.

3.19.14 COMMISSIONING:

After completion of installation works the contractor shall arrange to carry out following checks/tests in the presence of DEPARTMENT representative / Engineer – in – charge.

3.19.14.1 Tests on Transformers:

a). Mechanical Completion Checks:

i). Compare name plate details with the specification.

ii). Check for any physical damage, in particular of bushings and cleanliness of bushing.

iii). Check for tightness of all bolts, clamps and connecting terminals.

iv). Check for oil leakage and oil level.

v). Breather condition, check whether breathing line is free, silica gel is reactivated, oil is available at the bottom.

vi). Check for clearances.

Vii). Water tightness of terminal boxes.

Viii). Earthing of transformer tank and neutral.

ix). Ensure that all cooler and header valves are open

x). Check that the transformer is correctly installed with reference to it phasing.

b). Commissioning Test:

i). Test oil for dielectric strength as per IS.

ii). Insulation resistance test of windings.

iii). Test the transformer for the following.

   Voltage/ turns ratio at all the taps.
   Winding resistance at all the taps.
   Short circuit impedance ( at low voltage )
   Magnetic balance
Core loss at normal tap at low voltage.
IR and PI.
v). Vector group test.
vi). Phase sequence test.

vii). Test the current transformers for following.

   Continuity test.
   Polarity test.
   Insulation resistance test.
   Magnetization characteristics.
   Rough ratio test ( if bushing CTs provided prior to mounting of busing )
   Measurement of secondary winding resistance.

viii). Line connection as per phasing diagram.
ix). Winding resistance.
x). Insulation resistance of control wiring.
xi). Buchholz relay operation ( for alarm and trip )

xii). OLTC control indicating and alarm circuit. (if used)
xiii). Operation test of all protective devices ( electrical and mechanical ) and interlocks.
xiv). Calibration of temperature indications ( oil and winding ) and temperature relays.

3.19.14.2 Tests of Motors:

a). Mechanical Completion Checks:
i). Compare name plate details with the specification.
ii). Check for tightness of all bolts, clamps and connecting terminals.
iii). Check ground connection.
iv). Bearing lubrication.
v). Check clearance inside terminal box.
vi). Megger testing of motor winding and cables.
vii). Motor winding, control and power cables continuity checks.
ix). Check / calibration if RTDs, BTDs for bigger motors, flow switches ( in case of water cooled motors ) and if any other instrument mounted.

b). Commissioning Tests:
i). Controls and interlocks.
ii). Ready test and settings.

iii). Phase sequence and rotation.

iv). Starting and no load currents.

v). No load operation (observe variation, noise level, temperature of bearing and windings of motor, check speed of motor).

vi). On load operation, starting and running currents operation (observe variations, noise level, temperature of bearing and windings of motor, check speed of motors), vibrations.

vii). In case of closed loop arrangement for cooling the windings of motor, inlet and outlet temperature of the cooling air/water.

3.19.14.3 Test on Control Panels and Switchboards:

a). Mechanical Completion Test:

i). Check name plate details of every associated equipment according to specification.

ii). Check for physical damage.

iii). Check for tightness of all bolts, clamps and connecting terminals.

iv). Check earthing.

v). Switch developments.

vi). Each wire shall be traced by continuity tests and it should be made sure that the wiring is as per relevant drawings. All interconnections between panels/equipment shall be similarly checked.

vii). All the wires should be maggered to earth.

b). Commissioning Tests:

i). Checks on relays, functioning of relays, simulation of fault for testing.

ii). Checks on motors.

iii). Setting of relays, other alarm, tripping devices and interlocks as per scheme.

iv). Phase angle checks, measurement of magnitude and phase angle of current transformer secondary currents and potential transformer secondary voltage.

v). Functional checking of all power and control circuits e.g. closing, tripping, control, interlock, supervision and arm circuits including proper functioning of the components equipment. If interlocks are provided with other equipment, it shall be thoroughly tested.
3.19.14.4 Test of Relays:

a). **Mechanical Completion Checks:**
   i). Check name plate details according to specification.
   ii). Check for any physical damage.
   iii). Check internal wiring.
   iv). Megger all terminals to body.
   v). Megger AC to DC terminals.

b). **Commissioning Checks:**
   i). Check operating characteristics over the entire range by secondary injection.
   ii). Check minimum pick up voltage.
   iii). Check operation of electrical / mechanical targets.
   iv). Relay settings to be checked by injecting different values of current.
   v). Setting of relays as per discrimination chart

3.19.14.5 Test for Meters:

a). **Mechanical Completion Tests:**
   i). Check name plate details according to specification.
   ii). Check for any physical damage.

b). **Commissioning Checks:**
   i). Check calibration.
   ii). Megger all insulated portions.
   iii). Check CT and VT connection with particular reference to their polarities for relevant meters.

3.19.14.6 Tests for Circuit Breakers:

a). **Mechanical Completion Checks:**
   i). Check name plate details according to specification.
ii). Check for any physical damage.
iii). Check for tightness of all bolts, clamps and connecting terminals.
iv). Check oil level, air pressure and leakage (wherever applicable).
v). Check earth connection
vi). Check cleanliness of insulators and bushings.
vii). Check all moving parts are properly lubricated.
viii). Check heaters provided.
ix). Check alignment of breaker trucks for free movement, check operation of shutters.

b. **Commissioning Tests:**

i). Check control wiring for correctness of connections, continuity and IR values.
iii). Power closing / operating manually and electrically.
iv). Breaker tripping and closing time.
v). Trip free and anti pumping operation.
vi). IR values, resistance and minimum pick up voltage.
vii). Contact resistance.
viii). Simultaneous closing and mechanical interlocks provided.
ix). Check electrical and mechanical interlocks provided.
x). Checks on spring charging motor, correct operation of limit switch and time of charging.
xi). Checks on CTs.
xii). All functional tests.

### 3.19.14.7 Tests for Voltage Transformers:

a). **Mechanical Completion Tests:**
i). Check name plate details.
ii). Check for any physical damage.
iii). Check cleanliness of insulators.
iv). Check for tightness of all bolts, clamps and connecting terminals.
v). Check earthing connections.
b). **Commissioning Tests:**

i). Insulation resistance test.

ii). Polarity test.

iii). Ratio test on all cores.

iv). Line connections are per connection diagram.

v). Open delta test with low voltage, wherever required.

vi). Measure core loss from LT side.

3.19.14.8 **Tests for Current Transformers:**

a). **Mechanical Completion Tests:**

i). Check name plate details according to specification.

ii). Check for any physical damage.

iii). Check cleanliness of insulators and bushings.

iv). Check for tightness of all bolts, clamps and connecting terminals.

v). Check for oil level and leakage.

vi). Check connections.

b). **Commissioning Tests:**

i). Megger between windings, winding terminals and body.

ii). Polarity test.

iii). Ratio identification checking of all ratios on all cores by primary injection of current.

iv). Magnetisation characteristics, secondary winding resistance.

v). Capacitance and tan delta test.

vi). Dielectric test of oil (wherever applicable).

3.19.14.9 **Tests for Isolators:**

a). **Mechanical Completion Tests:**

i). Check name plate details according to specification.

ii). Check for any physical damage.

iii). Check cleanliness of insulators.
iv). Check for tightness of all bolts, clamps and connecting terminal.
v). Insulation resistance of each pole.

b). Commissioning Tests:
i). Manual and electric operation and interlocks.
ii). Correctness of connections, continuity and insulation resistance values of control circuits.
iii). Contact resistance of each pole / gap between male and female contacts.
iv). Earth connections of structures and operating handle.
v). Clearance in open and closed position.
vi). Simultaneous closing of all phases.

3.19.14.10 Tests for Cables:
a). Mechanical Completion Checks:
i). Check name plate details according to specification, check internal /outer dia. of cores, cross sectional area of conductor.
ii). Check for any physical damage.
iii). Megger test between each core and armour/sheet.
iv). Continuity check.
v). Connections.

3.19.14.11 Test for Battery:
a). Mechanical Completion Checks:
i). Check name plate details according to specification.
ii). Check for any physical damage.
iii). Dimensional check of plates ( before assembly )
b). Commissioning Checks
i). Specific gravity test.
ii). Cell voltage test.
iii). Capacity test.
iv). Initial charging cycle.

3.19.14.12 Tests for Battery Charger:
a). Mechanical Completion Checks:
i). Check name plate details according to specification.
ii). Check for any physical damage.
iii). Check Connections.

b). Commissioning Checks:
i). Functional check of auxiliary devices, such as alarms, indicating lamp etc.
ii). Insulation test of all circuits.
iii). Measurement of voltage regulation.
iv). No load current and voltage (AC) and voltage and current both AC and DC at different points.
v). Voltage at tap cell (While boost charging).

3.19.14.13 Test for Electrical Installation:
a). Mechanical Completion Tests:
i). Check all closing, tripping, supervision and interlock of control devices.
ii). Check operation of all alarm circuits.
iii). Earthing:

Measure resistance of each earth electrode by isolating the same from station grid as well as from other earth electrodes. Check continuity of grid conductors and wires.

b). Commissioning Test:

i). Cable Testing.
   All 3.3 kV, 6.6 kV, 11 kV cables to be high voltage tested.
ii). In addition to above, any other tests specified by manufacturer shall be carried out as per manufacturer’s instruction.
iii). Measure voltage across bearing pedestal insulation and between rotor shaft and bearing.

3.19.14.14 Miscellaneous:
Mechanical completion checks and commissioning tests on items not covered above, shall be carried out by the contractor as per the instructions of Engineer - in - charge.
4 - SPECIFIC SPECIFICATION
(ELECTRICAL AND INSTRUMENTATION WORK)

4.0 Scope

The bidder's /contractor's scope covers the design, shop testing, supply, transport, storing at site, erection, testing and commissioning of all electrical and instruments required for the plant, as per enclosed General Specification, Specific Requirement, typical power distribution scheme and typical control system architecture.

Where there is any contradiction between General Specification and Specific requirements mentioned in this document, the specific requirements will rule the project requirement.

4.1 Design Basis

4.1.1 The Bidder/ Contractor shall strictly follow the typical power distribution single line diagram which is to be proposed by him and approved and accepted by department.

The bidder shall visit the site to satisfy himself about availability of voltage level, its condition, its probable route, etc. before quoting. The department will provide 415V, 3 phase electrical power at one point within the premises. From this point onwards the successful bidder shall extend supply to MCC room (Motor Control Centre).

4.1.2 Bidders shall follow the BIS guideline for voltage rating of motors while designing and selection of electrical motors. All motors of 100 HP (75 KW) and above shall be of slip ring type and below 75 KW shall be of squirrel cage type.

4.1.3 All motors shall be provided with class-F insulation and their temperature rise shall be limited upto Class-B. All motors above 100HP/75KV shall be provided with RTD's (atleast two RTD's per winding) earth leakage protection, comprehensive micro process based protection having locked current /over load, negative phase sequence relay, under load, over current, earth fault, start nos., transit currents etc.

4.1.4 All LT cables shall be designed and selected after considering a minimum de-rating factor of 0.65. Exact de-rating shall be calculated taking into consideration designed ambient temperature, grouping and minimum size as per fault level calculations of synchronised DG with grid). Bidder shall carryout detailed fault level calculation of main generating station and upto all distribution points.

Bidder shall carry out the earth resistivity test on his own and based on this result they should design the total earthing system to maintain a overall resistance value less than one ohm.

4.1.5 The electrical and instrumentation in gas handling area like etc. shall be flame proof type and adhere to CPCB norms.

4.1.6 Noise level (db levels & insertion level) inside and outside blower room shall be strictly as per latest amended pollution control board norms applicable at installation.
time. Whatever extra equipments required like scrubber, acoustic shall be provided to meet statutory guide lines as well as building should be able to accommodate all equipments.

4.1.7 The Control system and instrumentation for the total plant shall be provided as per typical control system architecture provided with this tender.

4.1.8 LT cable/ control cable/ lighting cable inside the plant shall be done on overhead cable tray mounted on steel structure etc.

4.1.9 Measuring instruments shall be provided by bidder as per standard measurement scheme enclosed herewith.

4.1.10 LT capacitor bank shall be provided with automatic power factor correction system. Its panel shall incorporate timer circuit to allow capacitor to discharge at minimum 50V before re-energisation of any individual bank.

4.1.11 Capacitor bank shall consist of many small capacitors so that banks can be in circuit as per system p.f requirement with the help of Automatic Power Factor Correction relay. Minimum 0.95 p.f will be maintained at power distribution agency meter on H.T. Side. Capacitor bank calculations submitted along with bid shall also take into consideration the transformer impedance. Each capacitor should be able to switch ON either in manual or auto mode independently.

4.2 Bidder’s Obligation

Bidder shall provide preliminary details for the items given below. However, if DEPARTMENT requires any further details during technical bid evaluation stage, the bidder shall provide the same.

- Load list (as per enclosed typical format)
- Maximum demand in KVA with duration (period) of the plant.
- Minimum demand in KVA with duration (period) of the plant
- Normal demand in KVA of the plant.
- Detailed Bill of material for electrical as well as instrumentation scope of work.
- P & I diagram of the total plant.

- Instrument index (as per enclosed typical format)

- Input/ Output List (as per enclosed typical format)

- Instrument Data sheet for each tag No.

- Interlock logic diagram

- Control system architecture.

- Instrument air requirement.

- Uninterrupted power supply (UPS) capacity requirement.

- UPS capacity and it’s battery backup calculation sheet.

- Lighting fixture capacity and quantity calculation.

- Single line diagram for LT Power. (main panel), L T distribution boards.

- Single line diagram for lighting and small power.

- Cable schedule of total plant, along with voltage drop calculation and deratings.

- Operating power factor of each equipment.

- Power factor improvement capacitor calculation.

- LT Panel board (DEPARTMENTC, MCC etc) Data Sheets.

- LT cable, control cable, telecommunication cable Data Sheet.
- UPS Data Sheet.
- Battery and Battery Charger Data Sheet.
- ACSR Conductor Data Sheet.
- Guaranteed Power generation by Gas Engine.
- Bus Duct Data Sheet
- Power mounted Isolator Data Sheet.
- Maximum Power consumption of the plant per day.
- Minimum power consumption of the plant per day.
- Guaranteed power consumption of the plant per day.
- Battery Charger Capacity Calculation Sheet.
- Battery Capacity Calculation Sheet.
- Motor List (as per typical format enclosed herewith).
- Control Valve sizing calculation sheet.
- DDC sizing calculation sheet.
- GA drawings of all electrical panels like MCC, Battery chargers and batteries, AC distribution board, DC distribution Boards, UPS and its batteries, Pole mounted Isolators, Lighting Arrestors etc.
- Typical drawings of Earthing station.
• A drawings of all analysers, control room equipments etc.

• Typical drawing cable laying under the ground.

• Typical structural drawing showing LT cable tray for power, control etc in outdoor areas.

• Layout for each section, layout with appropriate clearances as per IER and appropriate clearances for maintenance.

• Control room layout.

• Room size and quantity for total plant electrical and instrumentation work.

• List of Safety Items.

4.3 INDIAN STANDARDS / OTHER INTERNATIONAL STANDARDS

For the benefit of bidders, a few Indian Standards and Codes of practices and other international standards are listed below. Unless otherwise noted, equipment/devices/accessories/installations/testing etc. shall comply with relevant standards/codes mentioned herein. Where Indian Standards are not available equipment/devices etc. complying with relevant British or IEC standard or ISO standards shall be proposed. While referring to any standard, the latest revision/edition shall govern. Bidders are advised to include in their bid a list of equipment/devices and corresponding standards to which they conform. Translation in English of standards, which are available in other languages, shall be furnished along with the bid, in such cases the English translation shall govern.

4.4 LIST OF IS & OTHER INTERNATIONAL CODES (FOR ELECTRICAL EQUIPMENT / ACCESSORIES)

1. IS 5 - Colours for ready mixed paints and enamels.

2. IS 3 - Three phase induction motors.

3. IS 374 - Electric ceiling type fans and regulators.

4. IS 694 - PVC insulated cables for working voltages upped and including 1100V.
5. IS 722 - AC electricity meters.
6. IS 1248 - Direct acting indicating analogue electrical measuring instruments and their accessories.
7. IS 1271 - Thermal evaluation classification of insulating material.
8. IS 1293 - Plugs and socket outlets of rated voltage upped and including 250V and rated current upped and including 16A.
9. IS 1364 - Hexagon head bolts, screws and nuts of product grades A and B.
10. IS 1534 - Ballast’s for fluorescent lamps.
11. IS 1554 - PVC insulated (heavy duty) electric cables.
12. IS 1777 - Industries luminaries with metal reflectors.
13. IS 1913 - General and safety requirements for luminaries.
14. IS 2086 - Carrier and bases used in rewire able type electric fuses for voltages upped 650V.
15. IS 2223 - Dimensions of flange mounted AC induction motor.
16. IS 2253 - Designation for type of construction and mounting arrangement of rotating electrical machines.
17. IS 2254 - Dimensions of vertical shaft motors for pumps.
18. IS 2259 - Methods of tests for determination of insulation resistance of solid insulating materials.
19. IS 2419 - Dimensions for panel mounted indication and recording electrical instrument.
20. IS 2544 - Porcelain post insulators for system with nominal voltages greater than 1000V.
21. IS 2551 - Danger notice plates.
22. IS 2667 - Fitting for rigid steel conduits for electrical wiring.
23. IS 2705 - Current transformers.
24. IS 2713 - Tubular steel poles for overhead powerlines.
25. IS 2834 - Shunt capacitors for power systems.
26. IS 3156 - Voltage transformers.
27. IS 3231 - Electrical relays for power system protection.
28. IS 3725 - Resistance wire, tapes and strips for heating elements.
29. IS 3854 - Switches for domestic and similar purposes.
30. IS 3961 - Recommended current rating for cables.
32. IS 4691 - Degree of protecting provided by enclosure for rotating electrical machinery.
33. IS 4728 - Terminal marking and direction rotation for rotating electrical machinery.
34. IS 4889 - Method for determination of efficiency of rotating electrical machines.
35. IS 5216 - Guide for safety procedures and practices in electrical works.
37. IS 6098 - Method of measurement of air borne noise emitted by rotating electrical machinery.
38. IS 6875 - Control switches (switching devices for control and auxiliary circuits, including contractor relays) for voltage upped and including 1000V AC and 1200 V DC.
39. IS 7098 - Cross-linked polyethylene insulated PVC sheathed cables.
40. IS 8623 - LV switchgear and controlgear assemblies.
41. IS 828 - Circuit breakers for over current protection for house hold and similar installations.
42. IS 10322 - Luminaries.
43. IS 12729 - General requirement of switchgear and controller.

44. IS 13032 - MCB boards for voltage upped and including 1000V AC.

45. IS 13947 - Low voltage switcher and controller.

46. IS 732 - Code of practice for electrical wiring installations.

47. IS 3043 - Code of practice for earthing.


49. IS 10118 - Code for practice for selection, installation and maintenance of switchgear and control gear.

50. IS IEC 309 - Plugs, socket outlets and couplers for industrial purpose.

51. IS 2026 - Transformers

52. IS 13118 - Vacuum circuit breakers.

For all other process equipments and instruments contractor shall follow IS / ISO specifications and submit a copy of the same.

4.5 CLEARANCE FROM STAUTORY AUTHORITIES

Bidders shall note that the successful bidder shall be responsible for obtaining statutory clearances from all the relevant bodies (such as electrical inspector, Safety, Pollution Control Board, Fire Insurance and Explosive Department Authorities, etc.). Payment in respect of fees, deposit, etc., of such bodies shall be made by successful bidder Department shall assist the contractor in obtaining such clearances expeditiously by way of issue of introductory letters to relevant bodies but this will not absolve the Contractor from his responsibility of obtaining in writing clearances mainly from Electrical Inspector, Chief Explosive Officer, Pollution Control Board or any other local/central authority entirely at his own cost. No extra sum will be paid for these services.

4.6 CONTRACTOR ‘S LICENCE:

4.6.1 It shall be the responsibility of the contractor to obtain necessary license / authorization / permit for work for his personnel from the licensing board of the state. The persons deputed by the contract’s firm should also hold valid permits issued or recognized by licensing board of the state where the work is to be carried out.
4.7 WORKMANSHIP:

7.1 The contractor shall ensure workmanship of good quality and shall assign qualified supervisor/ engineers and competent labour who are skilled, careful and experienced in carrying out similar works. Department shall reserve the right to reject non-competent person/s employed by the contractor, if the workmanship is found unsatisfactory.

4.8 POWER DISTRIBUTION PHILOSOPHY:

The bidder shall design the power distribution scheme for this site on the basis of following guidelines and single line diagram. Voltage drop from transformer output to last point in electrical distribution shall not be more than 5%. Voltage drop in any cable for installed load or any single circuit for installed load shall not be more than 2%. Only aluminium conductor with PVC insulation armoured cables shall be used for size 2.75mm² and above. All power cables upto 2.75mm² shall be copper conductor PVC insulated armoured cables.

8.1 An indoor substation shall be planned to house switchgears for incoming and outgoing power supply circuits, metering equipments, communication equipment, control panels, auxiliary power supply distribution boards, DC system equipment etc. The following voltage of load factor and diversity factor shall be considered for calculating the maximum running load. The sizing of transformer shall be included along with the bid.

LOAD FACTOR

<table>
<thead>
<tr>
<th>Description</th>
<th>Factor</th>
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<tbody>
<tr>
<td>Main Pump Motor</td>
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</tr>
<tr>
<td>Aux. Loads</td>
<td>0.9</td>
</tr>
<tr>
<td>Lighting loads</td>
<td>1.0</td>
</tr>
<tr>
<td>Socket outlet, receptacle Diversity Factor</td>
<td>0.50</td>
</tr>
</tbody>
</table>

DIVERSITY

<table>
<thead>
<tr>
<th>Description</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main pump motor for working loads</td>
<td>1.0</td>
</tr>
<tr>
<td>Lighting Loads</td>
<td>1.2</td>
</tr>
<tr>
<td>Socket outlet, receptacle</td>
<td>1.2</td>
</tr>
</tbody>
</table>
8.2 Main incomer switchgear in various plant/process areas shall be fed by duplicate (two), 100% capacity feeders and outgoing feeders shall be so designed that at least 20% spare subjected to minimum of one feeder of every type shall be available. All control voltage inside switchgear panel shall be at 230V AC for Contactors and control supply. Single line diagram of all panels shall be attached with bid giving cable sizes in single line diagram.

8.3 DC system equipment (comprising batteries, chargers & DC distribution board) with adequate capacity shall be proposed for protection / control circuits and other vital devices of each substation. Further, in plant areas / substation a few lighting fixtures, suitable for operation on battery voltage shall be proposed in strategic areas. DC system, calculation of DC Battery size, DC battery charger, Voltage should be attached with the bid.

8.4 Following protections for incomer feeders in main MCC location for each process area of the plant. Each MCC shall be provided with 4 Pole two incomers and bus section with drawout ACB/MCCB as incomer. MCC’s shall be metal clad floor mounted, with cable entry from bottom (preferred) and environmentally protected to IP-52. MCC shall have fault rating of not less than the applicable fault levels. The two incomer neutral shall completely be isolated by using 4 pole ACB/MCCB.

Mechanical and electrical interlocking shall be provided between the incomers and the bus section ACB/MCCB to prevent parallel operation of main switchgear feeders. MCCs shall be housed within brick built buildings segregated from injurious effects of process fluids/gases are present. The major components of each starter shall comprise:

- Door interlocked isolator
- Fuse gear/ MCCB
- Contactor, overload relay with single phasing protection.
- Start/ Stop push button.
- Local/ remote selector switches (if applicable)
- Manual / off/ auto sector switch.
- Ammeter as per starter requirement
- Indication light for run, trip, emergency stop operated, power On, run dry protection operated (where such tanks are used)

i) Incomer feeder shall have electrostatic / microprocessor based control releases for over current, short circuit, earth fault with time delay and these releases shall directly work on tripping mechanism of drawout air circuit breaker. Outgoing feeder up to 630 Amps shall be switch fuse unit / MCCB and beyond 630 Amps shall be air circuit breaker. All Outgoing Air Circuits Breakers will be manual drawout type.

ii) Each motor upto 5 KW shall have DOL starter with O/C, short ckt protection, over load relay with single phasing protection along with ammeter, provision
for remote start/stop. Overload relay shall be reset type from front of panel. All starters component shall follow type-II coordination chart of established manufactures with components of same make. Each starter shall have On/Off/Trip indication. All necessary selector switches like auto manual switch and local remote switches shall be installed.

iii) Motors above 5 KW and upto 30 KW shall have Star / Delta starter with O/C, short ckt protection, over load relay with single phasing protection along with ammeter, provision for remote start / stop O/C relay shall be reset from front of panel. All starter components shall follow type-II coordination chart of established manufactures with components of same make. Each starter shall have on/off/trip indication. All necessary selector switches like auto, manual switch and local, remote switches shall be installed.

iv) Motor from 37 KW & above shall have auto transformer start and auto transformer shall have taps at 40%, 60% and 80%. Over load relay shall be reset from front of panel. All starter components shall follow type-II coordination chart of established manufactures with components of same make. Each starter shall have on/off/trip indication. All necessary selector switches like auto, manual switch and local, remote switches shall be installed.

v) Motor from 75KW and above shall have numeric type micro processor based relays along with short circuit protection. Each starter shall have on/off/trip indication. All necessary selector switches like auto manual switch and local, remote switches shall be installed. Since these motors will be slip ring, necessary either liquid rotor starter or air break contactors in minimum faultages shall be installed.

8.5. Cables proposed shall be suitable for operation on earthed/ unearthed system as applicable. LV cables shall be armoured PVC insulated. Outer sheath of all cables shall be of general purpose PVC and shall be of extruded type meeting latest IS-1554 requirements. The cable shall be designed after taking de-rating factors of ambient, grouping into consideration for its design. Power cables of cross section above 2.75 sq. mm shall be with aluminium conductors. All cables of cross section up to 2.75 sq. mm shall be with copper conductors. Unless otherwise stated all the cables shall be armoured. LV cables shall be of the armoured heavy duty type and of 1100 V grade. Voltage drop on cable for installed current shall not exceed 2% on installed load. Design ambient temperature shall be taken as 47°C. All cables shall also confirm to the relevant fault level of switch board for one second and supporting calculations must be submitted for fault level.
4.9 Cable Terminations

i) For termination of MV cables, single compression type glands shall be used for indoor locations. Glands shall be of brass, Lugs of Al/Cu or tinned copper shall be used as applicable, lugs shall be properly crimped on conductors. All glands used must be of heavy duty type.

ii) In outdoor areas, except within outdoor sub station area, cables shall be laid directly buried between building entry/exit points. Within buildings, cables shall be laid on cable trays to be supported from building walls columns/beams/floors/ceilings. In outdoor sub station area, cables shall be laid on cable trays in build up cable trenches. Ladder and perforated type cable trays shall be proposed. Ladder type cable trays widths shall be restricted between 300 mm and 600 mm. Perforated cable trays widths shall be restricted between 100 mm and 250 mm. Side members of ladder type cable trays shall be fabricated using structural steel angles of at least 6 mm thick. Perforated cable trays shall be of the formed type made from 2 mm thick sheet steel. For supports, structural angles or channels of appropriate strength shall be proposed. Vertical runs of cable trays shall be enclosed using perforated sheets as above. Cable trays, supports and covers shall be painted with epoxy paint of shade acceptable to DEPARTMENT. Tray width shall be so sized that at least 30% margin is available for addition at later date. This distance between the cables shall be minimum equal to outer dia of cable.

iii) At road crossings hume pipe/s of adequate size shall be provided at a depth of 1000 mm (center line depth) of passage of cables, earthing conductors etc. At building entry points pipe sleeves of GI or PVC shall be provided for the passage of cables and earthing conductors, such sleeves shall have projections on either side to facilitate extension.

4.10 ILLUMINATION:

4.10.1 All internal and external areas shall be provided with lighting. The illumination levels to be achieved shall be as follows:

<table>
<thead>
<tr>
<th>AREA</th>
<th>LUX.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office and labs</td>
<td>300 Lux</td>
</tr>
<tr>
<td>Switchgear Room</td>
<td>200 Lux</td>
</tr>
<tr>
<td>Control Room</td>
<td>300 Lux</td>
</tr>
<tr>
<td>Pump House</td>
<td>200 Lux</td>
</tr>
<tr>
<td>DG set room</td>
<td>200 Lux</td>
</tr>
</tbody>
</table>
Fluorescent luminaries shall be used primarily for internal lighting. High pressure vapour or metal halide type luminaries shall be used in indoor application where their use is appropriate. If mercury or metal halide is used in indoor then they should be supplemented with fluorescent luminaries to assure that minimum illumination levels are maintained following momentary power dips. All other internal areas shall be lit with fluorescent luminaries. Where specific recommendation of lux level are not covered above, illumination level in such areas shall be finalized in consultation with PWD. Contractor shall be required to measure levels of illumination after completion of lighting installation work and short fall in illumination level shall be made good by the contractor. Complete set of calculations showing, room, index, copy MF shall be given during detailed engineering.

4.10.2 Switches / sockets of piano type shall be used in general and in offices of staff, control room, MMI room, decorative modular switches shall be used. Suitable fans shall be provided in rooms/ plant areas as per PWD standards. For exhaust fans it must be provided in panel rooms, pump rooms, chemical rooms, stores, toilets and at least 20 air changes per hour must be maintained.

4.10.3 The following type of lighting fixtures shall be proposed:

a) Decorative type 2x36W fixtures for fluorescent luminaries inside office/ administrative buildings and control rooms.

b) Corrosion resistant fixture with canopy made of FRP for fluorescent luminaries for corrosive areas like chlorine handling or chemical store or area with corrosive smell/gases etc.

c) Industrial type vitreous enameled fixture for fluorescent luminaries inside 415V switchgear, MCC room and pump house.
d) In outdoor process areas, lighting fixtures shall be sodium vapour type subjected to minimum of IP protection class.

e) All outside lights as plant field lights, building outside lights, flood lights etc. which are to be switched on only during night hours should be controlled through photo cell/ clock switch installed at a central place. All lights shall have minimum IP65 protection class.

f) Street lighting wiring shall be through buried underground.

g) All bulb fittings (except fluorescent lamps) will have screw type caps.

h) For outdoor lighting, the lighting feeder shall be operated through a contactor, controlled by photocell/ clock switch and shall also have a manual by pass switch.

4.10.4 Luminaires shall be installed to permit ease of maintenance i.e. it shall not be necessary to shut down plant in order to carry out maintenance or to access luminaries located over areas of water etc. The contractor shall provide all equipment necessary to carry out maintenance on the lighting installation and demonstrate its operation to the satisfaction of department.

4.10.5 Indoor lighting circuit will be arranged in such a way that 50% lighting can be put off in each room through switches. All lighting circuits will be wired with 2.75sq.mm. stranded copper wire or through 2.75 sq.mm. armoured cable laid in cable trays. Sub circuit from switch to fixture could be wired with 1.5 sq.mm. stranded copper wire in MS conduits or armoured copper cable of similar size provided total voltage drop in any lighting distribution board to last lighting point shall not exceed 2%. All lighting circuits will have separate neutral, separate earth from Lighting Distribution Board.

4.10.6 For illumination of roads, outdoors areas where operation of equipment or units required and sub station area, lighting fixtures of appropriate type (such as street lighting type, flood lighting type, post top lanterns etc.) incorporating high pressure sodium vapour lamps shall be proposed. Street light poles shall not have less than 7500 mm height above the finished road level and the arm shall not project more than 1200 mm along the road width. Poles of bigger heights may also be used if some outdoor areas are to be illuminated. Poles of 4 / 4.5 Mtrs using post top lantern may be used in gate office, walk way or in front of office area. Complete area, streets, lanes, boundary shall be covered with street lighting.
4.10.7 Receptacles (Lighting & Small Power):

a. Decorative and industrial type units of above shall be proposed in all plant areas, offices, stores, workshop, plant room and they shall be located at least two numbers in each room. Distance between two receptacles shall not be more than 8 – 10 mtr. All small 5 amps 5 pin lighting & small power sockets shall be wired by multi stranded copper wire of 2.75 sq. mm laid in rigid MS conduits along with earth wire of 1.5 sq.mm flexible copper wire or equivalent size armoured cables. All wiring shall be coded with Red, Yellow, Blue & Black as per the phase used. If required, wiring can be done alternatively through armoured copper cables of similar size laid in MS perforated trays of minimum 2.0 mm thick.

b. Three phase power receptacles (convenience outlets) suitable for operation of 415V, 3 Phase 4 wire, 50 Hz power supply shall be proposed. In indoor areas one such unit shall be provided to cover areas of 20 meter radius (or at least one in each room housing plant items) and in outdoors areas on such unit shall be provided at 50 meter interval. Actual requirement of such units shall be finalized by department during detailed engineering. One three phase receptacle shall be provided near entrance of each building for utilities like welding.

c. Single phase 15 Amp 5 Pin / 6 Pin receptacles will be provided in each room and in halls they will be provided in such a way that with 15 meter cord we should reach every place in building. These shall be wired with 4 sq. mm copper earth wire in MS rigid conduits along with 2.75 sq. mm earth wire. Not more than two sockets shall be looped in one circuit. Alternatively they can also be connected through armoured cable of 4 sq. mm running in appropriate cable trays.

4.10.8 Separate lighting panels and lighting distribution boards shall be installed and they shall not take tapping for power from motor control centers or power distribution boards.

4.11 EARTHING & LIGHTNING PROTECTION.

.1 Bidders are advised to carry out soil resistivity measurement for designing the earthing system. Further, bidders are also required to study the guidelines in respect of lightning protection covered in relevant Indian Standards and accordingly include proposals for the same. The bidder shall make sure that earthing resistance value for both neutral conductor & body earthing shall be less than one ohm. All earthing station shall conform to latest amended IS 3043.
The Contractor shall provide an earthing installation at each site. Protective conductors shall be provided for all electrical installations and associated mechanical plant, exposed steel work and buildings. Protective conductors shall be provided in accordance with the requirements of IS-3043 or equivalent. The earthing system shall be designed for the earth fault current occurring at the point of supply. The neutral point of the 11/0.433 KV transformer secondary windings shall be solidly earthed. The calculation of earthing system and earthing valves must be submitted at detailed engineering stage.

The electrical installation shall be connected to the general mass of the earth by an earthing electrode. The earth electrode system shall be established adjacent to the transformer compound. GI plate earth electrodes shall be proposed in earthing system. MS conductors with allowance for corrosion shall be used for conductors to be buried in ground and they shall have stand fault for three seconds. GI conductors for earthing shall be used for above ground installations. Touch and step potentials shall be kept within permissible limits as per IS and this should be supported with earthing calculations. No earthing resistance shall be less than one ohm. Size of earthing conductor shall be arrived as per calculations subjected to minimum rating suggested below:

(Minimum size of earthing strip)

a. Main switch board and stand bye : 50 x 6mm GI Flat  
b. Interconnection to lighting protection system: 50 x 6mm GI Flat  
c. Interconnection to MCC’s : 50 x 6mm GI Flat  
d. Interconnection to control panels : 25 x 3mm GI Flat  
e. PF correction panel : 50 x 6mm GI Flat  
f. Local push button : 14 SWG GI  
g. Lighting distribution boards : 4 SWG GI  
h. Lighting & receptacle system : 12 SWG GI  
i. Outdoor street lighting : 8 SWG GI  
j. Ladder rack and cable tray at suitable points : 25 x 3mm GI  
k. Hand rails and metallic structure : 25 x 3mm GI  
l. Steel structure comprising storage tanks : 25 x 3mm GI

The complete plant shall have lighting protection in the form of lighting finials, horizontal earth continuity conductors, verticals risers, inspection links, earthing pits as per IS 3043. As detailed lightning calculations shall be submitted at the detailed engineering stage.
4.12 COMMUNICATION:

Bidders are required to provide communication facilities at site. The site shall also have facility to communicate with outside agencies through local telephone network. Bids shall take into account the above requirement. Bidders are free to propose means of communication within site; however communication with outside agencies shall be through local telephone network only.

4.13 INSTRUMENTATION

1 INTRODUCTION TO INSTRUMENTATION

Department wants to have latest technology with compatible automation system ON LINE to run the plant from a single location. A typical control system architecture is enclosed with bid which is to be strictly followed by bidder/contractor while designing the control system and instrumentation.

AIM

- To provide latest technology for ON LINE monitoring and control of various parameters department hopes to achieve following aim:
  - Improvement in effluent quality
  - Control methane emission to reduce water pollution
  - Proper monitoring and correction
  - Low manpower
  - Generation of all faults and trends
  - Correct display of input raw material and output treated effluent
  - Long term historical storage of process data
  - Analysis and graphical plots of historical data
  - Prevention maintenance management
  - Inventory control
  - Maintain plant operation summaries
  - Maintain record of generation of methane gas and consumption.
  - Improve plant efficiency and increase the plant life.

Bidder shall provide one centralised control room with PLC based SCADA system based on latest technology with following minimum feature.

Four nos. of Pentium-IV PC with 17” colour monitors with one no. Laser printer, one no. Deskjet and one no. Dot Matrix Printer.
All field instruments shall be controlled locally as well as by centralised control room.

In case of PC failure, the local control shall be able to control all the field instruments.

There should be two networks laid from first tier network to second tier network and one of them shall be only redundant.

Local display of parameters for all instruments shall be available near field instruments also.

SCADA should have graphics, alarm reports, process trends, history, etc.

Minimum 25% spare capacity for each analogue and digital I/O's shall be left at DDC level meaning 25% spare analogue inputs and outputs (app. 12% each) and 25% digital input and output (app.12% each) shall be made available for future use.

The software property shall be on the name of department,. Executive Engineer HUDA Divisions Hissar Instrumentation control system shall have dedicated earthing and shall not be joined with electrical earthing. Control system earthing shall have ideal zero voltage value.

Large General Product Description:

The Automation System shall integrate multiple sewage treatment plant functions including equipment supervision and control, alarm management, energy management, information management, and historical data collection and archiving.

The automation system shall consist of the following:

- Standalone Network Controllers
- Application specific direct digital controllers
- Personal Computer Operator Workstations.

The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, DDC’s, Network Controllers and operator devices, while re-using existing controls equipment.

System architectural design shall eliminate dependence upon any single device for total alarm reporting and control execution. Each Network Controller shall operate independently by performing its own specified control, alarm management, operator I/O, and historical data collection. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

Network Controllers shall be able to access any data from, or send control commands and alarm reports directly to any other Network Controller or combination of panels on the network without dependence upon a central processing device, such as a central file server. Network Controllers shall also be able to send alarm reports to
multiple operator workstations, terminals, and printers without dependence upon a central processing device or File Server.

.3 System Architecture

a. **First Tier Network**

The first tier network shall be based on a PC industry standard of Ethernet TCP/IP or ARCNET. PC Workstation LAN controller cards shall be standard “off the shelf” products available through normal PC vendor channels.

The FMS shall network multiple operator workstations, network controllers, system controllers, and application-specific controllers. The first tier network shall provide communications between operator workstations and first tier DDC (Direct Digital Control) controllers.

The first tier network shall operate at a minimum communication speed of 10M baud, with full peer-to-peer network communication and shall incorporate minimum 32 bit processor.

Network Controllers shall reside on the first tier.

**Network Controller:**

The Network Controller shall be a fully user-programmable, supervisory controller.

The Network Controller shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Controllers.

**First Tier Network** : The Network Controller (NC) shall reside on the first tier network. Each NC shall support a sub-network of a minimum of 100 controllers on the second tier network. This shall have redundant supervisory control in full "HOT BACK UP" configuration.

**Processor** : Controllers shall be microprocessor-based with a minimum word size of 32 bits and a maximum program scan rate preferably 2-3 msecs but less than 1 second. They shall be multi-tasking, multi-user, and real-time digital control processors. Controller size and capability shall be sufficient to fully meet the requirements of this Specification.

**Memory** : Each controller shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all second tier controllers.

**Hardware Real Time Clock** : The controller shall have an integrated, hardware-based, real-time clock.

**Communications Ports** : The NC shall provide at least two RS-232 serial data communication ports for operation of operator I/O devices, such as industry-standard
printers, operator terminals, modems, and portable operator’s terminals. Controllers shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems, printers, or terminals.

**Diagnostics**: Controller shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The network controller shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.

**Power Failure**: In the event of the loss of normal power, there shall be an orderly shutdown of all controllers to prevent the loss of database or operating system software. Nonvolatile memory shall be incorporated for all critical controller configuration data, and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.

During a loss of normal power, the control sequences shall go to the normal system shutdown conditions.

Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.

Should a controller memory be lost for any reason, the operator workstation shall automatically reload the program without any intervention by the system operators.

**Certification**: All controllers shall be listed by Underwriters Laboratories (UL).

**Second Tier Network**

DDC System Controllers shall reside on the second tier. Standalone DDC panels shall be microprocessor-based, multi-tasking, multi-user, real-time digital control processors. Each standalone DDC panel shall consist of modular hardware with plug-in enclosed processors, communication controllers, power supplies, and input/output modules. Input and output card module shall be replaceable under POWER ON conditions.

The DDCs should be application specific and should be located as near as possible to the controlled equipment reducing cabling runs. The DDCs should be able to control the equipment connected to it on a standalone mode so that in case of failure of the first tier network the DDCs will be able to perform the minimum control functions assigned to it. The DDCs should have inbuilt display on its fascia with keypad to access all the information being monitored by the DDC. All the DDCs should be equipped with electrically erasable PROMs and the control software for the DDC can be downloaded through the central operator workstation. It should additionally provide a serial port for downloading and reconfiguring of software through a laptop in case of second tier of network failure. All DDCs shall have minimum 16 bit processor.

DDC System Controllers
**Point types**: Each DDC panel shall support the following types of point inputs and outputs:

Analog inputs shall monitor the following analog signals:

- 4-20 mA Sensors
- 0-10 VDC Sensors
- 1000ohm RTDs

Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input “bouncing.”

Counter inputs shall monitor dry contact pulses with an input resolution of one HZ minimum.

Analog outputs shall provide the following control outputs:

- 4.20 mA – Sink or Source
- 0-10 VDC

Binary outputs shall provide SPDT output contacts rated for 2 amps at 24 VAC.

**Operator Interface – Personal computer operator interface**

The automation system Contractor shall provide and install a personal computer workstation for command entry, information management, network alarm management, and database management functions. All real-time control functions, including scheduling, history collection and alarming, shall be resident in the network controllers to facilitate greater fault tolerance and reliability.

**Workstation System Architecture** – The architecture of the workstation shall be implemented to conform to industry standard APIs (application programming interfaces), so that it can accommodate applications provided by the automation system Contractor and by other third party applications suppliers, including but not limited to Microsoft Office Applications. Specifically it must be implemented to conform to the following interface standards.

All historical information contained in Time Series Databases and all configuration data contained in relational databases must be accessed via ODBC (utilizing ANSI SQL database query specifications).

All real-time, online plant data must be accessible by all applications (including, but not limited to, graphics, reports, etc.) via OPC (OLE for Process Control).

All real-time event data (including alarms, change of state events, warning events, etc.) shall be accessible by all applications via OPC (OLE for Process Control).
The Automation system Contractor shall provide all necessary OPC servers for communicating to the DDC controllers that are provided as part of this contract. In addition, the system shall accommodate installation and registration of OPC servers provided in the future by other equipment suppliers.

Workstation Operator Applications architecture: Major operator viewing applications shall be implemented utilizing the current Microsoft Model of an Active-X control, to be contained in one or more Active-X compliant containers. Specifically, the graphics application shall be provided as an Active-X control (for example it shall be possible to embed a graphic in a web page and view it in Internet Explorer). Conversely, it shall be possible to embed other Active X controls—such as trends and other third party available controls—in the real-time graphic application.

**PC Hardware**: The personal computers shall be configured as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory</td>
<td>1 GB (Minimum) 533 NHB DDR2 RAM upgradeable up to 4GB Intel Pentium D945</td>
</tr>
<tr>
<td>CPU</td>
<td>Dual Core; 3.4 GHz 2 x x MB L2 Cache and 800 HZ FSB</td>
</tr>
<tr>
<td>FSB Chipset</td>
<td>Intel 945 G</td>
</tr>
<tr>
<td>Hard Disk Drive</td>
<td>160 GB Serial ATA or greater hard disk drive @ 7200 RPM</td>
</tr>
<tr>
<td>COMBO Drive</td>
<td>48 x 24 x 48 x or higher speed CR R/W and 16 x or higher speed DVD writer</td>
</tr>
<tr>
<td>Ports</td>
<td>6 USB ports (including 2 in front), 2 Serial port, 1 parallel port, 1 PS/2 keyboard port and 1 PS/2 mouse ports.</td>
</tr>
<tr>
<td>Keyboard &amp; Mouse</td>
<td>107 Mechanical Keyboard and Optical Mouse with 2 Button &amp; Scroll, Mouse pad.</td>
</tr>
<tr>
<td>Monitor response time built</td>
<td>17 inch TFTP LCD Monitor, with 12MS in speaker and Resolution 1024 x 1024 support.</td>
</tr>
<tr>
<td>Networking features</td>
<td>10/100/1000 onboard integrated Network Port, including Network Card, with remote booting facility, remote system installation, remote wake up provision of in built modem.</td>
</tr>
</tbody>
</table>

4 Operating System Software:

Windows XP minimum.

Complete operator workstation software package, including any hardware or software keys. Include the original installation disks and licenses for all included software, device drivers, and peripherals.

Peripheral Hardware

**Alarm printers:**

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Printer Make</td>
<td>Epson or equal</td>
</tr>
<tr>
<td>Printing Method</td>
<td>24-Pin Impact Dot Matrix</td>
</tr>
</tbody>
</table>
Workstation Application Components:

Operator Interface

An integrated software package shall be used as the operator interface program.

All Inputs, Outputs, Set points and all other parameters as defined or required as part of the system software, shall be displayed for operator viewing and modification from the operator interface software.

The operator workstation software shall provide context-sensitive help menus and instructions for each operation and/or application currently being performed.

All controller software operating parameters shall be displayed for the operator to view/modify from the operator workstation. These include set points, alarm limits, time delays, PID tuning constants, run-times, point statistics, schedules, and so forth.

The operation of the control system shall be independent of the operator workstation, which shall be used for operator communications only. Systems that rely on the operator workstation to provide supervisory control over controller execution of the sequences of operations or system communications shall not be acceptable.

Alarms:

Each workstation shall receive and process alarms sent to it by the control system. The alarm management portion of the operator workstation software shall, at the minimum, provide the following functions:

Log date and time of alarm occurrence.
Generate a “Pop-Up” window informing an operator that an alarm has been received.
Allow an operator, with the appropriate security level, to acknowledge, delete, or disable an alarm.

Provide an audit trail for alarms by recording operator acknowledgment, deletion, or disabling of an alarm. The audit trail shall include the name of the operator, the alarm, the action taken on the alarm, and a time/date stamp.
Record all alarms received at an operator’s workstation to that workstation’s hard drive.

Allow the operators to view/manage the alarm data archived to hard disk. Selection of a single menu item or tool bar button shall allow the user to acknowledge, disable, delete, or print the selected alarm.

Alarms shall be generated by the operator workstation for any controller that is “off-line” and is not communicating.
Changes made to alarm set points from the Operator Workstation shall directly modify the controller alarm management database.

Selection of a single menu item or tool bar button shall print any displayed alarm report on the system printer for use as a building management and diagnostics tool.

**Reports**

Reports shall be generated and directed to one of the following: workstation displays, printers, or disk. As a minimum, the system shall provide the following reports:

- All points in the network.
- All points in a specific controller.
- A listing of a user-defined group of points in the network. There shall be no limit to the number of user-defined groups
- All points currently in alarm.
- All points in hardware override.
- All disabled points.
- All weekly schedules.
- All or selected point attributes, including, but not limited to:
  - Values
  - Setpoints
  - Alarm Limits
  - Run Times
    - All programmed holidays and associated schedules.
- All disabled alarms.
- All active, unacknowledged alarms.
- All active, acknowledged alarms.
- Any and all other controller operating parameters.

The system shall allow for the creation of custom report point groups that shall be capable of including points from multiple controllers. Systems limiting point report displays to only a single controller’s point database shall not be accepted.
The number of custom reports or display groups shall be limited by the amount of available system memory.

Selection of a single menu item, tool bar item, or tool bar button shall print any displayed report on the system printer for use as a building management and diagnostics tool.

Multiple-level password access protection shall be provided to allow the user/manager to limit workstation control, display, and database manipulation capabilities as he or she deems appropriate for each user, based on an assigned password.

Each user shall have the following: a user name; a password, and an access level (from 1 - 5).

The system shall allow each user to change his or her password at will.

When entering or editing passwords, the system shall not echo the actual characters for display on the monitor.

**A minimum of five levels of access shall be supported as follows:**

Level 1 = Data Access and Display

Level 2 = Level 1 and Operator Overrides

Level 3 = Level 2 and Database Modification

Level 4 = Level 3 and Database Generation

Level 5 = All privileges, including Password Add/Modify

A minimum of 100 unique passwords, including user initials, shall be supported.

Operators shall be able to perform only those commands available for their respective passwords. Display of menu selections shall be limited to only those items defined for the access level of the password used to log-on.

User-definable, automatic log-off timers of from 1 to 60 minutes shall be provided to prevent operators from inadvertently leaving the operator workstation logged on.

Within applications the user shall easily be able to navigate to new information (for example, launch a new graphic within a graphic).

**Graphics**

The graphics shall be able to display and provide animation based on real-time data that is acquired, calculated, or entered.

Multiple graphic applications shall be able to execute at any one time on a single workstation.
The Operator shall be able to configure the speed at which data will be updated on the specific graphic.

**Basic graphical objects** : All graphics shall be able to be constructed from the following basic graphical objects:

- **Single or multi-segment lines of any thickness** : Line styles at a minimum shall include: solid, dotted, and dashed.

- **Rectangles** : User may fill with any color or no fill, and may configure the thickness of the outline.

- **Polygons** : User may fill with any color or no fill, and may configure the thickness of the outline. Arcs.

- **Circles and Ellipses** : User may fill with any color or no fill, and may configure the thickness of the outline.

- **Text boxes** : User may configure text boxes with any W98 TrueType font, any foreground color, any background color, and with 8 or more thickness levels.

- **Animation** : Any Basic object, any group of basic objects, or any symbol or group of symbols, shall be capable of being animated in the following manner:

  - **Size** : Any object’s size shall be able to be animated based on the value of an analog variable.

  - **Movement** : Any object can be animated to move either in a straight line, or can follow a configured path of any number of line segments.

  - **Rotation** : Any object shall be able to be animated to rotate up 360 degrees.

  - **Visibility** : It shall be possible to make any object dynamically appear or disappear based on the true / false result of any boolean equations.

- **Operation from graphics** : It shall be possible to change values (setpoints) and states in system controlled equipment by any of the following methods of operator interaction:

  By selecting the object with either the left, middle, or right mouse button:

  - **Load a specific graphic.**
  - **Drag/Drop to load a graphic in a selected window.**
  - **Link forward or backward to another graphic.**
  - **Change or toggle the value of an object.**
  - **Launch an executable application.**

- **Slider action** : Any object can be defined to be a slider and configured to change a setpoint or other variables as the user slides an object over a configured geometry.
**Dial action**: Any object can be configured so that it can change a configured analog value over a range as the object is rotated. This is most often used to represent dials.

**Data Entry**: A variable is displayed on a graphic. By selecting the variable, the data entry function for the value is enabled and the operator is able to enter a new value for the variable.

**Graphic editing tool**: A graphic-editing tool shall be provided that allows for the creation and editing of graphic files. The graphic editor shall be capable of performing all drawing functions, defining all calculations to be executed as part of the graphic, defining all animations, and defining all runtime binding. It is not acceptable for separate programs to be required to do these various functions.

The graphic-editing tool shall in general provide for the creation and positioning of objects by dragging from tool bars and positioning where required. It shall provide the ability to create, at a minimum, all of the object types, all of the animation algorithms, and all of the action types referenced in this section.

In addition, the graphic editing tool shall be able to add additional content to any graphic by importing any Windows metafile (.wmf) or any bitmap file (.bmp).

**Historical trending and data collection**:

Each Network Controller shall store trend and point history data for all analog and digital inputs and outputs, as follows:

*Any point, physical or calculated, may be designated for trending.*

Each network controller shall have a dedicated RAM-based buffer for trend data, and shall store 96 samples for each physical point and software variable, including an individual sample time/date stamp. Points may be assigned to multiple history trends with different collection parameters.

Trend and change of value data shall be stored within the controller and then uploaded to the trend database(s). Uploads shall occur based upon one of the following: user-defined interval, manual command, or when the trend buffers are full.

The system shall provide a configurable data storage subsystem for the collection of historical data. Data can be stored in either Microsoft Access or SQL database format.

To enable users to easily access stored data, the system shall provide the capability to store historical data in more than one file system (i.e., removable media, separate hard drives, or a remote network file system).

Trend data viewing and analysis.

Provide a trend viewing utility that shall have access to all database points. Provide database access through an Open Database Connectivity (ODBC) interface – a standard Application Programming Interface (API) for accessing data from
relational databases. Client applications can reside within a Windows 95, Windows 98, Windows NT or other latest windows environment. Graphic displays shall be able to be single or stacked graphs with on-line selectable display characteristics, such as ranging, color, and plot style. It shall be possible to display trend data in histogram (X-Y plots) format as well as area and bar graphs. Display magnitude and units shall both be selectable by the operator at any time without reconfiguring the processing or collection of data. This is a zoom capability.

Display magnitude shall automatically be scaled to show full graphic resolution of the data being displayed. This function shall also be operator selectable.

The display range shall consist of magnitude and units fields. The units are seconds, minutes, hours, days, and months.

4.14 Instrumentation Design Criteria

The design criteria to be applied to instrumentation system shall be as follows:

☐ All instruments shall suitable for continuous operation.
☐ All transmitting instruments shall have a 4-20 mA/0-10VDC linear output.
☐ All digital outputs shall be volt free.
☐ Instruments shall be designed for the ambient conditions of temperature and humidity.
☐ All wetted parts of instrument sensors shall be non-corrosive and suitable for use with sewage.
☐ All instrumentation system for use out of doors shall be protected to IP 65.
☐ All analogue displays shall be of the digital type with no moving parts utilizing back lit liquid crystal diode LCD/LED technology.
☐ Instrumentation shall utilize solid state electronic technology and avoid the use where practical of any moving parts.
☐ Minimum maintenance requirements.
☐ Instrumentation shall resume operation automatically on the application of power following a power failure.

Analogue instrumentation system shall be provided to monitor the following:

- Biochemical Oxygen demand, if used
- Treated Sewage Flow
- Raw Sewage Flow
- Sump levels
- Clogging of screens through differential level monitoring
- Total Power consumed by Plant

Digital systems shall be provided as detailed in the Employer’s Requirements and as necessary for the efficient and safe operation of the treatment plant.

The Contractor shall provide plant to measure any other parameter required for the efficient and safe operation of the treatment plant. Instrumentation sensors shall be suitable for the environment in which they are expected to work. Sensor located in hazardous (flammable) or potentially hazardous atmospheres shall be certified for use in these areas.
4.15 **Flow Measurement**

Flow metering as specified will be either open channel type or full bore electromagnetic type as applicable.

a. **Open Channel Flow meter**

The open channel flow meter should employ a ultrasonic principle to measure level and level to flow conversion should be inbuilt in the unit. It should provide isolated 4-20mA/0-10VDC output based on flow rate. It should have inbuilt LCD display and housed in a IP65 enclosure. It should have inbuilt temperature sensor for automatic compensation for changes in air temperature to ensure measurement accuracy. Maximum error in measurement should be within +/-0.2% m at head change of 3m at 22degC and 40-70%RH. The probe unit should be in-corrosive and unaffected by H₂S laden atmosphere.

b. **Electromagnetic Flow meter**

The electromagnetic flow meter should provide isolated 4-20mA/0-10VDC output based on flow rate. It should be housed in IP65 enclosure. It should have an accuracy of +/- 0.5% of flow rate at maximum mean velocity of 15m/sec. It should have a non-full pipe detection system inbuilt in it. The lining of material should be polyurethane with transducers. No rubber lining will be allowed.

4.16 **Level Measurement**

Ultrasonic level type measurement devices shall be used to monitor all tanks. They should be housed in a IP68 enclosure with an integrated display unit. It should have a 4-20mA/0-10VDC output based on level and a resolution of at least 1mm. Measuring range should be at least 0.3 to 8m. The unit should be CE/UL certified.

4.17 **Dissolved Oxygen Measurement**

The DO measuring device should have a 4-20mA/0-10VDC output and integral LCD display for connectivity to automation system and display DO data. It should be housed in IP54 enclosure. It should have a max lag time of 15 min. for generation of DO data with a measurement range of 0.1mg/liter DO Minimum. The unit should be CE/UL certified.

4.18 **Instrumentation Cables**

All signal cables (Analog/Digital) shall be 660V, PVC insulated with stranded tinned copper conductors and laid up as twisted pairs with approximately one twist per 30mm approx. Each cable shall be overall screened of aluminium-mylar type including drain wire giving coverage of 85%, and overall PVC sheath. The analog signals shall have conductors of .8 sq.mm. All external cables should be armored.
4.19 Control System Protection

**Short Circuit**

All power supplies to DDCs, instrument power supplies shall be protected against short circuit by the provision of adequate numbers of fuses or miniature circuit breakers.

**Duty/ Standby Drives**

The duty pump for each duty drive shall be selected on basis of minimum runtime and will be rotated for runtime equalization. The control logic shall automatically start an ‘available’ standby in the event of the duty drive failing.

4.20 Uninterruptible Power Supply (UPS)

All the DDCs and control instrumentation should be powered through centralized UPS. The Network Controllers and Operator workstation should also be powered through online UPS.

Bidder shall provide true ON Line 3 Phase UPS system with rated working load plus 100% standby with parallel redundant in a room. The UPS system shall be provided with necessary by pass arrangement. Each UPS shall have minimum 30 minutes battery back up. The batteries shall be of maintenance free type.

All DC or AC voltage required for instrumentation system shall be derived within the control panels by providing a regulated DC power supply units or transformers. Generators of small capacity sufficient to feed UPS, shall be supplied and installed along with control gear, changeover scheme, exhaust and earthing.

4.21 PROCESS PLANT CONTROL PHILOSOPHY

**General**

The control system in addition to providing the facilities detailed in the preceding clauses shall provide the following process plant specific requirements.

The automation system should automatically on the restoration of power (following a power failure) start the plant operation sequence after expiry of delay timers and follow a startup sequence to prevent the simultaneous start up of various drives.

The typical input/ output (I/O) requirements of various drives to be controlled and monitored through DDCs are shown in Table 1.1.
4.22 **Intercom System**

An intercom system with 3x24 EAPBX shall be provided at all suitable locations especially between the following points within the treatment plant:

- Control room
- All rooms within the Administration and Control Building
- The pump and compressor room with the adjacent main distribution panel room
- The laboratory
- Duty Room
- Security Cabin at the entrance of the campus
TABLE 1.1 : TYPICAL I/O SCHEDULE

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Items</th>
<th>DDC I/O, Controls and Alarm requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Tank and associated Pumps</strong></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Tank Level (Through Ultrasonic level transmitter)</td>
<td>x Level control High and low</td>
</tr>
<tr>
<td></td>
<td>Pump Start/Stop (2A rated potential free relay contact output)</td>
<td>x Duty cycling on demand and runtime equalization. Standby to come online in case of duty failure</td>
</tr>
<tr>
<td></td>
<td>Pump Status (Through current relay)</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Pump trip status (Through potential free contact of overload relay)</td>
<td>x Trip alarm</td>
</tr>
<tr>
<td></td>
<td>Pump auto manual switch status (Through auxiliary potential free contact of auto manual switch)</td>
<td>x Manual mode</td>
</tr>
<tr>
<td></td>
<td>Pump current consumption (Through current transducer)</td>
<td>x Over current</td>
</tr>
<tr>
<td>2.</td>
<td>All electrical drives (aerators, fans etc)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Start/Stop (2A rated potential free relay contact output)</td>
<td>x Duty cycling on demand &amp; runtime equalization. Standby to come online in case of duty failure</td>
</tr>
<tr>
<td></td>
<td>Status (Through current relay)</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Trip status (Through potential free contact of overload relay)</td>
<td>x Trip alarm</td>
</tr>
<tr>
<td></td>
<td>Auto manual switch status (Through auxiliary potential free contact of auto manual switch)</td>
<td>x Manual mode</td>
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<tr>
<td></td>
<td>Current consumption (Through current transducer)</td>
<td>x Over current</td>
</tr>
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<td></td>
<td>Control sensors for automatic operation of the drives if required</td>
<td>x High/low value</td>
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<tr>
<td>Sl. No.</td>
<td>Items</td>
<td>DDC I/O , Controls and Alarm requirement</td>
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<td>3.</td>
<td>Power failure</td>
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<td>4.</td>
<td>Power failure restart</td>
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<tr>
<td>7.</td>
<td>Plant energy consumption and electrical parameters monitoring</td>
<td>x</td>
</tr>
</tbody>
</table>

**Notes:**

i. The I/O schedule detailed is indicative. The Contractor shall provide all the I/Os necessary in order to achieve the complete control and monitoring of the plant.

ii. 25% spare for each type of digital and analogue I/Os shall be provided in each DDC.
5 - INSPECTION, TESTING, ERECTION, COMMISSIONING OF MECHANICAL, ELECTRICAL EQUIPMENT OF PLANT

GENERAL:

All equipments prior to dispatch for the site shall be tested at works as per relevant IS codes. International codes shall be used wherever Indian standards are not available.

1.1. TEST INSTRUMENTS:

The Contractor shall satisfy the Engineer as to the accuracy of all the instruments used for tests and if required shall produce recent calibration tests, or otherwise have them calibrated at his own expense by and independent authority.

1.2. TEST CERTIFICATES:

Copies of certificates of all works, routine tests shall be provided as detailed.

The Contractor shall obtain and submit to the Engineer and to other parties as may be directed, certificates of test of all items, certifying that they have been satisfactorily tested and describing and giving full particulars of such tests.

1.3. MANUFACTURER’S WORKS INSPECTION TESTS AND GAURANTEES:

All Schedules of Particulars shall be completed and the Guaranteed Particulars and the efficiencies of the equipment offered at the duties specified will be binding and may not be varied except with the consent in writing of the Engineer.

The Engineer shall be provided with the facility for inspection of all equipment and material and shall be given at least 10 days notice when such equipment and material is ready for inspection at manufacturer or vendors workshops.

Full witness testing to the relevant standards and to prove guarantees given will be required for the following items:
i). All pumps for performance testing.

ii). Electric motors for type on routine one motor of each size.

iii). All control panels.


v). All transformers for routine and type test on.

   □ EOT Crane as per relevant standards.

In addition all other items of equipment not subject to witness testing shall be temporarily erected at the manufacturer’s works and tested for satisfactory operation and shall be offered for inspection. Copies of manufacturer’s test readings shall be submitted to the Engineer, all prior to packing for shipment.

Such inspection, examination, or testing, shall not release the Contractor, manufacturer or supplier of any item from any obligation under the Contract.

Certified copies of manufacturer’s test readings of all items shall be submitted to the Engineer within 7 days of the satisfactory completion of the tests.

Whilst the Engineer shall be provided with facilities for witness testing and / or inspection of all items of equipment at the manufacturer’s works, he may at his discretion advise that the tests shall proceed in his absence. These tests shall be made as if in his presence, and duly certified copies of test readings shall be submitted.

Where items of equipment are of identical size and duty it may be required, at the Engineer’s discretion, that a reduced number of the items be subjected to witness tests; however this shall not relieve the manufacturer from the requirement of carrying out the performance tests on all items prior to offering a witness testing.

If after inspecting, examining or testing any material or equipment, the Engineer shall decide that such items or any part thereof is defective, or not in accordance with the Specification or performances, he may reject the said items or part thereof, giving to the manufacturer within a reasonable time, notice in writing of such rejection, stating therein the ground upon which the said decision is based. All re-testing shall be at the Contractor’s expense.
1.4. SITE TESTING:

The Contractor shall arrange for the full site testing of all items of equipment and shall include provision of:

a). All skilled and qualified operating and test staff for the testing of all equipment.

b). Provision and disposal of all services, lubricants, and fuels other than electricity.

c). All measuring and testing instruments to demonstrate equipment operates to the fulfillment of the works sheet.

1.5. Manufacture’s Work Tests

1.5.1 Power Transformers

i). Measurement of winding resistance.

ii). Ratio polarity and phase relationship.

iii). Impedance voltage.

iv) Load losses.

v). No-load losses and no-load current.

vi). Insulation resistance.

vii). Included over voltage withstand.

viii). Separate source voltage withstand.

1.5.2 Type Tests

i). Impulse voltage withstand both chopped and full wave.

ii). Temperature rise.

Unless otherwise stated by the Engineer, evidence of type of tests carried out on identical transformers to those being provided under the contract will be accepted in lieu of actual tests.

1.5.3 CIRCUIT BREAKERS AND CONTROL GEAR :
i). Routine tests including pressure test, milli-volt drop (Ductor) tests.

ii). To ensure operation of the closing coil and satisfactory closing of the circuit breaker with the voltage on the coil down to 80% of its rated voltage, and that mal-operation does not occur with a voltage on the coil of 120% of its rated voltage.

iii). To ensure the satisfactory trip operation of the circuit breaker at no load conditions with the trip coil energized at 50% of its rated voltage.

iv). Test figures for heat – run tests performed on identical panel types shall be made available.

v). All interlocking, circuit breaker draw in & draw out operation.

1.5.4 PROTECTION AND CONTROL CIRCUITS:

Base on the completeness of the circuits in the final manufactured form within the manufacturer’s works, the following tests shall be carried out:

i). Primary injection tests to ensure correct operation of the current operated protection relays and direct acting coils over their full range of settings.

ii). Balanced earth fault stability tests by primary current injection. Care must be taken to reproduce accurately the burdens of interconnecting cables. A further test to ensure correct polarity must be made after assembly.

With different pilot wire schemes it may not be possible to apply primary injection testing. In this case the circuits shall be proved by secondary injection. Current transformer characteristics and calculations associated with the above tests shall be available for inspection by the Engineer.

iii). Correct operation of control circuits at normal operating voltage by operating voltage by operation of local control switches, and simulation of operation from remote control positions.

1.5.5 MOTORS:

Motors over 100 KW site rating shall be subject to full performance tests which may be witnessed by the Engineer at the Motor manufacturer’s works.

Motors of 5.5 KW to 22 KW site rating shall be subject to performance tests but will not be witnessed.
Motors under 5.5 KW site rating shall be subject to “type test” standards.

Type test certificates which shall include the following shall be provided for all motors:

i). Manufacture to BS.
ii). Class of Insulation.
iii). Type of cable fittings.
iv). Type of bearing sizes and lubricant.
v). Type and rating of motor heaters.

Motor testing shall be carried out in accordance with the requirements of BS 4999.

1.5.6 INSTRUMENTS AND METERS:

Tests to ensure operation of all ammeters, voltmeters and transducers and checks for correct calibration KWH meters shall be checked for correct rotation and creep tests shall be carried out to ensure that the meter is inoperative with voltage along, if the secondary of the current transformer is left connected with the primary current interrupted.

1.6. TESTS ON CABLES DURING MANUFACTURE:

All cables supplied under the Contract shall be subject to routine tests in accordance with the relevant British Standard. Cables will not be accepted on Site for installation until certificates giving proof of compliance with the Specification and date of tests have been received and approved by the Engineer. A certificate shall be applicable to each drum.

The tests to be carried out on every drum at manufacturer’s premises shall include:

a). High voltage A.C insulation pressure test between cores, each core to earth metallic sheath or armour as applicable.
b). Insulation resistance test.
c). Core continuity and identification.

1.7. PROCESS CONTROL AND INDICATING INSTRUMENTS:

All flow, level and process measurement controllers, transmitters, recorders, indicators, vacuum and pressure gauges shall be subject to routine in accordance with BS 88, BS 1780 and BS 3680.

Test Certificates shall be provided against each item of equipment.

1.8. ELECTRICAL MEASURING INSTRUMENTS AND METERS:

Tests to ensure accurate operation of all meters, voltmeters and kwh meters shall be undertaken in accordance with BS 89 and BS 37.

1.9. ALARM SYSTEMS:

The Contractor shall be responsible for testing all items of equipment comprising the Works alarm system for correct operation and sequence action.

1.10. SITE TESTS:

Leakage Tests at the test pressure shall be carried out on all erected pipe work and valves immediately after erection and before being built in. The Contractor shall advise the Engineer when these tests are to be carried out.

1.11. TESTS ON CABLE DURING INSTALLATION:

During the period of site installation the Engineer will carry out inspection of the Works to ensure the standards of workmanship meet the specification and are to his satisfaction. In the even of any part of the cabling installation failing to meet these requirements the Contractor shall remedy the deficiency to the satisfaction of the Engineer.
After completion of various parts of the installation the Contractor shall provide a test engineer, labour and materials to demonstrate to the Engineer that the cables have been correctly installed.

The Contractor shall inform the Engineer prior to the testing of cables and shall be responsible for liaison with any other contractor to whose equipment the cables may be terminated to ensure all parties concerned are aware of the impending tests, to guarantee safety of personnel and that isolation of any particular equipment has been completed. Any special isolation or preparation required to be carried out before cable testing will be completed by the Contractor responsible for that equipment. All tests shall be carried out by the Contractor to the satisfaction of the Engineer.

1.12 **PUMPS SETS**:

Tenderers shall complete the Schedule of Particulars and Guarantees and shall state therein, inter alia, the guaranteed efficiencies of the pumps and motors offered, and the overall guaranteed rates of energy consumption of the complete pump sets at the duties specified.

The contractor’s guarantees given when tendering in respect both of performance and efficiency shall be binding and considered part of the contract. The fulfillment of these guarantees shall be verified at the test works to be witnessed by PWD and at Site trials in accordance with the procedure given in British Standards 5316 and 4999 etc.

This site trials shall be carried out under the control of the contractor’s staff to the satisfaction of the Engineer. The Contractor shall provide all the necessary labour and instrumentation to conduct the tests. The discharge from the pumps shall be measured wherever possible by the volume drawn from a sump or delivered to a tank over timed intervals.

1.13 **ELECTRICAL PLANT**:

After all the deficiencies apparent during the installation inspection have been rectified to the Engineer’s satisfaction, the following tests shall be carried out.

1.13.1 **CIRCUIT BREAKERS AND CONTROL GEAR**:

i). Routine tests, including H.V. pressure tests.

1.13.2 **PROTECTION AND CONTROL CIRCUITS**:
Tests at 1.5.4 with the addition of satisfactory operation of all inter-tripping circuits in conjunction with other items of plant.

**TESTS ON CABLES AFTER INSTALLATION:**

Every cable shall be subject to the following tests after installation.

High voltage pressure tests:

The following D.C. test voltages shall be applied at full valve.

i). PLYSWS 11,000 volt grade cable
Between cores 30,000 volts Between any core and armour 17,500 Volts.

ii). XLPESWAPVCC 3,300 volt grade cables.
Between cores 10,000V Between any core and armour 5,800 V

iii). XLPESWAPVC OR PVCSWAPVC 1,100 volt grade mains cable.
Between cores 3,000 V Between any core and armour 3,000V.

Witnessed high voltage pressure tests shall not be carried out on PVCSWAPVC control cables, but it shall remain the responsibility of the Contractor to test the insulation of these cables both between cores and between cores and earth during installation with a ‘Megger’ 5000 volt hand generator.

The Contractor shall test all cables after installation to ensure correct phasing out of cores, continuity of cores sheath and armour over the whole length of the cable.

**1.14. EARTHING SYSTEM TESTS:**
The Contractor shall demonstrate to the Engineer that the resistance of the electrodes to earth and the earth conductor continuity is in accordance with the Specification and IS 3043. The tests shall be made on completion of the installation.

The test shall be performed from each major item of plant, by using an “Earth Megger” and auxiliary return conductor. The each earthing station shall be separately tested and value of earthing resistance shall be displaced under man hole cover.

1.15. INSTALLATION INSPECTION:

In additional to the progressive supervision and inspection by Department the Contractor shall offer for inspection to Engineer, the completely created plant/ part of plant on which tests are to be carried out. After such inspection by Engineer, each equipment / sub system shall be tested by the contractor in accordance with the applicable standards in the presence of Engineer. Such tests shall include but not be limited to the tests specified in following clauses.

1.16. PRECOMMISSIONING TRIALS, TESTS OF ELECTRICAL EQUIPMENTS.

1.16.1 START UP:

On completion of erection of the equipment and before start-up, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Engineer and the Contractor for correctness, completeness of installation and acceptability for start-up, leading to initial pre-commissioning tests at site. The list of pre-commissioning tests to be performed shall be as mutually agreed by the Engineer and Contractor.

1.16.2 INITIAL OPERATION ( INITIAL RUN )

After the pre-commissioning tests are satisfactorily over, the complete plant shall be placed on Initial Operation during which period the complete equipment shall be operated integral with sub-systems and supporting equipments as a complete plant and necessary adjustments made while operating over the full load range enabling the plant to be made ready or commissioning. The period of Initial Operation shall be as mutually agreed by the Engineer and the Contractor.

An Initial Operation report comprising of observations and recordings of various parameters to be measured in respect of the above Initial operation shall be prepared by the Contractor. This report, besides recording the details of the various observations during Initial Operation shall also include the dates of start and finish of the Initial Operation and shall be signed by the representatives of both the parties. The report shall
have sheets, recording all the details of interruptions occurred, adjustments made and any
minor repairs done during the Initial Operation. Based on the observations, necessary
modifications repairs to the plant shall be carried out by the Contractor to the full
satisfaction of the Engineer to enable to latter to accord permission to carry out the
commissioning the conduct. Performance and Guarantee Tests on the Plant. However,
minor defects which do not endanger the safe operation of the equipment shall not be
considered as reasons for with holding the aforesaid permission.

The cost of all labour, energy and consumables other than water required for Pre-
commissioning, Initial Operation shall be borne by the Contractor. Water required for
running the plant will be supplied free by the Department.

1.17. COMMISSIONING :

The plant shall then be commissioned and put on Trial Operation at full load when
Performance Guarantee Tests shall be conducted.

During the period of trial operation the Contractor shall

i). Operate the full works on behalf of the Department.

ii). Supply the labour and materials including consumable required for the operation and
maintenance of the works and bear the cost of electrical energy.

iii). Instruct the Department’s operators in the operation and maintenance of the work; a
programme shall be submitted by the Contractor for the training of operators, both
supervisory and subordinate levels. This program shall be submitted to the Engineer
three months before the scheduled start of commissioning. The training of the
departments staff shall be carried out with reference to the operation and maintenance
manual furnished by the Contractor.

iv). Carry out maintenance repairs of defects immediately.

    During the period of trial operation of working hours of the Contractors shall be 24
hours daily, 7 days week.

    The Contractor shall provide for the expenditure on all the consumables any energy
required during the trial operation. All labour and cost of any other materials shall also
be met fully by the Contractor. Water for operating the Plant will be supplied free by the
Department.
The Trail Operation shall be considered successful, provided that each item of the equipment can operate continuously at the specified characteristics, for the period of Trial Operation and the Performance Guarantees are successfully met.

Any special equipment, tools and tackles required for the successful completion of the Performance and Guarantee Tests shall be provided by the Contractor free of cost.

The guaranteed performance figures of the equipments shall be provided by the Contractor during the Performance and Guarantee tests. Should the results of these tests show any decrease from the guaranteed values, the Contractor shall modify the equipments as required to enable them to meet the guarantees. In such case, Performance and Guarantee Tests shall be repeated within one month from the date the equipment is ready for re-test and costs for modifications including labour, materials and the cost of additional testing to prove that the equipment meets the guarantees, shall be borne by the Contractor.

Performance and Guarantee Tests shall make allowance for instrumentation errors as may.

1.18. COMPLETION

a). The Works will be certified as virtually completed by Executive Engineer HUDA Division No.1 Hissar Haryana only after it has successfully completed trial operation for a continuous period of six months.

b). A Virtual Completion Certificate for plant shall not be issued unless the following documentation are dully compiled and submitted in final formats in duly bound volumes.

c) A Completion of all shop inspection results/reports of the plant/machinery with due attestation that the plants have been manufactured to specified standards (6 copies)

d) All erection/construction quality control checks in appropriate approved formats for installation works with attestation that installation has been carried out as per acceptable/stipulated standards (6 copies)
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**INSPECTION, TESTING, ERECTION, COMMISSIONING OF MECHANICAL, ELECTRICAL EQUIPMENT AND INSTRUMENTATION OF PLANT**

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### ANNEXURE – 1: LIST OF ACCEPTABLE MAKES OF EQUIPMENT

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<th>Category-I/II</th>
<th>Short Form</th>
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<tbody>
<tr>
<td>1.</td>
<td>Pumps</td>
<td>Kirloskar Brothers Limited Mather &amp; Platt (I) Ltd.</td>
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<td>(KBL)</td>
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<tr>
<td></td>
<td></td>
<td>Jyoti Ltd., Beacon Wier Ltd. Worthington India Ltd.</td>
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<td>(MP)</td>
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<td>Bharat Pumps &amp; Compressors Ltd. KSB Pumps</td>
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<td>Shiva Durga Iron Works (P) Ltd. Intervalle Crane</td>
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<td>Jash Engineering (P) Ltd. The Indian Valve Co.</td>
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<td>Baroda Rollings Mills The Indian Iron &amp; Steel Co. Ltd.</td>
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<td>b) Chain Pulley Block</td>
<td>Reva Engg. Hercules Hoists Ltd. W.H. Brady &amp; Co. Ltd.</td>
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<td>(ALSTOM)</td>
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<td>415 V Switchgear Control gear Components/Bus Duct</td>
<td>Larsen &amp; Toubro Ltd. Siemens India Limited Voltas Ltd. English Electric Ltd. Jyoti Ltd. Control and Switchgear Bhartia Cutler Hammer Electrical Control gear Ltd. ASPL</td>
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<td>(SIEMENS)</td>
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<td>De-gritting Mechanism</td>
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| 14. Lighting Fixtures | Siemens India Limited  
Asian Brown Boveri  
ALSTOM  
Kirloskar Electric Ltd.  
Bharat Heavy Electricals Ltd.  
Crompton Greaves  
VOLTAS Ltd. | (SIEMENS)  
(ABB)  
(ALSTOM)  
(KIRLOSKAR)  
(BHEL)  
(CGL)  
(VOLTAS) |
|---|---|---|
| 15. 415 V Air Circuit Breaker | Bajaj Electrical Ltd.  
Crompton Greaves Ltd.  
Philips  
Wipro Ltd.  
Klipsal | (BAJAJ)  
(CGL)  
(PHILIPS)  
(WIPRO)  
(KLIPSAL) |
| 16. Cables | English Electric Ltd.  
Larsen & Toubro Ltd.  
Siemens India Ltd. | (EEL)  
(L&T)  
(SIEMENS) |
| 17. Power Capacitors | Indian Cables Ltd.  
Fort Gloster Industries Ltd.  
Cable Corpn. Of India  
Universal Cables  
Indian Cable Co.  
Asian Cables Corporation Ltd.  
Gemscab  
Finolox Cables Ltd  
Delton Cables  
Polycab | (ICL)  
(FGI)  
(CCI)  
(UNISTAR)  
(ICC)  
(ASIAN)  
(GEMSCAB)  
(FCL)  
(DELTON) |
| 18. Instrument & Meters | Crompton Greaves Ltd.  
Universal Cables Ltd.  
NGEF  
Bharat Heavy Electricals Limited.  
MEHER (L&T)  
DULATI  
Manohar Brothers  
Madhav  
Khatau & Junker  
VOLTAS Ltd. | (CGL)  
(UNIVERSAL)  
(NGEF)  
(BHEL)  
(MEHER)  
(DULATI)  
(MB)  
(MADHAV)  
(KHATAU)  
(VOLTAS) |
| 19. Motor Starters | Bharat Heavy Electricals Ltd.  
Perimal Engineering Ind. | (BHEL)  
(PEI) |
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<td>Push Buttons and Indication lights</td>
<td>Larsen &amp; Turbo</td>
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<td>Relays (for 3.3 KV 11 KV switchgear)</td>
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<td>Chloride India Ltd.</td>
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<td>Applied Electronics Ltd.</td>
<td>APLAB (JINDAL)</td>
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<td>NELCO</td>
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<td>Instrument Transformers (CT’s &amp; PT’s)</td>
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<td>Vacuum Pump</td>
<td>Kirloskar Brothers Ltd.</td>
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<td>SLM Manek Lal Industries Ltd.</td>
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<td>UPTRON (STATCOM)</td>
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<td>Kooverji Devshi &amp; Co. Ltd. Ltd.</td>
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<td>Vijay Fire Protection System Pvt. Ltd.</td>
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<td>Ceiling Fans</td>
<td>Bajaj, Orient, Usha, Crompton</td>
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<td>Multimeter</td>
<td>Excrop, Motwane</td>
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<td>(EXCROP), (MOTWANE)</td>
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<td>Push Button For non-flame-proof Flameproof Weather Proof</td>
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<td>Trozan, Wedico, Suntech, INFILCO</td>
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<td>(HUMBOLT), (PENAVOLT), (ALFA LEVEL), (FLOTTWEG)</td>
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<td>Page</td>
<td>Description</td>
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<td>Guinard (GUINARD), Broadbent (BROADBENT)</td>
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<td>(TRICOLITE)</td>
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<td>Larsen &amp; Toubro Siemens Jakson Associated Electrical Bhartiya Cutler Hammer Control &amp; Switch Gear GE Power Chavare Engineering Spark Electro</td>
<td>(L &amp; T), SIEMENS JAKSON ASPL BCH C &amp; SG G.E POWER</td>
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<td>DELINK CORDS RR ICON AKSH</td>
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<td>Flow Meters Krone marshall ABB Schlumberger Endress Hauser YBL Yokogawa Magnetrol Toshbro (Nivo Control)</td>
<td>KM ABB SB EH YBL</td>
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<td>Actuator Marsh L&amp;T Rotork AUMA</td>
<td>MARSH L&amp;T ROTORK</td>
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<td>Pressure Switches Pressure transmitters Danfoss Switzer Fiebig Varna Trifag H. Guru High Tech (Orion)</td>
<td>DANFOSS SWIT FIEBIG VARNA HG HT</td>
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<td>Level Switch Endress Hauser EIP Nivo Control ABB Level Cone Magnetrol</td>
<td>EH EIP NIVO ABB LEVEL CONE</td>
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<td>Electronic Ballast Philips Opal Washlow</td>
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<td>Micro GE Power</td>
<td>GEP</td>
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NOTE: CTS & PTs of the makes, guaranteed by switchgear manufacturer for its performance and as per specification shall be acceptable subject to approval by Board. Any other equipment whose make is not approved will be got approved from Department, before supply.

**PARAMETERS/ ANALYSIS**

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<td>PH/ Conductivity Meter</td>
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5.4 START UP AND PERFORMANCE RUN

1 TEST ON COMPLETION:

1.1 General
Prior to the commencement of Tests on Completion the Contractor shall submit the following:
Site Acceptance Test Documents
As built drawings
Operation & Maintenance Manuals
Test on completion shall not be commenced until the aforementioned documents are approved by the competent authority.

The initial charges necessary for Tests on Completion shall be borne by the contractor. Electricity required for Tests on Completion will be provided by Department free of charge for a period not exceeding 30 days. In case the test on completion period exceeds 30 days, the cost of power upto the start of the performance run shall be borne by the contractor.

The cost towards any consumables and chemicals required for the tests shall be borne by the contractor.

1.2 Dry Test Requirements

1.2.1 General
As a minimum requirement, the following dry tests shall be carried out as a general requirement:
A general inspection to check for correct assembly and quality of workmanship
A check on adequacy and security of Plant fixing arrangements
A general check to ensure that all covers, access ladders, water-proofing, guard railings etc. are in place,
A check on damp proofing, rust proofing and vermin proofing and particularly the sealing of aperture between building structure, chambers, etc. and the outside.

1.2.2 Civil and Building Works
As a minimum requirement the following dry tests shall be carried out on the civil engineering and building works:
Check for the presence of foreign bodies in pipe work and structures.

1.2.3 Mechanical Works
As a minimum requirement the following dry tests shall be carried out on the mechanical systems:
Carry out preliminary running checks as far as is permitted by circumstances in order to ensure smooth operation of Plant.

1.2.4 Electrical Works
As a minimum requirement the following dry tests shall be carried out on the electrical systems:
Check phasing and polarity
Carry out point to point check on all cables
Check on security of cable terminations
Check on completeness and adequacy of earthing systems;
Check setting on protection relays, sizes of fuses and motor overload
Carry out checks on cabling systems in accordance with the requirements of the relevant standards
Check operation of main circuit breakers by secondary injection methods
Check rotational direction of plant
Check instrument loop integrity, functionality and calibration;
Check operation of standby generator installation and mains/generator changeover procedures; a 4 hrs load test (using the normal load| Works) shall be carried out on the generator when the load is available
Check plant functionality
Check functionality of the central MMI and its power supply

1.3 Process Plants/Equipments
All process plant items/equipments shall be tested to ensure that they meet the HUDA requirements for quality of workmanship, construction and performance.

1.4 Hydraulic Wet Test Requirement
Hydraulic wet tests shall be carried out on completion of dry tests.

Potable water shall be used for hydraulic wet tests. The purpose of this is to prove, as far as is practical the hydraulic performance of the Works. In order to demonstrate this, the Contractor shall ensure that each part of the Works is hydraulically loaded to its maximum rated load throughout for a period of at least seven days at twenty-four hours intervals.

In order to ensure a sufficient supply of potable water to carry out these, the Contractor shall provide facilities for the disposal off site in an approved manner.

In order to remove doubt the following tests inter-alia shall be carried out:-
Pressure testing of all piped systems laid direct in ground in accordance to the relevant standards;
Fill all structures and check for leaks as per IS: 3370;
Running of all pumped systems in order to check for
  - Correct functionality
  - Absence of leaks
  - Correct running temperatures
  - Smoothness of running and the absence of undue vibration or stress
  - Check drive running currents
Carry out calibration of instruments where appropriate
Carry out valving, diversion etc. to fully hydraulically load each element (or where there is a requirement to withstand an overload, (overload each process element;)
Demonstrate correct functionality of electrical, control and instrumentation systems.

The Contractor shall simulate, where practical, the conditions that will be when operating as a process in order to demonstrate the correct functions, process control, loop etc.

During these tests a check on the performance of Plant shall be made, as far as site facilities will allow, to compare its site performance with the factory test data and to identify any constraints on the performance due to site conditions.
1.5 Process Wet Test
On approval by the Department the Contractor shall carry out process wet tests.

Raw water shall be used as the primary feed stock for process wet tests. These tests shall be carried out to demonstrate the process performance of the Works. In order to demonstrate this, the Contractor shall ensure that each part of the Works is loaded to its rated throughput (including a period of overload if required in order to demonstrate compliance with the Department’s Requirements) for continuous stable operating period of not less than 48 hours.

The Contractor shall provide facilities for the disposal off site in an approved manner.

The following tests inter alia shall be carried out;
Check and rectify leakage on civil structures, pumps and pipe work;
Running of all pumped systems in order to check for;
- Correct functionality,
- Absence of leaks,
- Correct running temperatures,
- Smoothness of running and the absence of undue vibration or stress,
- Check drive running currents where the solution pumped is different from that pumped during hydraulic wet tests;
Carry out calibration of instruments;
Carry out valving, diversion etc to fully hydraulically load each process element (or where there is a requirement to withstand an over load), overload each process element;
Demonstrate correct functionality of electrical, control and instrumentation systems not checked during dry or hydraulic wet tests or which may have changed as a result of the different operating conditions now prevailing.

On completion of process wet test on the various parts of the works, the Contractor shall run the plant as a whole in order to demonstrate the full functionality and performance of the Works at various throughput rates for a continuous period of not less than 7 days. This shall be considered as completion of Test on Completion’ and shall be certified by Department.

2 PERFORMANCE RUN AFTER START UP
2.1 General
On successful completion of ‘Test on Completion’ i.e. start up and commissioning, certified by Department, Contractor should start the performance run of the plant for 6 months.

The Contractor is to carryout Operation & Maintenance (O&M) of the whole plant including civil works for 6 (six) months under performance run. Department shall monitor the operation and maintenance by the Contractor.

During performance run period, the Contractor shall provide following as minimum for round the clock operation.

(1) Staff
   Plant In-charge : One
   Chemist : One
   Operators : One for each shift
   Maintenance Units : One fitter, one electrician
Helpers : One for each shift  
Watchman : One for each shift  

(2) **Chemicals and consumables**: As required  

(3) **Spares**: As required for replacement during performance run period. The spares used from the spare supplied under the contract shall be replaced by the Contractor.

Department shall supply power and water during Performance Run period free of cost. All other material such as chemicals, consumables, lubricants, tools & plant spares etc. shall be provided by the contractor. The contractor, if required shall provide activated sludge or any other material for the stabilisation of the plant.

The Contractor shall provide operators for various units/plants for three shifts and other staff/supporting personnel in general shift.

The Contractor shall submit a weekly report to the HUDA , about the operation and maintenance indicating the manpower, electric power, chemicals / consumables consumed and also problems faced and rectified.

During this period, the Contractor shall ensure that the design treated quality standards are met in accordance with the specification within the rate of power and chemical consumption as committed by the Contractor. The treated sewage analysis pH, SS, BOD and oil & grease shall be carried out on daily basis from the day of commissioning at a reputed laboratory as approved by Engineer-in-Charge. 90% of the treated sewage samples should fall within prescribed limits of the treated sewage. The sampling location for raw sewage shall be at raw sewage sump and that of treated sewage shall be at chlorine contact tank.

The analysis of sewage for the above parameters at different locations at outlet of Cyclic Activated Sludge Process / SBR Process basin shall also be carried out on weekly basis Contractor shall take immediate steps to correct the operation of the meet the guaranteed performance. The charges for analysis at the laboratory to be borne by the Contractor.

The Contractor's responsibility includes the safety and security of works/plants during the course of performance run of six month.

The Contractor shall provide key personnel for performance run with minimum qualification and experience as given below:-

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Category</th>
<th>Qualification and Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Plant In charge</td>
<td>Graduate in Engineering/Technology (Civil/Environmental Engineering) having 3 years of experience in O &amp; M/ Maintenance of water/wastewater treatment plant.</td>
</tr>
<tr>
<td>2</td>
<td>Plant Operator</td>
<td>Diploma in Engineering/Technology (Civil/Environmental/Chemical Engineering) having 3 years of experience in Operation/Commissioning of water/wastewater treatment plants</td>
</tr>
</tbody>
</table>
3 Chemist
Graduate in Environmental Science/ Chemistry having 3 years of experience in sampling/ analysis in water/wastewater treatment plants.

4 Electrician / Fitter
Diploma in respective field with 3 years of experience in erection, commissioning and O&M of M&E equipment in water/wastewater treatment plants.

3 PERFORMANCE RUN CERTIFICATE
The conditions for issuance of a Performance Run Certificate as detailed in the Conditions of Contract shall comprise:
The completion of the six months operation and maintenance under performance run of the treatment plant to the satisfaction of department.
90% of treated sewage samples fall within the prescribed limits of the treated sewage mentioned in the tender-document.
Operation & Maintenance Manual have been updated following six month's operational experience and approved by department.
All defects during the six months operation of the works have been rectified.

department shall issue a Completion Certificate for "Performance Run of Plant" after successful completion of Performance Run of plant for 6 months by contractor to the satisfaction of department.
5.5 SPECIFICATIONS FOR OPERATION & MAINTENANCE OF WORKS

1. SCOPE OF WORK


Salient features of works are:

1) To Operate and maintain the Raw Sewage Pump House, sewage treatment plant, all instruments and mechanical, electrical equipments in accordance with the aim and purpose of treatment. The plant & equipments covered under the above contract will be totally attended to, by the contractor including any “Trouble shooting” to ensure smooth and trouble free operation.

2) The contractor will monitor the performance of the sewage treatment plant; conduct the analysis of the inlet sewage and water quality after treatment. Contractor shall initiate and take adequate actions to ensure smooth and satisfactory performance / running of the plants on a 24 hours / round the clock basis.

3) The contractor shall prepare and implement an effective plant maintenance programme in consultation with Executive Engineer HUDA Division NO.1, Hisar. Except during major overhauling, if required in a year. Department will not provide any skilled or unskilled work force. It is absolutely the contractor’s responsibility to look after all sorts of maintenance whether preventive, Minor, Major, or break-down.

4) The contractor will determine operating parameters, select settling (Chemical doses etc.) and generally optimize the process, and working of the treatment plant. Excessive chemical dosing i.e. doze more than normal should be avoided otherwise penalty shall be levied and recovered from the contractor.

5) The contractor should plan & procure all spares, Polyelectrolyte and all consumables including chemicals, grease, lubricating oil, cleaning agents, laboratory reagents etc. Further the contractor will plan about the requirement well in advance (At least 4 months) and procure the material from the market.

6) The contractor will be responsible for keeping up-to-date record of documents including History Card for equipments and maintaining every day log book relating to various analysis performed.
7) The contractor 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.

8) The contractor will prepare and submit a daily report of plant performance and will assist the department in preparing the necessary documents for their purpose and records.

9) The contractor will be responsible to carry out day to day periodic maintenance, necessary to ensure smooth and efficient performance / running of all equipments / instruments comprising the sewage treatment plant and maintaining the record of the same.

The contractor will 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 department mentioning qualification & experience.

10) The contractor will also be responsible to carry out day to day Maintenance of the 400 mm dia. rising main inside the STP premises.

11) The contractor will employ minimum staff for operation and maintenance of the Plant as per the list mentioned in the detailed scope of work.

The above staff shall be distributed in three shifts as per mutual agreement between Contractor and department. As per agreement the number of staff in each shift should always remain present otherwise penalty towards absence of any staff shall be levied and recovered from the Contractor. The Engineer in Charge of the Department, shall decide the penalty. The contractor shall make the arrangement of reliever for weekly off/holiday etc. Absence on any ground like weekly off or holiday shall not be considered. The presence of staff in each shift should be marked in muster to be maintained at office of shift in charge at Sewage Treatment Plant that shall be considered as final. The Contractor’s staff must mark their presence in this muster.

The Contractor may maintain a separate register for his own purpose.

12) The staff of contractor will always remain in contact with the Junior Engineer, Assistance Engineer/Electrical Supervisor, In charge of the Drainage Department /Sewerage Project Department of the Corporation and follow their instructions.

13) Unsatisfactory and inefficient running of the plant and unnecessary and excessive usage of spare, consumable, etc. supported by the reasons which are under control of contractor will be highly objected. In such cases Engineer-in-charge’s decision will be final and binding to the contractor.
14) It is required that at least once in every one months a technical expert other than the Monthly Staff of the contractor will visit the plant and will suggest if required, to improve the efficiency and working of the plant etc. No separate payment will be made for such visits. The visit must be recorded in department 's document and out come of the visit/minutes of the meeting should be got signed by department's authorities without which the visit shall not be considered.

15) Contractor will comply with all safety rules and regulations and all inter disciplinary as followed by the department.

16) The department will not be responsible for any accident/injury to the staff of the contractor. Further the department will not provide any insurance or medical facility to the staff of contractor. The responsibility lies with the contractor.

17) All Central/State Government / Semi-Government / Local Body’s Rules and Regulations pertaining to this contract shall be followed and observed by the contractor without any extra cost to the department.

18) No accommodation / guesthouse / transportation facility will be provided by the department to the contractor. Operation & maintenance staff will not be allowed any accommodation facility inside the plant premises.

19) The duration of the O&M shall be 48 months from the date of successful commissioning of the STP. The same can be extended for the further period if Department, so desires. However department reserves the right to terminate the contract at any time by giving one-month notice to the contractor.

20) The contractor should employ all the staff immediately after successful commissioning.

21) The contractor will provide the necessary tools and tackles required for day-to-day maintenance & self cleaning of all the sensors.

22) Chlorine toner /cylinder will be provided at the doorstep of the plant. The contractor will carry out disconnecting and removal of empty toner and reconnection of filled toner. The spares required for disconnection / reconnection i.e. clamp /’o’rings / washer shall be arranged by contractor.

23) The scope of work also includes cleaning of complete plant area including floor, toilet block railing, door, windows, light fixtures and ceiling etc. The entire premises of the plant area shall also be cleaned and maintained by the contractor regularly.
24) This work is inclusive of but not limited to operation, maintenance, house keeping, cleaning, removing sludge by its own carrier arrangement & dispose it off as per department’s instructions. Preparing data recording, correspondence work to department and Government Department s, etc. All this work should be done as per standard practices and by following labour, factory, electrical, Haryana Pollution Control Board, and all other old and new law and order, Indian standards etc. as applicable of Local, State and Central Government of India.

25) The contractor shall not employ any offensive, guilty or indiscipline persons.

26) Department reserves the right to suspend, dismiss or terminate any officer / staff employed by the contractor. The contractor shall take prior permission of the Department to employ or to terminate the services of his personnel.

27) No watch and ward, safety insurance, security, storage, housing accommodation etc. will be provided by department. This will be responsibility of contractor.

28) Consumable items like rubber bush, graphite packing, rubber sheet, nut-bolts, material required for cleaning and house keeping etc. are to be brought by the contractor.

29) Electricity, Chlorine required for operation & maintenances of the plant will be provided by department. The contractor should provide all other consumables like polyelectrolyte, oil & grease etc. All the formalities to all Government authorities for factory, Electrical, Haryana Pollution Control Board etc. for having NOC, water consent, Hazard waste concern, approval etc. shall be done by the contractor.

30) Monitoring should be done as per guideline given by Engineer-in-charge. Contractor has to maintain all the parameter of effluent within stipulated limit or he will be penalized for not maintaining the parameters given by Haryana Pollution Control Board and department. All expenditure incurred for the same like, suit fee, court fee, case fee, or the penalty as decided by Engineer of department and penalty charged by Haryana Pollution Control Board will be charged to the contractor and deducted from his bills, S.D etc.

31) Contractor shall have to test the effluent / influent at his own cost at the plant laboratory on daily basis. The same shall be verified by and checked by department whenever required. The contractor shall also have to test the effluent / influent at Haryana Pollution Control Board lab for different parameter on weekly basis at his own cost.

32) No equipment shall remain idle or un-attended or damaged for a period of more than 3 days. If any equipment is not repaired, rectified and or replaced within 3 days, the contractor will be penalized with no limit at the rate of Rs. 2000/- per day delay per each individual equipment of the plant.
33) If the staff on duty remains absent, the contractor will be penalized at the rate of Rs. 500/- per man per day up to no limit.

34) The payment of O & M charges will be made as per the tender conditions.

35) All Retention money/BG shall be released on successful completion of O & M period.

36) The other terms and condition described in these complete tender documents, wherever applicable shall remain unchanged. In case of any discrepancy, the decision of Engineer-In-Charge will remain final & binding on the contractor.

37) During Operation & Maintenance period, contractor has to supply all the spares, at his cost during preventive, major-minor breakdown, replacement and maintenance work. No extra payment will be made for such maintenance on any ground. The payment for the same will be made strictly as per tender document irrespective of the number of break down / minor, major repairs replacements. During the O & M, contractor will have to enter annual maintenance agreement with Manufacturers of all major Mechanical Equipments like Centrifuge, Air Blowers, Screens, Decanters etc.

38) Contractor will have to maintain required Power Factor as per Haryana Electricity Department rules and regulations. Incase penalty is levied by Haryana Electricity Department for not maintaining the Power Factor the same will be recovered from the contractor.

39) Maintenance of Garden, Lawns, Plants, Bushes, Plantation of new Plants, Lawns etc. and feeding, gardening, cleaning etc. is in the scope of the contract. No separate payment will be made for the same.

40) The Contractor during his O&M period will have to follow all the guidelines set by Haryana Pollution Control Board.

41) Operation and maintenance of all General facilities and utility services including all other components of work done under this contract.

42) Operation and maintenance of PLC based automation system and all instruments installed in the STP. All repairs, replacements towards the entire instrumentation works during the O & M period shall be in the scope of the contract.

43) Any other services required for smooth running of the scheme.

44) The contractor shall also dispose off the sludge, screenings, grit and any other material, as per specifications and to the satisfaction of the Engineer-in-Charge. It is to be noted that all costs during the O&M period, excluding the cost of power and chlorine are to be borne by the contractor. Within his quoted cost, the
contractor is to ensure that the following guarantees are maintained during the operation & maintenance period:

- for quality of treated effluent
- for consumption of chemicals
- for automation

45) The contractor shall provide on job training to the department staff as per specifications.

46) At the end of every 2 year of operation & maintenance period, an assessment of the condition of the plant has to be done by the contractor through third party inspection at his own cost and based on that assessment the contractor shall, at no extra cost to the department, repair and re-condition all the mechanical equipments in the concluding year of the O&M contract to a condition so that they are in running condition with regular preventive and recommended maintenance as per manufacturer's recommendations or as per CPHEEO manual. The contractor's scope shall include supply of all necessary spares, lubricants and other consumables that may be required to operate for another 4 years. The list of critical spares shall be drawn up depending upon the maintenance record of equipments in the penultimate year of the contract and the spares shall be supplied in the concluding year of the contract. Based on the performance of the plant for 4 years, the O &M contract can be extended by department for another 4 years.

2. OUTPUT AND OPERATIONAL GUARANTEES

The contractor is fully responsible for treating all the Sewage reaching at the inlet chamber. The performance of the contractor shall be treated as unsatisfactory if he fails to treat the complete sewage or does not maintain the guarantees listed in this clause except in force majeure condition or fails to fulfill other conditions of the contract.

2.1 Treated Effluent Quality

The contractor shall operate the Sewage Treatment Plant in such a way that at all times the treated effluent quality attains the following parameters:

- $\text{BOD}_5 (20^\circ\text{C}) < 10 \text{ mg/1}$
- $\text{SS} < 20 \text{ mg/1}$

Quality of treated effluent after tertiary treatment shall be as specified in section 1 of scope of work.

Treated Sludge Disposal

The contractor shall operate the Sewage 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 sludge generated from the STP shall be disposed off by the contractor outside the plant site and at or promote it as manure.

2.4 Chemical Requirements

The chemicals other than chlorine consumed to operate the Sewage Treatment Plant and other facilities under this contract will be borne by the contractor.
TESTS TO BE CARRIED OUT DURING O&M PERIOD

The sampling and testing to be carried out twice a day and at least at the points given below. This schedule shall also be maintained during the O&M period.

Inlet chamber at sewage treatment plant for flow, BOD, pH, SS, temp., COD and oil & grease, TDS.
Outlet of the sedimentation units for BOD, suspended solids, PH, COD and oil & grease, TDS.
Inlet of the reactor unit for MLSS, Dissolved Oxygen & pH.
Outlet of the reactor unit for Dissolved Oxygen, Sludge volume Index & pH.
Outlet of the secondary treatment units for BOD, Suspended solids, pH, COD and oil & grease.
Outlet of the SBR for BOD, Suspended solids, pH.
Excess sludge for Volatile suspended solids, total solids, specific gravity.
Various parameters to be tested by online monitoring system at these locations as per specific requirements of Instrumentation.
Outlet of the Chlorination units for BOD, Suspended Solids, pH.
Residual Free Chlorine after Chlorination.
REPORT FORMAT FOR DAILY TESTING SCHEDULE
FOR VARIOUS PARAMETERS

TIME: (1000 & 1600 HOURS)

<table>
<thead>
<tr>
<th>Test/Parameter</th>
<th>Inlet To Raw Sump Eqt</th>
<th>Inlet To Cyclic Activated Sludge / SBR Process</th>
<th>Outlet of Cyclic Activated Sludge / SBR Process</th>
<th>Final Discharge</th>
</tr>
</thead>
<tbody>
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</table>

**Laboratory Chemicals & Haryana Pollution Control Board Testing Charges:**
Contractor should run the laboratory (both chemical & Biological) by expertise hand to evaluate the results & different parameters stated above and for that he should supply required chemicals, reagents filters & glass wares etc complete.

He should analyze the treated & untreated sewage samples for Fecal Coliform Count once a week for that also contractor should support & supply necessary chemicals.

He should analyze the quality & contents of bio gas regularly & submit the reports to department.
The list of minimum Chemicals to be procured monthly by the contractor is as follows.
## LABORATORY CHEMICALS FOR ONE MONTH O & M

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Particular</th>
<th>Qty</th>
<th>Unit</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PH Tablets - 40</td>
<td>1.00</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PH Tablets - 7.5</td>
<td>1.00</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PH Tablets - 9.2</td>
<td>1.00</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Whatman filter paper</td>
<td>1.00</td>
<td>Box</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Manganese Sulphate</td>
<td>500.00</td>
<td>gm</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Sodium Hydroxide</td>
<td>500.00</td>
<td>gm</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Sodium Azide</td>
<td>100.00</td>
<td>gm</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Sodium Iodide</td>
<td>100.00</td>
<td>gm</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Starch</td>
<td>500.00</td>
<td>gm</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Sodium Thiosulphate</td>
<td>500.00</td>
<td>gm</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Disodium Hydrogen Phosphate</td>
<td>500.00</td>
<td>gm</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Ammonium Chloride</td>
<td>500.00</td>
<td>gm</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Magnesium Sulphate</td>
<td>500.00</td>
<td>gm</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Ferric Chloride</td>
<td>500.00</td>
<td>gm</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Calcium Chloride</td>
<td>500.00</td>
<td>gm</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Sulphuric Acid</td>
<td>1500.00</td>
<td>ml</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Petroleum Ether</td>
<td>1000.00</td>
<td>ml</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Ammonium Ferrous Sulphate</td>
<td>500.00</td>
<td>gm</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Potassium Dichromate</td>
<td>500.00</td>
<td>gm</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Ferron Indicator</td>
<td>100.00</td>
<td>ml</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Beakers - 500 ml</td>
<td>2.00</td>
<td>No.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Beakers - 200 ml</td>
<td>2.00</td>
<td>No.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Beakers - 50 ml</td>
<td>2.00</td>
<td>No.</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Distil Water Coil</td>
<td>1.00</td>
<td>No.</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Water Bath Coil</td>
<td>1.00</td>
<td>No.</td>
<td></td>
</tr>
</tbody>
</table>

Contractor shall also procure the other chemicals required to carry out the different tests as per Department requirements, HPCB & Other governing authorities. The HPCB Guidlines for Operation & maintenance should be followed for performing different laboratory tests, record keeping, as well for Operation & Maintenance of the entire plant.

**Haryana Pollution Control Board Testing Charges:**

The contractor should get analysed / checked the untreated as well as treated sewage samples every week from HPCB for parameters like BOD, COD, TSS, SS, PH, etc.
The necessary HPCB testing charges are to be borne by the Contractor. The HPCB Vigilance testing charges for samples directly collected by HPCB are also to be borne by the Contractor.

**STAFFING**

The work shall be carried out on a 24 hr basis, without intermission and the staff deployed by the contractor shall be in accordance with this contract. The contractor shall give or provide all necessary superintendence during the O&M and as long thereafter as the Engineer-in-charge 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.

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Personnel</th>
<th>No</th>
<th>Total experience</th>
<th>Main Task of the Personnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Plant Manager (BE, Civil / Environmental)</td>
<td>1</td>
<td>3 years</td>
<td>Co-ordination of activities for satisfactory performance of the STP and reporting to the Engineer-in-charge and responsible for the proper functioning &amp; maintenance, data collection of STP.</td>
</tr>
<tr>
<td>2</td>
<td>Operators (Diploma, ITI Qualified)</td>
<td>4</td>
<td>3 years</td>
<td>Responsible for overall operation for STP</td>
</tr>
<tr>
<td>3</td>
<td>Electrician (Diploma, ITI Qualified)</td>
<td>1</td>
<td>3 years</td>
<td>Responsible for maintenance of electrical equipments</td>
</tr>
<tr>
<td>4</td>
<td>Fitter (Diploma, ITI Qualified)</td>
<td>1</td>
<td>3 years</td>
<td>Responsible for maintenance of mechanical equipments</td>
</tr>
<tr>
<td>5</td>
<td>Helpers (12th pass)</td>
<td>10</td>
<td>3 years</td>
<td>Responsible for keeping STP premises clean and Also they will assist operators in day to day activities</td>
</tr>
<tr>
<td>6</td>
<td>Gardener (12th pass)</td>
<td>1</td>
<td>3 years</td>
<td>To maintain the garden/landscaping of the plant</td>
</tr>
<tr>
<td>7</td>
<td>Security Guards (12th pass)</td>
<td>3</td>
<td>3 years</td>
<td>To maintain the garden/landscaping of the plant</td>
</tr>
</tbody>
</table>
No labour below the age of 18 years shall be employed by the contractor on the work.

List of staff is to be given by the agency to the Engineer-in-charge and advance intimation to be given before deputing/removing any staff from site during the period of contract. Not more than one of the contractor'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 contractor shall provide replacement with equivalent or better qualifications. The CVs of such replacements shall be got approved from department in advance.

Engineer-in-charge shall be authorized to direct the contracting agency to remove any or all staff employed on O&M of the plant if in his opinion the continued presence of such staff is detrimental to safety or proper O&M of the plant. The contractor shall comply with such directions & post suitable substitute(s) thereof. Whenever the Engineer has to inform the contractor in writing that any person on the work is in his opinion unsatisfactory or/and incompetent or unfaithful or dishonest, untruthful or disorderly or to be otherwise unsuitable, such person shall be discharged by the contractor from the work and shall not be employed again on it.

5.0 SAFETY/SECURITY

The contractor shall take all safety precautions under various Acts/Rules under central/State Govt. from time to time and he shall be responsible for safety of its staff and the consequences thereof. The contractor shall deploy round the clock security personnel at entrance of plant’s premises and in the compound for the safety of the plant and premises during the 2 yrs O&M period. The contractor shall be completely responsible for the safety of the plant, equipment and personnel during this period.

- **Responsibility for damages**
  The care of the whole of the permanent works shall remain with the contractor who shall be responsible for all accidents or damages from whatever cause arising and chargeable for any thing that may be stolen, removed, destroyed or damaged to whomsoever belonging and also for making good all defects and damages to the said works or to any property adjoining or any cause whatever, whether such damage or defects were occasioned by the negligence of the contractor or not or may be or might have been discovered during the progress to be known after the completion whereof or whether payment may wholly or partially have been made or the works approved as supposed to have been properly done and no certificate of approval of any works by any officers or members of the Board shall affect or prejudice the right of the Board against the contractor or be considered or held as at all conclusive as to the sufficiency of any work materials.

Adequate safety precautions against fire, flooding, lightening, electrical shocks, accident due to moving/non-moving heavy/light equipments shall be strictly observed by the contractor at his own cost. Suitable safety measures like gumboots, gloves, safety belts, ladders, safety lamps, gas masks, Oxygen apparatus, insulated tools, alarms etc. shall be provided by the
contractor except those provided by the Department. Necessary medical first aid kit shall be
made available all the time. In absence of observance of above safety precautions, the
contractor shall be responsible for any unforeseen loss of the equipments or persons
dealing with it. Special care shall be taken by the contractor while carrying out the work in
sewage gas zone. Any incidence of human life or accident will be totally contractor's
responsibility.

The contractor shall ensure that the staff employed takes all necessary precautions while carrying out the work either in shift duties or any general shift as per Indian Electricity Rules/Factory Act/CPHEEO Manual, or manufacturer's special instruction for safety / gas handling. The staff should use Gas masks, Oxygen apparatus, Gum Boots, Safety Belts and Safety Lamps, etc. while carrying out the work in Bar Screens, sumps etc.

The contractor will make arrangement for all necessary safety equipments for persons working at STP as per Factory Act/Safety Rules. In the event of any accident on or off site, in which the contractor or his personnel are involved, in which an injury occurs to any person whether directly concerned with the project or a third party, the contractor shall inform department within 24 hrs. of the occurrence of the event. The plant will be open to local/state/central agencies for verification of safety/emission/acts compliance.

During night hours, the main gate should be locked. However, shift duty staff should be alert and open the gate during surprise checking of department staff or any other Government Authorities or his nominee without any wait. Only bona-fide persons be allowed in the plant premises being a prohibited area. Smoking and drinking are prohibited in the plant.
The staff engaged shall wear common uniform with name plate indicating name and designation during duty hours.

6.0 REPORTING

The Contractor will prepare daily and monthly reports (in department format) of pumping/treatment and project performance and submit to the Engineer-in-Charge and will assist the Department in preparing the necessary documents for this purpose and record as per proforma given from time to time. The reports shall contain, inter-alia, the following:
   Raw Sewage quantity and quality and effluent quality as per the on-line monitoring programme and other tests as specified in Clause 3.0 of this section and print outs of online monitoring shall be submitted to Engineer-in-charge.
   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 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 contractor during the reporting period.
Any major repair works, if any.

Contractor is required to maintain separate register/computerized records at all sites of following information:
- Pumping register
- Quantity of sewage treatment and performance register
- Working hours register
- Electric break down register
- Maintenance register
- Staff attendance register
- Equipment breakdown, repair record and extent of repair

**Site Order Book**

Site order Book shall be kept by the Engineer –in-charge at the plant site. Orders entered in this Book by the Engineer-in-Charge or his authorised representative shall be held to have been formally communicated to the contractor. The Engineer-in-Charge or his authorised representative shall sign each order as it is entered and will hand over the duplicate to the contractor or his agent, who shall sign the original in acknowledgment of having received the order.

**Record Keeping**

Running Records are required to be kept for various operating machines such as Mechanical Screens, Mechanical Grit Removers, Pumps, Motors, Scrapers, Air Blowers, Chemical consumption, Chlorine consumption etc. as maintained by the operators and kept at Control Room or duty room of the operators that is closer to the location of the machines.

The records of effluent quality and other laboratory tests are kept in the laboratory as per daily sample collection and testing schedules.

The record with respect to flow shall be maintained by operators as per Table below. The operator passes the daily log sheet to the plant Manager on the subsequent day duly signed in the first shift. All operators shall be responsible to fill up their part of observations and calculations. The plant Manager shall verify the daily record as well as the calculations and shall be responsible to generate further data using these.

It is pertinent to mention that there shall be a requirement of drawing site-specific procedures and formats / forms for keeping records. This shall be the responsibility of the plant manager.
Hourly record of Flow as measured / recorded through the Notch / Weir / Flow meter:

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Head Over The Notch / Weir / Meter</th>
<th>Rate Of Flow</th>
<th>Average Rate Of Flow In Past Hour</th>
<th>Flow Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>/</strong>/__</td>
<td>METERS</td>
<td>CUM./HOUR</td>
<td>CUM./HOUR</td>
<td>CUM</td>
</tr>
<tr>
<td>0800</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0900</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1200</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date/Time</td>
<td>Head Over The Notch / Weir / Meter</td>
<td>Rate Of Flow</td>
<td>Average Rate Of Flow In Past Hour</td>
<td>Flow Quantity</td>
</tr>
<tr>
<td>1300</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1400</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1500</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1600</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7.0 OPERATION

In case, the motor or any other equipment is burnt or damaged due to negligence of the contractor or due to faulty operation, it shall be the sole responsibility of the Contractor 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, contractor or his staff at duty will immediately report to the Engineer-in-charge about it.

The Contractor shall run the plant unit after ensuring proper voltage. He shall also record all the power failures and voltage in daily log sheet. He will bring into the notice of power supply agency as well as control room and Departmental Engineer about the break down/power failure. He will also get the electricity restored simultaneously.
Any dispute with the workmen shall be contractor’s responsibility as per Labour Laws/Govt. Rules and Regulations. In no way the Department shall be responsible for the disputes between them.

The contractor shall follow the rules and regulations as per Factory Act, as applicable.

The contractor shall arrange all necessary required tools, tackles and instruments in advance for proper operation and maintenance of the entire plant.

The contractor shall operate and maintain all (E&M) equipment as per the recommendations of the respective equipment manufacturer. He shall further maintain and operate the plant, as per CPHEEO manual to obtain the treated effluent results as per approved norms specified in this document elsewhere along with the Technical Bid. The contractor shall be free to follow manufactures manual in this regard. However in case of any doubt, the dept. shall refer to best of the above standards and the contractor shall be bound to carry out the works accordingly.

The floating material/scum should be collected in bins and dispose the same in open pits away from the plant, machinery which should be dried and disposed off regularly at a location outside the plant and approved by statutory authority. During rainy season, this should be buried after using lime.

The treated effluent should be disposed off or to be recycled for using for any purpose within the plant. The conveyance of treated and chlorinated sewage should be by means of closed conduit made by RCC or any RCC box channel.

The screened material, grit and the dried sludge cake from the centrifuge should be collected in trailers, trucks or tractor and the same should be disposed off at appropriate place away from the plant on his own. Suitable site for this purpose shall be identified by the contractor himself. Regarding cost of sludge manure if sold, the contractor has to follow department practice and rules.

The Tenderers shall know all Central/State Government/ Semi-Government/Local Bodies rules regulations to this contract without any excuse. Gas coming out of sewage is hazardous containing Methane, CO, CO$_2$ and H$_2$S etc. Therefore, necessary precaution and measures are to be taken in regard to human life and installations. No structure of any kind will be allowed to be constructed/altered within the plant premises, without the permission of department. Nothing is to be paid by department 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 contractor. The decision of Engineer-in-charge in this regard shall be final and binding.

### 8.0 MAINTENANCE

The contractor shall use only the original and genuine spares of the original equipment as per recommendations given in the maintenance booklet of the manufactures/as per directions of the Engineer-in-charge. Adequate stock of such
spares is to be maintained by the contractor. Test certificate of manufacturer is required for bearings along with supplies. Test certificate of all major equipment will be submitted from the manufacturer.

If any material brought upon the site of works or to the places where any Operations have been or are being carried out in connection with or for the purpose of the works, be in the judgment of the Engineer, of an inferior or improper description or improper be used in the works, the said materials or workmanship shall where required by the said officer be removed or amended by the contractor forthwith or within such period for every breach by the contractor in this clause, the Engineer is hereby authorized to remove or cause to be removed the materials and workmanship so objected to or any part thereof and replace the same with such other materials and workmanship as shall be satisfactory to him and there upon the contractor shall on demand repay to the Board the expenses incurred there by or to which the board may be put or be liable in connection therewith, the amount thereof to be certified by the Engineer whose certificate shall be final.

He shall be responsible for civil maintenance of buildings and roads changing of broken glasses, white washing and painting every two years and watering of lawns/plants within the plant premises.

The contractor shall also be responsible to maintain cleanliness in around the plant including machineries, disposal of floatings removed from the Bar Screens/reactors, etc. Grit and other unwanted material.

All the steel structures and machines installed in open areas should be painted after every monsoon period after cleaning the surface as per PWD manual.

Entire plant including all civil structures, mechanical equipments, HT panel and Transformers etc. shall be repainted after 1 year & 6 months as per original painting specifications.

Surface drains shall be cleaned every year before start of monsoon.

All leakages should be attended promptly to avoid any nuisance etc. Chokages should be removed at once. All the valves/gates which are not used regularly should be operated at least once a week and make sure that they are properly lubricated /greased.

All safety valves should be checked daily and ensure that they are working properly. In case of any fault the same should be attended immediately without any wait. The maintenance of the plant shall be as per maintenance manuals of the manufacturer for all equipments. Contractor shall keep all the safety devices in working order.

The contractor should make sure that no unwanted material should float/grow in and around different units. In case it is found the same shall be removed /cleaned immediately. He shall also be responsible for cleaning/sweeping the plant buildings
inside and outside, roads, foot path etc.

Launders/Weirs etc. of reactors etc to be maintained clean round the clock. During preventive/ breakdown maintenance, the contractor has to visit the unit/units as and when needed. The pumping units or other machineries required if any shall have to be arranged by the contractor at his own costs for completing the work. In case of battery operated auto system panels and also system alarm etc., batteries are required to be maintained and replaced as and when needed by the contractor.

The contractor has to make sure that proper fire extinguishers are used to cover any kind of fire during any mishaps within the total boundary area including plant machineries. The expiry period of refills of various fire extinguishers should be watched and maintained during the period of contract.

The contractor has to maintain all the toilets for proper use of the staff etc. In no case, in-sanitation conditions are developed. The contractor has to maintain minor repair in Civil structures, including replacement of sanitary items, glass panes etc. as and when needed.

The Contractor shall provide all consumable items in the office provided for department for the 4 year O&M period.
The Contractor shall maintain the PLC system in working condition for the 4 year O&M period.

The contractor shall not remove/shift any equipments/machinery even temporarily without written permission of the Engineer-in-charge or authorized representative.

Though the contractor has to operate and maintain all the equipments/machineries, lighting (plant area, boundary walls, gate lightening etc.) but the machine of the equipment under warranty should not be dismantled without prior permission of the Engineer-in-charge. The list of such equipments (Under warranty), if any, will be given by the contractor.

POL (petrol/Diesel Oil & Lubricants) has to be arranged by the contractor as and when needed as per manufactures recommendations for periodical maintenance of entire plant. The Department will not provide such items.

The contractor shall have to carry out periodical testing of the installations/equipments as per PWD specifications, CPHEEO manual and I.E. Rules as amended up to date and shall have to maintain complete record in the maintenance register. The contractor has to provide necessary protection systems wherever necessary including alarms and fire extinguishers.

HUDA Department, Haryana will be at liberty to post its staff for surveillance/inspection at the plant along with access to all units, control room and records, log books, MIS (Management Information system), data etc. round the clock as required. The logbooks and other records shall be properly maintained and any cutting should be attested by the staff from authorized department Officials and this record shall be
open for further inspection/checking by department and all other Government Agencies CPCB etc. for further action/improvements/rectifications. The staff in each shift shall mark their attendance on the log sheet individually. The plant and equipments covered under the above contract shall be totally attended by the contractor including any 'Trouble Shooting' to ensure smooth and trouble free operation.

In case of major repair due to normal wear and tear/break down, the contractor should bring the same to the notice of the Engineer-in-charge immediately and necessary measures for its repair should be taken simultaneously. Breakdown, all repairs of any kind are to be attended by the contractor. Any unit/equipment being irreparable in the opinion of the Engineer-in-charge will be replaced by the contractor at no cost to department. During 4 years O & M period, the machinery/media to be replaced from time to time as per manufacturer's recommendations/CPHEEO manual. All relays and HT equipments shall be calibrated and tested at least once a year and the report shall be submitted to the Engineer-in-Charge.

The Department reserves the right to carry out any work including capital works in the STP & RSPS for improvement of the parameters including coliform reduction. The contractor shall not obstruct/create hindrance object to any such work/works by department or its authorized agencies.

The contractor shall give his telephone no., contact addresses, etc. to the department as well as shift duty staff to contact him during emergency/odd hours etc.

The contractor will be responsible to carry day to day as well as periodic maintenance, necessary to ensure smooth and efficient performance/running of all equipments instruments installed at the Sewage Treatment Plant.

He shall be responsible for maintenance/replacement of street light poles and light etc. Also the plant, building land, Sewage treated/untreated/sludge, etc. shall remain the property of department.

**Oil & Grease Schedule**
Routine & preventive maintenance of electrical/Mechanical/hydraulic/machines & equipments is to be carried out as per the operation & maintenance manual. Minimum oil & grease requirement for one year Operation & maintenance of the Plant is to be procured by the Contractor well in advance.

**Routine, Preventive, Minor & Major maintenance of all Civil, Electrical, Mechanical, hydraulic machines & equipments of the plant.**

The contractor should prepare schedule of daily maintenance & preventive
maintenance of all the equipments & machineries operated & run by him in the premises of the plant. The schedule should be as per the guidelines mentioned in the tender & as per the O& M manual.

The scope covers Routine, Preventive, Minor & Major maintenance of all major/minor equipments, and machines in the Plant like Submersible pumps, Coarse & Fine screens, Grit Removal Mechanism, Channel gates, Decanters, Sludge pumps, Centrifuge feed pumps, Centrifuges, All dosing systems including Chlorine Dosing equipment, etc.

The scope also covers Routine, Preventive, Minor & Major maintenance of all the instrumentation system installed like PLC, Actuators, Flow meters level indicators etc.

The Contractor should also carry out Routine, Preventive, Minor & Major maintenance of all major/minor electrical equipments like Electrical Panels, Switch Gears, Power Cables, Control cables, 11Kv/22kv Switchyard, Changeover switches, DG set etc so as to ensure uninterrupted round the clock operation of the Plant.

The Contractor should maintain all civil structures including Administrative building, Store room, Storm Drains, Retaining walls Compound Walls etc in Sturdy manner. He should maintain all civil structures of the plant sturdy to complete the natural/design lifetime.

The contractor should carry out the safety audit of the plant & obtain necessary certificate from the competent authorities.

This item includes all types of Routine, Preventive, Minor & Major maintenance of all Civil, Electrical, Mechanical, hydraulic machines & equipments of the plant covering supply erection test & trial run of the part/machine to be repaired/replaced with material & labour expenses, necessary hardware, sundry materials, lubricant oils, power oils, grease other materials plus machining charges etc.

The contractor should procure all the spares required for all types of maintenances in advance. The part/equipment/machine to be repaired/replaced should be as per the department approved list & as per the O& M manual or as per the existing manufacturer’s brand.

**9.0 RELEASE OF HAZARDOUS SUBSTANCES OR HAZARDOUS WASTE**

The Contractor, after first notifying the Board shall be responsible for fulfilling all requirements associated with any release of any substance into the environment (from the facility or the site) as required by Applicable law or by any Legal Entitlement including but not limit to the notification or reporting of release of Hazardous substances or Hazardous Waste. The Contractor shall prepare a memorandum evidence of such notification or reporting and provide copies thereof to the Board,
along with any documents provided to the relevant regulatory agency regarding such release.

The contractor shall process and obtain the clearance of all such agencies as required for the purpose, including all clearances during 5 years O&M period. He shall be fully responsible to comply with all requirements of Laws including hazardous substances, emission standards for air, discharge standards for effluent oil, sub-soil pollution.

The contracting agency shall not release any hazardous/toxic materials inside the premises.

10.0 TECHNICAL AUDIT
The Board has the right to conduct a technical audit of the Facility and to perform any analysis or inspection it deems necessary. Before any such inspection, the Board shall give a prior written notice of three days to the Contractor. The contractor shall at the Contractor's sole cost and expenses provide all assistance the Board requires to complete these inspections. Such audits may cover all or any of the obligations of the Contractors, including without limitation.

(a) Verification of the system / capacity for normal wear and tear during the O&M period.
(b) Verification of the performance standards and useful life of the individual assets of the facility, for normal wear and tear during O&M period.
(c) Verification of the capacity of the facility to meet Output standards.

11.0 FACILITY VISITS
(i) At any time or at the end of each twelve month period, or at the initiative of the board, a visit shall be organized so that both parties can check the condition of the installations at the facility.
(ii) A report shall be drawn up to record the opinions of the both parties. The Board reserves the right to call the equipment manufacturers or specialized technicians for these visits. All expenses are to be borne by the contractor for the purpose.

12.0 OPERATION AND MAINTENANCE MANUAL

a) The contractor shall provide six copies of draft O&M Manual to department , at the time of the commissioning of the project and on approval of draft, 10 copies of operation & maintenance manual shall be supplied by the contractor.

b) 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.

c) 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.

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

e) During the construction period, the contractor shall revise the draft O&M Manual to reflect any updates, changes or revisions it deems appropriate, inter alia based on its experience and as necessary to reflect any modifications or adjustments to the plant. Without limiting the above, the contractor shall annually fully review, revise, update and modify the draft O&M Manual as may be necessary or appropriate. Any revision to the draft O&M Manual shall be subject to the review and approval of department . department shall have the right to require revisions to the draft O&M Manual as it may deem appropriate. The contractor shall prepare and submit to department , for its review and approval, 30 days prior to the proposed date of “Taking Over”, a revised draft O&M Manual which reflects all changes, revisions and modifications. The contractor shall prepare the O&M Manual, as approved by the Department , prior to the date of Taking Over.

f) During the term of this Agreement, the contractor shall promptly notify department 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 Department . In addition, during the term of this Agreement, Department shall have the right to requisite relevant changes, revisions, or additions to the O&M Manual as it, shall deem appropriate to ensure full compliance with the O&M Standards.

g) The contractor shall submit 10 copies of the final O & M manual along with a soft copy in Microsoft Word Format.

13.0 TAKING OVER

The plant will be taken over by department on satisfactory completion of the Operation & Maintenance of the plant provided that

• The plant/equipment are in good, smooth running condition.
• The result of the treated wastewater quality for last six months of operation of the plant is within the limits specified.
• In case of major repairs /replacement of equipment, the performance guarantee for such unit/equipment is extended by six months from the date of putting back in to satisfactory operation of such unit/equipment. In case such putting back is at the end of completion of operation & maintenance period.

• All records of operation & maintenance are handed over to department in proper condition.

• The Third Party Inspection of the plant viz: Civil units, Mechanical units/equipments, Electrical units/equipments, instruments, & all other Major & minor units/machines has to be carried out & the defects/unsatisfactory working performances of the equipments/ machines are to be corrected by the contractor at his own cost. The necessary Third Party inspection Charges are also to be borne by the contractor.

• The Contractor should repaint the plant including all civil structures, mechanical, electrical equipments/ units /structures as per the tender specifications

In case taking over is delayed on account of contractor's failure, the operation & maintenance period will be extended further till it meets the requirement without any extra cost to department. The contractor will also be penalized for such delays.

TECHNICAL SCHEDULES

The schedule formats given on following pages for technical details of the bidders are to be necessarily filled in by the bidders. However, the bidder, should feel that the formats or items are not sufficient to cover all types of plant, machinery, automation system etc. that are to be provided by him he is free to provide additional formats for the other items. Those formats however must provide all technical details of items supplied, to enable the employer to scrutinize the adequacy or functionality of these items in the plan. However, no financial data or cost is to be indicated in the Technical Proposal as the same are to be indicated in a separate financial proposal.
Company Seal

Signature of the Bidder
SCHEDULE – I

DEVIATIONS FROM TECHNICAL SPECIFICATIONS

NIL

We undertake that our bid is strictly as per the technical specifications, where given in the bid document.

__________________________  ________________________
Company Seal               Signature of the Bidder
SCHEDULE – II
DEVIANES FROM CONDITIONS OF CONTRACT

NIL

We undertake that our bid is strictly as per the conditions and requirements of the bid documents.

_________________________  _______________________
Company Seal                      Signature of the Bidder
SCHEDULE –III

WORK SCHEDULE

The bidder shall submit the following along with the bid in sufficient details to enable evaluation of their grasp of the work and ability to execute it within the Time of Completion.

1.0 Construction Schedule

1.1 This shall consist of a detailed bar chart showing in sufficient details completion of various sections of Work and the date and order in which the Bidder proposes to carry out different part of the Works. The bar chart shall indicate the principal quantities of work forecast for execution monthly and payments expected to be made in connection therewith. In preparation of the programme appropriate allowance should be made for loss of time due to inclement weather. This construction schedule shall form the basis for preparation of detailed CPM Schedule to be furnished after the award of the Contract.

The bidder shall keep above in view while preparing his Work Schedule, which should be in conformity with the following:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Period from the date of Letter of Award (LOA)</th>
<th>Cumulative Value as a percentage of total value of work to be completed, till the end of Period specified under column no.2</th>
<th>Description of works, to be completed during the Quarter specified under column no.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1st period i.e. w.e.f. the date of official date of start upto the end of 4th month</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2nd period i.e. w.e.f. the first day of the 4th month and upto the end of 6th month.</td>
<td>40%</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3rd period i.e. w.e.f. the first day of the 6th month and upto the end of the 9th month</td>
<td>65%</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>4th period i.e. w.e.f the first day of the 9th month and upto the end of 12th month.</td>
<td>90%</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>5th period i.e. w.e.f the first day of the 12th month and upto the end of 15th month.</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

Note: 1. The percentage in column 3 indicates works to be done under the Schedule of items in that period.

2. The contractor shall indicate the items to be executed against each quarter in blank column 4.
2.0  Employment Schedule

This shall consist of a chart showing deployment of monthly manpower (including skilled and unskilled labour of various categories) commensurate the Construction Schedule.

3.0  Equipment Use Schedule

This shall consist of a chart showing deployment of monthly construction equipment (under various categories) commensurate with the Construction Schedule.

___________________________  _________________________
Company Seal                  Signature of the Bidder
SCHEDULE-IV

METHODOLOGY

(The bidder shall submit a detailed work plan and Methodology i.e. a write up with full technical particulars indicating the method of construction). In case of the Pumping station and STP, the technical write-up shall clearly delineate the treatment train adopted by the bidder along with electrical load calculation. Each type of unit in the process and the numbers of each type shall be listed clearly. The bidder shall also state the additives (chemicals/coagulants) used, if any. A comprehensive layout of the Pumping Station, STP, a hydraulic flow diagram, a P&I diagram and a single line electrical diagram along with preliminary design calculations and drawings shall be submitted by each bidder. In addition, he shall submit all other data and documents required in Volumes I & II. Similarly, related details for the pump houses will have to be provided. The bidder will also provide extensive details of civil, electro-mechanical and automation of the project for the understanding of Department.

______________________________    ________________________
Company Seal                     Signature of the Bidder
The Bidder shall enter this Schedule a list of the sections and appropriate value of the work for which he proposes to use sub-contractors together with the names and address of the proposed sub-contractors. Names of sub-contractor shall be got approved by department. The bidder shall also enter a statement of similar works previously executed by the proposed sub-contractors, including description, location and value of work, year completed, and name and address of the employer/engineer. Not withstanding such information the bidder, if awarded the Contract, shall remain entirely and solely responsible for the satisfactory completion of the Works. However, HUDA, Haryana will have right to accept or reject any proposal of sub-contractor without explaining the reason to the bidder.

<table>
<thead>
<tr>
<th>Element of Work</th>
<th>Approximate Value</th>
<th>Name &amp; Address of Sub-Contractor</th>
<th>Statement of Similar Works Previously Executed by the Sub-Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
**SCHEDULE – VI**

**LIST OF RECOMMENDED SPARE PARTS**

The bidder shall give below a list of spare parts recommended for the two years trouble free performance (after one year warranty period) of the equipment offered by him.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Eqpt. No.</th>
<th>Manfg. &amp; Part No.</th>
<th>Delivery Period (weeks) from date of LOI</th>
<th>Description</th>
<th>Material</th>
<th>Qty. Set per unit eqpt.</th>
<th>Remark</th>
<th>Locally available</th>
<th>Imported</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
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<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
</tbody>
</table>

All unused spare parts shall become employer's property at the end of 2 years operation and maintenance period.

Prices of all above items are deemed to be considered in lump sum prices and no separate payment shall be made.

Any additional spare parts required for O & M but not covered in the above list shall be supplied by the contractor free of cost to the employer.

The Contractor will keep Department, informed time to time the details of using of spare parts.

During the 2 years O&M period the contractor will give the list of major replacements proposed by him year wise.

____________________
Company Seal

____________________
Signature of the Bidder
**SCHEDULE – VII**

**LIST OF MAINTENANCE TOOLS AND TACKLES**

The bidder shall give below a list of special maintenance tools and tackles offered by him and included in the prices quoted by him.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Particulars</th>
<th>Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- In case any additional tools & tackles is required by the contractor for O & M but not included in the above will be supplied by the contractor free of cost to the employer.

- The contractor shall hand over all the maintenance tools & tackles in good condition to the employer at the time of handing over the works on expiry of O & M Contract of 2 years.

- The Contractor shall keep Department, informed time to time about the usages of Tools and Tackles.

_________________________  __________________________
Company Seal               Signature of the Bidder
## SCHEDULE – IX
### LIST OF CONSTRUCTION EQUIPMENT & PLANT (Proposed and Owned)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description</th>
<th>Quantity</th>
<th>Capacity Or Output</th>
<th>Make and Model</th>
<th>Year of Manufacturer</th>
<th>Owned or Leased</th>
<th>Present Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>List of principal Plant / Equipment owned by the Contractor</td>
<td></td>
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<tr>
<td>(a)</td>
<td>Cranes (Mobile)</td>
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<td>Crane (Tower)</td>
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<tr>
<td>(c)</td>
<td>Trucks / Dumpers</td>
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<td></td>
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<td></td>
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<tr>
<td>(d)</td>
<td>Excavators</td>
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<td>(e)</td>
<td>Concrete Transit Mixers</td>
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<td>(f)</td>
<td>Concrete Batching Plant</td>
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<td>De-watering Pump</td>
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<tr>
<td>(h)</td>
<td>Site lab facilities</td>
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<td>(i)</td>
<td>Slip from Shuttering</td>
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<tr>
<td>(j)</td>
<td>Electrical tooling kit</td>
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</tr>
<tr>
<td>(k)</td>
<td>Other (Bidder to list)</td>
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<td>2</td>
<td>List of principal Plant / Equipment owned, leased, hired which Contractor considers necessary for the contract</td>
<td></td>
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<tr>
<td>(a)</td>
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</tr>
<tr>
<td>Sl. No.</td>
<td>Description</td>
<td>Quantity</td>
<td>Capacity Or Output</td>
<td>Make and Model</td>
<td>Year of Manufacturer</td>
<td>Owned or Leased</td>
<td>Present Location</td>
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<tr>
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<td>Quantity</td>
<td>Capacity Or Output</td>
<td>Make and Model</td>
<td>Year of Manufacturer</td>
<td>Owned or Leased</td>
<td>Present Location</td>
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<td>(h)</td>
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<td>(i)</td>
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<td>(j)</td>
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<td>(k)</td>
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</tr>
</tbody>
</table>

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

(Signature)

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

(Name)

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

(Designation)

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

(Company)

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

COMPANY SEAL

(Date)

Note: Attach copies of form as necessary
The technical qualification and experience of key staff will form an important part of the evaluation process. A CV should be attached for each of the staff categories with areas of responsibilities as follows:

**During Construction Period**
- Project Manager
- Site In-charge (Civil)
- Site In-charge (Mechanical)
- Site In-Charge (Electrical & Instrumentation)
- Planning Engineer

**During O & M Period**
- Project Manager
- Site In-charge (Civil)
- Site In-charge (Mechanical)
- Site In-Charge (Electrical & Instrumentation)

.................................................    (Signature)
.................................................          (Name)
................................................. (Designation)
..............................................   (Company)

COMPANY SEAL
____________________________(Date)
SCHEDULE - XI

PROJECT EXECUTION PLAN (PEP)

The bidder is required to furnish Project Execution Plan (PEP) in the following format. A brief but clear PEP is required for describing planning and programming of the works.

(a) Project Strategy: Outline statement of the organization and methods to be employed by the applicant to undertake the work.
(b) Organization Chart: Preliminary Organization chart indicating relationship between the design team, site management and the head/branch office, the on site direct works operations, the sub-contractors, suppliers and the supervising Consulting Engineer.
(c) Responsibilities of Key Personnel: Identify key personnel with management responsibilities by activity or section of work.
(d) Quality Management System: Provide a description of the Quality Assurance / Quality Control System; organization and procedures in use and identify the accreditation authority
(e) Project Safety Plan: Provide a statement outlining the Health and Safety Plan operated by the company.
(f) Contractor shall indicate any permanently established groups within the organization which would provide specific functions in the execution of the contract.
(g) Program / Bar chart showing major activities

_________________________ Signature)
___________________________ (Name)
_________________________(Designation)
_________________________ (Company)
______________________________ (Date)

COMPANY SEAL
SCHEDULE-XII
EQUIPMENT INFORMATION
SEWAGE TREATMENT PLANT

This schedule is to be in one – to – one co-ordination with the bidder’s layout drawing. The bidder is to list each of the major mechanical/electrical equipment provided in each of the plant and non-plant structure and comprehensive technical specifications for all these mechanical/electrical equipments are to be furnished by the bidder, so as to allow department to meaningfully evaluate the bidder’s technical offer. Performance for some standard equipment are attached here, for all other special/patented equipment, the specifications are to be provided by the bidder. However, the bidder shall furnish all additional data/information required by department at the time of tender evaluation.

I. DATA SHEET FOR VALVES (Bidder to furnish details of all types of valves considered for STP)

- Provided in structure -
- Type -
- Nos. -
- Diameter - mm
- Seat Pressure - Kg/m²
- Make -

Company Seal ____________________________  Signature of the Bidder
II. **DATA SHEET FOR PROCESS EQUIPMENT**

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Units</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I</strong> General &amp; Process</td>
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</tr>
<tr>
<td>1</td>
<td>Process details</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Average flow</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Peak factor</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Peak flow</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Raw sewage BOD₅ at 20 °C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Raw sewage SS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Treated sewage BOD</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Treated sewage SS</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Total head loss (m) in STP.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Total land area (hectare) proposed for STP</td>
<td></td>
</tr>
<tr>
<td><strong>II</strong> Raw Sewage Pumping Station</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Receiving Chamber</td>
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<td></td>
</tr>
<tr>
<td>1</td>
<td>Design peak flow</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>No of units</td>
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</tr>
<tr>
<td>3</td>
<td>Detention period</td>
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<td>4</td>
<td>Liquid depth (m)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Length (m)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Width (m)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Water level (m)</td>
<td></td>
</tr>
<tr>
<td>(b) Coarse Screen Channel</td>
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</tr>
<tr>
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<td>Design peak flow</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>No of units (working + stand by)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Clear spacing through bars</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Width of channel (m)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Length of channel (m)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Liquid depth (m)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Upstream water level (m)</td>
<td></td>
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<tr>
<td>8</td>
<td>Downstream water level (m)</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Head loss (mm)</td>
<td></td>
</tr>
<tr>
<td>(c) Moderate Screen Channel</td>
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<td></td>
</tr>
<tr>
<td>1</td>
<td>Design peak flow</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>No of units (working + stand by)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Clear spacing through bars</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Width of channel (m)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Length of channel (m)</td>
<td></td>
</tr>
</tbody>
</table>

Company Seal ___________________________  Signature of the Bidder ___________________________
<table>
<thead>
<tr>
<th>Sr.</th>
<th>Units</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Liquid depth (m)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Upstream water level (m)</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Downstream water level (m)</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Head loss (mm)</td>
<td></td>
</tr>
<tr>
<td>(d)</td>
<td>Wet Well and Pump House</td>
<td></td>
</tr>
<tr>
<td>(i)</td>
<td>Wet well</td>
<td></td>
</tr>
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<td>Design peak flow</td>
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</tr>
<tr>
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<td>No of units</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Detention period</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Liquid depth (m)</td>
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</tr>
<tr>
<td>5</td>
<td>Length (m)</td>
<td></td>
</tr>
<tr>
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<td>Width (m)</td>
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<td>Water level (m)</td>
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<td>Pump House</td>
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<td>Size (m x m)</td>
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<td>Height (m)</td>
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<td>Sewage Treatment Plant</td>
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<td>Detention period</td>
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<td>Liquid depth (m)</td>
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<td>(b)</td>
<td>Fine Screen Channel</td>
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<td>Clear spacing through bars</td>
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<td>Length of channel (m)</td>
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<td>Upstream water level (m)</td>
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<td>Downstream water level (m)</td>
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<td>9</td>
<td>Head loss (mm)</td>
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<tr>
<td>(c)</td>
<td>Degritting System</td>
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<td>Design flow</td>
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</tr>
<tr>
<td>2</td>
<td>No of units</td>
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<td>Particle size to be removed (mm)</td>
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<tr>
<td>Sr.</td>
<td>Units</td>
<td>Details</td>
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<td>Efficiency of removal (%)</td>
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<td>Length of channel between screen chamber and grit chamber (m)</td>
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<td>Width of channel between screen chamber and grit chamber (m)</td>
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<td>8</td>
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<td>- Capacity (MLD)</td>
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<td>- Size (m)</td>
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<td>Surface overflow rate (cum/sq.m/day)</td>
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<td>Water level (m)</td>
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<td>11</td>
<td>Number of gates (nos.)</td>
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<tr>
<td>12</td>
<td>Size of gate openings (m)</td>
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</tbody>
</table>

(d) **Flow Measuring Channel**

1. Width of Flow Measuring Channel
2. Length of Flow Measuring Channel
3. Depth of Flow Measuring Channel
4. Size of Parshall Flume

(e) **Cyclic Activated Sludge Process / SBR Process**

1. Inlet BOD, mg/l
2. Inlet SS, mg/l
3. BOD removal efficiency
4. SS removal efficiency
5. F/M ratio
6. MLSS, mg/l
7. MLVSS / MLSS
8. SRT, days
9. Max. Water depth in basin
10. No. of tanks
11. Volume of Each Tank (m³)
12. Total Volume provided (m³)
13. Hydraulic Retention Time (hrs.)
14. Kg O₂ / kg BOD removed
15. Details of basins
   - Side Water Depth (m)
   - Length (m)
   - Width (m)
   - freeboard (m)
16. Oxygen Uptake Rate Control | Provided / Not provided

**Diffusers**

1. Type of diffusers
2. Make
3. Material of diffusers

---

Company Seal ____________________________ Signature of the Bidder ____________________________
<table>
<thead>
<tr>
<th>Sr.</th>
<th>Units</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Dia and length of each diffuser</td>
<td></td>
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<tr>
<td>5</td>
<td>Total no of diffusers</td>
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<tr>
<td>6</td>
<td>Air flow through each diffuser</td>
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<tr>
<td></td>
<td><strong>Air blowers</strong></td>
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<tr>
<td>1</td>
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<td></td>
</tr>
<tr>
<td>2</td>
<td>Make</td>
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<td>3</td>
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<td>No of stand by blowers</td>
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<td>6</td>
<td>Head of blower</td>
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<tr>
<td>7</td>
<td>Motor rating</td>
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<td>8</td>
<td>No. of Blowers with VFD operation</td>
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<td></td>
<td><strong>Decanting Mechanism</strong></td>
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<td>1</td>
<td>Decanting rate of treated sewage</td>
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</tr>
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<td>2</td>
<td>Type</td>
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</tr>
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<td>3</td>
<td>Speed</td>
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<td>Decanting Capacity of each decanter</td>
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<td>5</td>
<td>No. of Decanters per basin</td>
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<td>6</td>
<td>Operating hrs. of each Decanters</td>
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<td>7</td>
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</tr>
<tr>
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<td>No. of Decanters with VFD operation</td>
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<td>5</td>
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<td>7</td>
<td>Motor rating</td>
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<td>Material of Construction</td>
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</tr>
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<td></td>
<td><strong>Excess Sludge Pumps</strong></td>
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<td>2</td>
<td>Make</td>
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</tr>
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<td>No of working pumps</td>
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<td>4</td>
<td>No of stand by pumps</td>
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<td></td>
<td><strong>Chlorine Contact Tank and House</strong></td>
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<td>1</td>
<td>Hydraulic Retention Time (minutes)</td>
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Company Seal __________________ Signature of the Bidder ___________________
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<thead>
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<tbody>
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<td>2</td>
<td>Size of tank (mm x mm)</td>
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<td>3</td>
<td>Depth of the tank (mm)</td>
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<td>4</td>
<td>Number of baffles (nos.)</td>
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<td>5</td>
<td>Length of travel of liquid (m)</td>
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<tr>
<td>6</td>
<td>Length of final effluent pipe/conduit to Outfall Structure (m)</td>
</tr>
<tr>
<td>7</td>
<td>Size of final effluent pipe/conduit to Outfall Structure (mm x mm)</td>
</tr>
<tr>
<td>8</td>
<td>Size of Chlorination room (m x m)</td>
</tr>
<tr>
<td>9</td>
<td>Size of chlorine tonner room (m x m)</td>
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<tr>
<td>10</td>
<td>Area allocated by loading/unloading (sq.m)</td>
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(g) **Sludge Sump**

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<tr>
<td>1</td>
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<td>Holding Time in Sludge Sump (hrs.)</td>
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<td>Size of sump (m)</td>
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<td>4</td>
<td>Depth of sump (m)</td>
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<td>5</td>
<td>Detention Time (minutes)</td>
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<tr>
<td>6</td>
<td>Length of pipe from Excess Sludge Sump to Centrifuge (m)</td>
</tr>
<tr>
<td>7</td>
<td>Diameter of pipe from Excess Sludge Sump to Centrifuge (mm)</td>
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<tr>
<td>8</td>
<td>MOC of Air grid</td>
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<tr>
<td>9</td>
<td>Type of air grid</td>
</tr>
<tr>
<td>10</td>
<td>Air mixing rate provided (m3/hr/m3 of liquid)</td>
</tr>
<tr>
<td>11</td>
<td>Type of air blower</td>
</tr>
<tr>
<td>12</td>
<td>Make</td>
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<tr>
<td>13</td>
<td>No of working blowers</td>
</tr>
<tr>
<td>14</td>
<td>No of stand by blowers</td>
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<tr>
<td>15</td>
<td>Capacity of blower</td>
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<tr>
<td>16</td>
<td>Head of blower</td>
</tr>
<tr>
<td>17</td>
<td>Motor rating</td>
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</table>

_________________________  _______________________
Company Seal              Signature of the Bidder
III – DATA SHEET FOR CHLORINATION SYSTEM

Chlorine Plant Equipment

1. Chlorinators:
   Number of Units
   Manufacturer:
   Type:
   Cabinet material:
   Details of instruments mounted:
   Maximum output:
   Minimum output:
   Type of injector:
   Injector water requirements:

2. Chlorine Drum Store Crane
   Number:
   Manufacturer:
   Type and class of crane offered:
   Safe working load:
   Effective span to center of gantry rails:
   Hoisting speeds:
   Slow speed:
   Fast speed:
   Cross traversing speed:
   Down-shop traveling speed (long travels):
   Number of motors:
   Motor details:

3. Manual Hoists:
   Manufacturer:
   Type:
   Location:
   Number:
   Safe working Load (Kg or tones):

4. Drum Weighing Equipment
   Number:
   Type:
   Full scale range:
   Smallest division on scale:

5. Drum Supports
<table>
<thead>
<tr>
<th>Chlorine Plant Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of castors :</td>
</tr>
<tr>
<td>Number of rollers per castor :</td>
</tr>
</tbody>
</table>

Company Seal __________________________ Signature of the Bidder __________________________
6. **Gas Chlorine Pipe Work**
   a) **Pipe**
      
      | Material | : |
      | Size     | Mm |
      | Rating   | : |
      | Test pressure | Bar |
   b) **Valves**
      
      | Type | : |
      | Material | Body |
      | : Plug | : |
      | Size | : |
      | Test pressure | : |
      | Actuator Details (where provided) | : |

7. **Drum Change over Device (Automatic)**
   
   | Number | : |
   | Manufacturer | : |
   | Type | : |
   | Capacity | : |
   | Operating medium | : |

8. **Chlorine Gas Filter**
   
   | Number | : |
   | Manufacturer | : |
   | Filter Material | : |
   | Capacity | : |
   | Maximum pressure drop | : |

9. **Gas Inlet Heater Rating**
   
   | Thermostat | : |
   | Details of Accessories: | : |
   | Range of control (temperature) | °C |
   | Setting temperature | °C |

10. **Injector Motive Water Pumps**
    
    | Total number of pumps | : |
    | Standby number | : |
    | Manufacturer | : |
    | Type | L/s |
    | Pump output | : |
    | Total head | : |
    | Speed | Rpm |

   a) **Efficiency at rated output specification of materials for:**
      
      | Impellers | : |
      | Casing | : |
      | Shaft and sleeves | : |
      | Bearings | : |

   b) **Motor manufacturer**
      
      | Type | : |
      | Standard | : |
      | Motor rating | : |
      | Maximum power absorbed | : |
Company Seal

Signature of the Bidder
11. **Chlorine Solution Pipe Work**
   a) Pipe
      Material: 
      Size: Mm
      Rating:  
      Test pressure: Bar
   b) Valves
      Material: 
      Size: 
      Rating: 
   c) Diffuser
      Number: 
      Type: 
      Material: 
      Size: 
      Number of holes at each dosing point: 
      Diameter of holes: 

12. **Chlorine Lead Detectors**
   a) Chlorine Drum Store
      Number: 
      Manufacturer: 
      Type: 
      Adjustable range of alarm: ml/alarm
   b) Chlorinator Room
      Number: 
      Manufacturer: 
      Type: 
      Adjustable range of alarm: ml/cum

13. **Ventilation Plant**
    Continuous Operation
    Intermittent Operation
    a) Chlorine store
       Number of fans: 
       Manufacturer: 
       Capacity: 
       Type: 
       Speed: 
       Power rating: 
       Details of ducting: 
    b) Chlorinator room
       Number of fans: 
       Manufacturer: 
       Capacity: normal cum/h
       Type: 
       Speed: rpm
       Power rating: Kw
       Details of ducting: 
    c) Details of Air Inlet
14. **Safety Equipment**

a) Breathing Apparatus
   - Number : 
   - Manufacturer : 
   - Type : 
   - Capacity of canisters : 
   - Number of spare canisters : 

b) Safety Drench Shower & Eye Bath Unit
   - Number : 
   - Manufacturer : 
   - Type : 
   - Water demand and minimum : L/s
   - Operating pressure : M

c) Drum repair kits
   - Number : 
   - Manufacturer : 

d) Drum submersion pit
   - Dimensions : 

15. **Chlorine Residual Instruments**

   - Function : 
   - Location : 
   - Point of measurement : 
   - Manufacturer of sampling/measuring cell unit : 
   - Type designation : 
   - Range of measurement : 
   - Electrode materials : 

16. **Chlorine Leak Detectors**

   - Function : 
   - Location : 
   - Point of measurement : 
   - Manufacturer of electrolyte capsule : 
   - Alarm level ml/cum : 
   - Life of the electrolyte : 

__________________________  _________________________
Company Seal  Signature of the Bidder
**IV- DATA SHEETS FOR MEDIUM SCREENS**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Description</th>
<th>Units / requirement</th>
<th>Particulars offered screen</th>
</tr>
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<tbody>
<tr>
<td>SCREEN DETAILS:</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Peak flow per screen</td>
<td>MLD</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Average flow per screen</td>
<td>MLD</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Type of offered screen</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Bar Spacing</td>
<td>-</td>
<td></td>
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<tr>
<td>5</td>
<td>Angle of inclination from horizontal</td>
<td>Degrees</td>
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<tr>
<td>6</td>
<td>Minimum rake travel speed</td>
<td>M / min</td>
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<td>Overall width of screen</td>
<td>mm</td>
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<tr>
<td>8</td>
<td>Screen opening width</td>
<td>mm</td>
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</tr>
<tr>
<td>9</td>
<td>Overall length of screen</td>
<td>mm</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Discharge height over platform</td>
<td>mm</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Screen bar profile</td>
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<td>12</td>
<td>Screen bars dimension</td>
<td>mm</td>
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<tr>
<td>13</td>
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<td>mm</td>
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<td></td>
<td>- Rated output</td>
<td>kW</td>
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<td></td>
<td>- Rated voltage</td>
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<td>- Speed</td>
<td>Rpm</td>
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<td>- Starting current</td>
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<td>- Class of insulation</td>
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<td>- Degree of protection</td>
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<td>- Screen bars</td>
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<td></td>
<td>- Guide rails / channel</td>
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<td></td>
<td>- Rake</td>
<td>-</td>
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<td>- Rake traveling carriage</td>
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<td>- Screen frame structure</td>
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<td>- Dead plate</td>
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<td></td>
<td>- Discharge chute and scraper</td>
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<td></td>
<td>- Apron</td>
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<td>- Drive chain (hardened &amp; temper)</td>
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<td>- Control panel ( Epoxy painted)</td>
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## V - DATA SHEETS FOR FINE SCREENS

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Description</th>
<th>Units / Requirement</th>
<th>Particulars of offered screen</th>
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<tbody>
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<td>(A)</td>
<td><strong>SCREEN DETAILS:</strong></td>
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<td>Peak flow per screen</td>
<td>MLD</td>
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<td>Average flow per screen</td>
<td>MLD</td>
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<td>Inverse Step Type Fine Bar Screen</td>
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<td>Angle of inclination from horizontal</td>
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<td>Overall width of screen</td>
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<td>Overall length of screen</td>
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<td>Discharge height over Platform</td>
<td>mm (Minimum)</td>
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<td>Screen bar thickness</td>
<td>mm</td>
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<td>11</td>
<td>Velocity through bar</td>
<td>1.2 m / sec (Maximum)</td>
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<td>Head Loss</td>
<td>mm (Maximum)</td>
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<td>- Hydraulic Hoses</td>
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<td>- Class of insulation</td>
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<td>- Duty Class</td>
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<td>- Protection</td>
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<td>- Switch Gears</td>
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<td>Level Sensor</td>
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<td></td>
<td>- Type</td>
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<td>16</td>
<td>MOC of Screen parts</td>
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<tr>
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<td>- Screen Bars</td>
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<td>- Side Channels</td>
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<td>- Mounting Bracket</td>
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<td>- Side members</td>
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<td>- Protection Plate</td>
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<td></td>
<td>- Blinding Plate</td>
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<td>- Side Sealing</td>
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<tr>
<td>Company Seal</td>
<td>Signature of the Bidder</td>
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VI- DATA SHEETS FOR PUMPS
(Bidder to furnish details for all pumps considered for STP)

<table>
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<tr>
<th>Details Required</th>
<th>Design Duty</th>
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<td>Design delivery rate</td>
<td>l/s</td>
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<tr>
<td>Static head</td>
<td>m</td>
</tr>
<tr>
<td>Friction head</td>
<td>m</td>
</tr>
<tr>
<td>Total head against pumps</td>
<td>m</td>
</tr>
<tr>
<td>Size of pumps suction/delivery</td>
<td>m</td>
</tr>
<tr>
<td>Calculated power at pump coupling</td>
<td>kW</td>
</tr>
<tr>
<td>Rated power of motors to be installed</td>
<td>kW</td>
</tr>
<tr>
<td>Guaranteed efficiency of pump at duty point</td>
<td>%</td>
</tr>
<tr>
<td>Guaranteed efficiency of motors at duty point</td>
<td>%</td>
</tr>
<tr>
<td>Power input at pump duty point</td>
<td>kW</td>
</tr>
<tr>
<td>Pump speed</td>
<td>rpm</td>
</tr>
<tr>
<td>Weight of heavies piece of machinery</td>
<td>kg</td>
</tr>
<tr>
<td>Velocity through eye of impeller</td>
<td>m/sec.</td>
</tr>
<tr>
<td>NPSH required</td>
<td>m</td>
</tr>
<tr>
<td>Material impeller</td>
<td></td>
</tr>
<tr>
<td>Material casing</td>
<td></td>
</tr>
<tr>
<td>Material of shaft</td>
<td></td>
</tr>
<tr>
<td>Material of Gland Sleeve</td>
<td></td>
</tr>
<tr>
<td>Material of neck bushes</td>
<td></td>
</tr>
<tr>
<td>Material of neck ring</td>
<td></td>
</tr>
<tr>
<td>Type of motor coupling</td>
<td></td>
</tr>
<tr>
<td>Type of thrust bearing</td>
<td></td>
</tr>
<tr>
<td>Guaranteed motor efficiency at full load</td>
<td>%</td>
</tr>
<tr>
<td>Guaranteed motor efficiency at ¾ load</td>
<td>%</td>
</tr>
<tr>
<td>Guaranteed motor efficiency at ½ load</td>
<td>%</td>
</tr>
</tbody>
</table>

Enclose Pump Efficiency curves.

__________________________  _______________________
Company Seal                Signature of the Bidder
VII- DATA SHEETS FOR CENTRIFUGES

1. Operating Conditions

Function:
Fluid (Sludge Particulars):
Nature of the sludge for dewatering:
Type of thickening device producing sludge:
Amount of sludge to be dewatered per day:
Sludge concentration at centrifuge inlet:
Maximum volatile solids rate:
Screening at plant inlet spacing between bars:
Grit removal process at plant inlet:

2. Main Characteristics

Nominal mass flow rate at machine inlet:
Required dry solids content:
Dry solids content proposed by supplier:
Polymer:
Percentage recovery:
Operation without supervision (process guarantee):
Diameter of the bowl:
Bowl length (length:diameter ratio):
Taper angle:
Maximum speed acceleration (centrifugal force):
Nominal operation velocity/RPM:
Variable relative velocity (differential speed):
Variable speed drive system:
Torque control:
Nominal operating torque:
Acoustic Information:
Maximum acceptable sound level:
Sound level of the full unit measured 2 mt. away from the unit:

3. Other Characteristics

Scroll:
Vibration (MM/SEC):
Weight of machine (with frame/without frame):
Building Materials (M.O.C.):
Bowl:
Scroll:
Frame:
Sediment discharge device(chute):
Protection/Coating:
Surface preparation:
Type of coating:
Thickness (microns):
Color:
Overall dimensions for packing (LXBXH) in meters:
Documents to be provided:
- Dimensional drains
- Sealing drawings
- Load drawings
- Minimum height drawings
- Traveling bridge force over head crane capacity
- Minimum height under hook
- Other dimensions so the Traveling bridge to be specified

4. **Scope of supply**

Motor
Frequency converter
Operation platform
Automatic Valve at solids outlet/automatic trap door (if yes, Type)
Flexible sleeve/connection
Feed connection/pipe
Gas separator tank
Torque control unit
Sound proof cover (if so gain of DB)

5. **Electrical Characteristics**

5.1 **Motors selected**

Brand
Motor type(model)
Rated power (Nominal)
Power input(consumed power)
Motor rotation speed
Protection index
Insulation class
Temperature rise
Efficiency at duty point
Nominal Intensity
Starting intensity
Cos. q
Supply voltage (V)
Frequency (Hz)
Temperature sensor (PT 100) with relay
Bimetallic temperature switch PTO
Cable diagram number
Weight of the motor

5.2 **Auxiliary motor**

Brand
Type
Rated power (Nominal)
Power input
Motor rotation speed
Protection index
Insulation class
Temperature rise
Efficiency at duty point

____________________
Company Seal

____________________
Signature of the Bidder
### Nominal intensity
- Starting intensity
- Cos q
- Supply voltage (V)
- Frequency (HZ)
- Cable diagram number
- Weight of the motor

### 5.3 Main motor converter
- Brand
- Type
- Supply voltage
- Signal type

### 5.4 Auxiliary motor converter
- Brand
- Type
- Supply voltage
- Signal type

### 5.5 Automatic valve at solids outlet
- Brand
- Type
- Supply voltage
- Frequency
- Rated power
- Limit switches (Quantity)

### 6. Trials, Inspection, Tests
- Check dimensions and appearance
- Take over by contractor in factory witnessed by the client
- Number of centrifuges to be tested at
- Takeover
- On site vibration tests

### 7. Maintenance Operation spare parts
- Scroll service life (years & hours)
- Service life of removable protective tiles or satellite coating before first replacement
- List of top priority spare parts or typical list
- List of spare parts for/after two years operation or typical list
- Main maintenance operations
- Operation – 1
- D Type(centrifuge lubrication)
- Frequency
- Product required
- (Recommended grease grades)
VIII - INTERCONNECTING PIPING
(Bidder to furnish details for all pipes considered for STP)

1. Connects Structures : 

2. Material of Construction : 

3. Internal Diameter : mm

4. Lining Provided : 

   From: To:

   Type of Fluid Handled : 

   Whether Above water / under water : 

   Note: To be provided separately for each pipe.

__________________________________________  ____________________________
Company Seal                               Signature of the Bidder
IX DATA SHEET FOR ELECTRICAL ITEMS

A. HT Panel Board

i. GENERAL

a. Manufacturer/Type :

b. Busbar

Material (Al./Cu.) :

Continuous rating, A :

c. Short time (one second) withstand rating KA (rms) :

d. Clearances :

Between phase, mm :

Between live part and earth, mm:

e. 1.2/50 μsec withstand voltage KV (Peak) :

f. One minute power frequency withstand voltage KV (rms) :

________________ _______________________
Company Seal Signature of the Bidder
g. Thickness of sheet steel

Frame, mm :

Door, mm :

Covers, mm :

h. Dimensions of cubicle (in mm)
   (Width x Depth x Height) :

i. Drawout space required in front (mm) :

j. Weight of heaviest cubicle, (KG) :

ii. CIRCUIT BREAKER

a. Manufacturer/ Type :

b. Rated Voltage , V :

c. Rated current for various circuit breakers
   Normal, A :
   Derating factor for site conditions, A :
   When installed within cubicle :

d. Method of closing
   □ Normal :
   □ Emergency :

e. Type of closing mechanism :

f. Normal ratting of closing mechanism (V/W) :

g. Type of tripping mechanism :

h. Normal rate of tripping mechanism (V/W) :

i. Spring charging motor details
   Output rating (KW) :
   Rated voltage (V) :
iii. **FUSES (FOR PT’S)**

a. Manufacturer :  
b. Type :  
c. Rated Voltage, V :  
d. Rated Current, A :  
e. Category of duty :  
f. Rupturing capacity (prospective current), KA:  

B. **LT DEPARTMENT C / MCC**

i. **GENERAL**

a. Manufacturer/ type :  
b. Whether single front or double front :  
c. Fully drawout semi-drawout/ fixed type :  
d. Busbar  
   - Material, Alu./ Cu :  
   - Continuous rating, A :  

ii. **CIRCUIT BREAKER**

a. Manufacturer/ Type :  
b. Rated Voltage, V :  
c. Rated Current Nominal, A :  
   - Derating factor for site conditions :  
   - When installed within cubicle :  
d. Method of closing  
   - Normal :  
   - Emergency :  
e. Type of closing Mechanism :  
f. Normal rating of closing mechanism (V/W) :  
g. Type of tripping Mechanism :  

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h. Normal rating of tripping Mechanism (V/W):

i. Spring charging motor details

Output rating, KW : 

Rated voltage, V : 

Spring charging time, sec : 

iii. ISOLATING SWITCHES

a. Manufacturer : 

b. Type : 

c. No. of poles : 

d. Rated voltage, V : 

e. Rated continuous current, A : 

iv. FUSES

a. Manufacturer/ Type 

b. Rating V and A 

v. MOTOR CONTACTORS (FOR ALL CATEGORIES)

a. Manufacturer : 

b. Type : 

c. Utilisation Category : 

d. No. of poles : 

e. Rated Voltage for main contacts : 

f. Rated voltage of coil, V : 

g. Rated voltage of auxiliary contacts, V : 

h. Rated (thermal) current, A : 

i. Rated duty : 
j. Rated making capacity, KA (rms) :
k. Short time rating, KA (rms) :

l. Thermal overload relay

Setting range :
No. of contacts :

C. LIGHTING FIXTURE (FOR ALL TYPE)

a. Manufacturer/ type :

b. Nominal working voltage, V :

c. Power loss per ballast at nominal working voltage and frequency, W :

d. Temperature within fixture housing (°C) :

e. Guaranteed maximum hot spot temperature of ballast case under site conditions (°C) :

f. Average total light output per fixture as percentage of combined lamp light output at nominal working voltage and frequency in still air ambient temperature of 45 degree Centigrade (%) :

D. POWER AND CONTROL CABLES

i. 11KV Earthed Grade Power Cables

a. Manufacturer :

b. Type :

c. Rated Voltage, V :

d. Continuous current rating with cable laid in air under specified ambient temperature for specified maximum conductor temperature, A :

e. Specify various applicable Derating factors :

ii. 1100V Grade Power Cables

a. Manufacturer :

b. Type :
| Company Seal | Signature of the Bidder |
c. Rated Voltage, V : 

d. Continuous current rating with cable laid in air under specified ambient temperature for specified maximum conductor temperature, A :

e. Specify various applicable Derating factors :

iii. 1100V Grade Control Cables

a. Manufacturer :

b. Type :

c. Rated Voltage, V :

d. Conductor

i. Material :

ii. Cross section, sq.mm :

iii. No. and diameter of strands :

E. DATA SHEET FOR MOTOR
(Datasheet for each type category of motor shall be submitted)

1. i. Make & Type

   ii. Reference standard

2. Type of Frame size

3. Degree of protection

4. Rotor Shaft (Solid/ Hollow)

5. Mounting

6. Rated Output KW/HP

7. Rated Voltage and range

8. No. of Phases and frequency

9. Load Cycle

10. Synchronous R.P.M. RPM

11. Full Load speed RPM

12. Starting Current A
<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.</td>
<td>Full Load Current</td>
</tr>
<tr>
<td>14.</td>
<td>Starting torque in % of full load torque</td>
</tr>
<tr>
<td>15.</td>
<td>Breakdown torque in % of full load torque</td>
</tr>
<tr>
<td>16.</td>
<td>Locked rotor withstand time</td>
</tr>
<tr>
<td></td>
<td>i. Under Hot Condition</td>
</tr>
<tr>
<td></td>
<td>ii. Under cold condition</td>
</tr>
<tr>
<td>17.</td>
<td>Starting time at minimum starting voltage</td>
</tr>
<tr>
<td></td>
<td>i. With Load</td>
</tr>
<tr>
<td></td>
<td>ii. Without Load</td>
</tr>
<tr>
<td>18.</td>
<td>Number of starts permissible</td>
</tr>
<tr>
<td></td>
<td>i. Under Hot condition</td>
</tr>
<tr>
<td></td>
<td>ii. Under cold condition</td>
</tr>
<tr>
<td>19.</td>
<td>Locked rotor withstand time at minimum permissible starting voltage</td>
</tr>
<tr>
<td>20.</td>
<td>Locked rotor withstand time at 110% voltage</td>
</tr>
<tr>
<td>21.</td>
<td>Max. permissible running time with full load at minimum allowable voltage</td>
</tr>
<tr>
<td>22.</td>
<td>Method of starting</td>
</tr>
<tr>
<td>23.</td>
<td>Power factor</td>
</tr>
<tr>
<td></td>
<td>i. at full load</td>
</tr>
<tr>
<td></td>
<td>ii. at ¾ load</td>
</tr>
<tr>
<td>24.</td>
<td>Efficiency</td>
</tr>
<tr>
<td></td>
<td>i. at full load</td>
</tr>
<tr>
<td></td>
<td>ii. at ¾ load</td>
</tr>
<tr>
<td></td>
<td>iii. at ½ load</td>
</tr>
<tr>
<td></td>
<td>iv. at ¼ load</td>
</tr>
</tbody>
</table>

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Company Seal

Signature of the Bidder
25. Insulation
   i. Class of insulation
   ii. Material and treatment
   iii. Tropical and fungicidal treatment

26. Temperature rise over an ambient of 45°C while delivering rated output
   i. By resistance method
   ii. By thermometer method

27. Maximum allowable temperature rise over an ambient of 45°C

28. Stator winding
   i. Connection
   ii. Type and Nos. of terminals brought out
   iii. Resistance per phase in ohms at 20°C
   iv. Make & No. of embedded temperature detector per phase
   v. Range of temperature as per class of insulation
   vi. Range of temperature
   vii. Terminal and terminal size for R.T.D

29. Space heater
   i. Number
   ii. Location
   iii. Capacity
   ix. Voltage
30. Direction of rotation viewed from driving end

31. Bearing
   i. Driving end
   
   ii. Non driving end
   
   iii. Recommended lubricant
         a. Type
         b. Quantity
   
   iv. Anticipated bearing life
   
   v. Bearing housing temperature detection arrangement for bearing temperature

32 Terminal boxes for stator winding
   i. Phase segregated or not
   
   ii. Number provided
   
   iii. Fault level upto which terminal box can be used

33. Location of terminal box viewed from driving end
34. Cable gland size

35. Terminal box for space heater
   i. Number provided
   
   ii. Location
   
   iii. Cable size
   
   iv. Cable entry

36. GD$^2$ of motor Kg-M$^2$

37. Critical speed RPM
38. Total weight for the motor Kg
   i. Weight of stator Kg.
   ii. Weight of rotor Kg.

39. Water Cooling system
   i. Dimension of the cooling system
   ii. Cooling tubes

   a. No. of cooling tubes Dia mm.
   b. Size of Cooling tubes Length mm
   c. Material of cooling tube Thickness mm.
   iii. Type of coat for inside cooling system and its antiscale property
   iv. Other Special feature if any

40. Total guaranteed losses comprising iron loss copper less, friction, windage and stray losses/
   i. Break up:-

   ii. Iron Loss KW
   iii. Copper Loss KW
   iv. Friction windage and stray losses KW

F. POWER FACTOR IMPROVEMENT CAPACITOR

A HV Power Factor Improving Capacitor

1. Manufacturer
2. Reference Specification
3. Type
4. Rated Capacity KVAR
5. Rated continuous voltage KV
6. Rated Frequency
7. Rated Line Current A
8. Formation of capacitor
   Element
   a. Shape of the Element
   b. Type of PP/ film/paper used
   c. Nos. of capacitor elements
      i. In series
      ii. In Parallel
d. Type of Dielectric used
e. Whether unit fuse provided
9. Method of internal connections
10. Maximum operating temperature °C
11. Type of discharge service
12. Formation of bank
   a. Total Nos. of capacitor unit per bank
   b. Nos. of unit in series per phase
c. No. of units in parallel per
d. Dimension of complete bank
e. Whether foot insulators
f. Whether bus bar material for bank included.
g. Whether inter task insulations included
h. Whether interconnecting material included
i. Whether any other item required for erection and commissioning of the bank, if so details and price thereof.
13. Tangent of Loss angle i.e tan delta
14. Mounting details of capacitor bank

i. Structural section

ii. Dimensions of each unit (W x D x H) MM^3

iii. Weight of each capacitor unit

15. Cable entry box with cable and gland for 3 core cable of the required size.

16. Type of Neutral Displacement protection Device provided RVT / NCT

________________________  _______________________
Company Seal                 Signature of the Bidder
G. DATA SHEET FOR ISOLATOR

1. Name of Manufacturer
2. Type of Model
3. Standard Followed
4. Rated Voltage – KV (RMS)
5. Rated Current (Amps)
6. Frequency
7. Nos. of Poles
8. Short time withstand current and duration
9. Short time withstand current and Peak withstand current type test certificate or report enclosed (YES/NO)
10. Nos. of breaks in circuit per pole
11. Total length of break per pole
12. Type of contacts
13. Whether indoor or outdoor
14. Whether oil or air break
15. Minimum clearance in air
   i. Between poles and
   ii. Between live parts & earth
16. Type of operation including details of mechanism
17. Weight of insulator and operating mechanism
18. Operating time for opening
19. Operating time for closing
20. Type of interlocks
21. Whether provided with earth switch or not, if provided,- details of the earth switch.

__________________________  ____________________________
Company Seal                  Signature of the Bidder
H. DATA SHEET FOR ACSR CONDUCTOR

1. Name of Manufacturer

2. Type/ Code Name

3. Standard Followed

4. Steel Core
   i. No. of Stands (No.)
   ii. Dia of earth stand (mm)
   iii. Cross Section (total) (mm$^2$)
   iv. Percentage of:
       Carbon
       Sulfur
       Phosphorous
       Combined Phosphorous & Sulfur

5. Aluminium conductor
   i. No. of Stands (No.)
   ii. Dia of earth stand (mm)
   iii. Cross Section (total) (mm$^2$)
   iv. Purity of aluminium (%)

6. Overall diameter of conductor (mm)

7. Max. allowable temperature (°C)

8. Current rating based on specified ambient temp.

9. Rise of temp above ambient when conductor carrying normal rated current

________________________  __________________________
Company Seal               Signature of the Bidder
I. DATA SHEET FOR BUSDUCT

1. Make : 
2. Type designation : 
3. Degree of protection : 
4. Maximum weight of each section : 
5. Overall dimensions
   - Length : 
   - Width : 
   - Height : 
6. Clearance in air
   - Phase to Phase : Mm
   - Phase to earth : Mm
7. Busbar current rating : Amp.
8. Busbar size
   - mm²
8.1 Main busbar : 
8.2 Earth busbar : 
8.3 Minimum size for S.C. withstand : mm²
9.1 Main Busbars : 
9.2 Earth Busbar : 
10. Insulating material : 
10.1 Type : 
10.2 Tracking index : 
11. Voltage withstand
11.1 1 min power frequency : KV
11.2 Impulse (1.2/50µ S) : KV
12. 1 sec. Short circuit withstand capacity : KA
13. Safety features
13.1 Earth jumpers for each bus duct section enclosure : Provided / Not provided
13.2 Slope at bottom with drain plug : Provided/ Not Provided
14. Spare heater : Provided/ Not provided

__________________________ ____________________________
Company Seal Signature of the Bidder
J. TECHNICAL DATA FROM EQUIPMENT VENDORS

i. UPS SYSTEM

1. Make :
2. Type designation :
3. Rating (KVA at 0.8 p.f) :
4. Mode of operation :
5. Dynamic Response under following conditions
   For 50% step load :
   For 100% step load and unload :
   Power supply interruption and restoration :
   Load Transferred to bypass line :
   When one inverter gets faulty and load transferred to healthy inverter :
6. Maximum recovery time to reach steady state after above disturbance :
7. Type of cooling/ Redundancy in cooling system :
8. Degree ingress protection of panels :
9. Noise Level :
10. Colour shade :
11. Overall efficiency of UPS system (Ratio of output load to input power drawn from mains when all chargers and inverters are ON and synchronized with bypass
    At 100% Load :
    At 75% Load :
    At 50% load :
12. Guaranteed dimensions (L x D x H) of UPS system except ACDB and battery :
13. Heat loss of the total system (KW) :
14. Cable entry :

_________________________  ____________________________
Company Seal  Signature of the Bidder
ii. **INVERTOR**

1. Rating (at specified ambient)/ No. of phases : 
2.1 Steady state output voltage (Nominal/ Variation) : 
2.2 Steady state output frequency (Nominal/ Variation) : 
3. Output voltage adjustment range at rated load : 
4. Input voltage DC (Nominal/Range) : 
5. Frequency variation limit for inverter phase locked with mains : 
6. Allowable unbalance between phases (for 3 only) : 
7. Harmonic distortion at inverter output at rated load 
   a. For linear load : 
   b. For nonlinear load : 
8. Overloading capacity and duration : 
9. Short circuit capacity and duration : 
10. Efficiency at 100% / 75% / 50% load : 
11. Output voltage and phase angles (for 3-ph. Only) 
   For 30% unbalance load : 
   For 40% unbalance load : 
   For 50% unbalance load : 
   For 100% unbalance load : 
12. Type of control circuit : 
13. Load crest factor (for which UPS is designed) : 
14. Max. allowed rating of outgoing feeders for fault clearance of feeder fault by UPS with and without mains bypass supply back up (as percentage of UPS rating) : 
   With fast acting semi-conducting fuse : 
   With normal HRC fuse : 

____________________________________  ______________________________________
Company Seal                             Signature of the Bidder
iii. STATIC SWITCHES

1. No. of static switches in each UPS system:
2. Current rating at specified ambient:
   (continuous / short time):
3. Type of static switch:
4. Transfer time:
   Synchronized mode:
   Unsynchronized mode:

iv. BATTERY CHARGER

1. Current Rating:
2. Type of Charger:
3. Output voltage under float/ rapid charging condition:
4. Output voltage accuracy under specified input:
5. Maximum ripple content on DC side with battery connected/ disconnected:
6. Maximum harmonic content in input current:
7. Efficiency at 100%/ 75 % 50% of load:
8. Input transformer rating:

v. MANUAL TRANSFER DEVICES

1. Make/ Type designation:
2. Rating Continuous/ short time:

vi. BATTERY

1. Make:
2. Type designation:
3. Type:
4. AH rating:
5. End cell voltage:
6. Nominal voltage:
7. No. of cells in each bank:
8. No. of battery banks:
9. Battery charging requirement
   Nominal Volts/ Cell:
   Float Voltage/ Cell:
   Rapid charging Voltage/ cell:
10. Rapid charging time:
11. Overall rack dimensions, no. of racks and tiers with clearances:
12. Container type:
1. Make

13. No. of recommended air charges/ hour for battery room

________________
________________

Company Seal

Signature of the Bidder
vii. **STEP DOWN BY PASS TRANSFORMER WITH SOLID STATE VOLTAGE STABILIZER**

1. Make/ Type designation : 
2. Rating and voltage ratio : 
3. Accuracy of stabilizer : 
4. Type of control : 
5. Type of cooling : 
6. Type of stabilizer : 

viii. **AC DISTRIBUTION BOARD**

1. Make/ Type designation : 
2. Rating of board : 
3. No. of outgoing feeders/ rating of each : 
4. Overall dimension (L x D x H) : 
5. Maximum and minimum operating height : 

ix. **CELL BOOSTER**

1. Make/ Type designation : 
2. Voltage range : 
3. Current range : 

x. **RELIABILITY**

1. Safety factor used for selecting the components
   - Electronic devices : 
   - Electric devices : 
2. MTBF/ MTTR : 
3. Availability factor : 

__________________________  ________________________
Company Seal               Signature of the Bidder
K. BATTERY, BATTERY CHARGER AND D.C. DISTRIBUTION BOARD  
(For all Sub-station’s requirement)

A Battery
1. Make
2. Type
3. Nos. of Cells
4. Nominal Voltage V
5. DC Supply Voltage V
6. Rated Voltage of Battery V
7. Battery Capacity (at 10 hour Discharge rate) AH
8. Expected Life year

B Battery Charger
1. Make
2. Type (Thyristor control or other)
3. Input Supply V
4. Output Rated Current (Booster Amps
5. Output rated Current (Float)
6. Voltage regulation %
7. Type of Surge suppression
8. Each Leakage relay
   i. Make
   ii. Type
C DC Distribution Board
1. Make
2. Dimensions of Board

Company Seal ____________________  Signature of the Bidder ____________________
A. DATA SHEET FOR DO ANALYSER

a  DO Probe

  Minimum Measuring range
  DO
  Temperature
  Accuracy
  DO
  Temperature
  Reaction Time

  Temperature Tolerance
  Protection Class
  Resolution of Data
  Probe Type

  Zero point calibration required/not required
  Make

  Transmitter

  Display Type

  Air compensation (yes/No)

  Separate output for Temperature (Yes/No)
  Output Type

  Housing MOC

  Voltage Protection

  Immersion Armature and Support

  Depth of immersion

  Support Type

  Float Type
B   ULTRA SONIC FLOW TRANSMETER

i.   GENERAL
a. Tag No.
b. Quantity
c. Meter Size
d. Accuracy

ii.   DESIGN DATA
a. Fluid
b. Press. (Nor./ Max) Kg/ Cm²
   g

c. Temp. (Nor/ Max)  °C
d. Flow Rate (Nor/ Max) m³/hr
e. Velocity  m/sec
f. Range  m³/hr
g. SP. GR.
h. Viscosity  CP
   i. Min. Conductivity  S/Cm

iv.   MATERIAL
a. Body
b. Tube
c. Electrode
d. Liner
e. Grounding Ring

v.   FLOW TRANSMITTER
a. Output Isolated
b. Local Display Indicator
c. Power Supply
d. Cable Entry
e. Location
f. Cable (In case of Remote)
g. Mounting

vi.   REMARK
a. Area Classification
b. Enclosure Protection
c. Liner Heating System
d. Ambient Temp.
e. Relative Humidity

________________  _______________________
Company Seal                 Signature of the Bidder
C. PRESSURE GAUGE

i. GENERAL
   a. Tag No.
   b. Quantity
   c. Service
   d. Type
   e. Range
   f. Pressure (Nor./ Max.) Kg/ Cm²g
   g. Temperature (Nor./ Max.) °C
   h. Case Mat’l
   i. Bezel Gasket
   j. Zero Adjustment
   l. Window Mat’l
   m. Accuracy
   n. Below Out Protection
   o. Over Range Protection

ii. DIAL
   a. Size
   b. Color

iii. ELEMENT
   a. Sensor
   b. Sensor Mat’L
   c. Movement Mat’L

iv. CONNECTION
   a. Gauge End Connection
   b. Connection Location
   c. Process Connection
   d. Rating Connection

v. ACCESSORIES
   a. Snubber/ Syphon
   b. Snubber/ Syphon Conn.
   c. Snubber/ Syphon Mat’L

vi. DIAPHRAGM SEAL
   a. Primary Element
   b. Primary Element Material
   c. Other Wetted part
   d. Upper Body Mat’L
   e. Lower Body Mat’L
   f. Seal Fluid

vii. REMARKS
   a. Enclosure Protection
   b. Mounting
   c. Area Classification
   d. Ambient Temp.
D CONTROL VALVE

i. GENERAL
a. Tag No.
b. Quantity
c. Name
d. Line Size

ii. BODY
a. Body/ Port Size
b. No Port
c. Port Style
d. Port Form
e. Guiding
f. End Connection
g. Flange Rating
h. Body Material
i. Bonnet Type
j. Packing Material
k. Trim Form
l. Trim Mat’l (Plug/ Seat/ Seat Ring)

iii. DESIGN DATA
a. Fluid
b. Flow rate (Nor./Max) Nm³/hr
c. Inlet Pr. Kg/ Cm²g
d. Closed Pr. Kg/ Cm²g
e. Diff. Pr. Kg/ Cm²g
f. Cv Reqd./ Set
g. Temp. (Nor. Max.) °C
h. SP. Gravity
i. Viscosity CP
j. Velocity m/sec
iv. ACTUATOR
   a. Type
   b. Spring Range
   c. Air Failure Valve To

v. POSITIONER
   a. Air Supply Press.
   b. Input
   c. Output

vi. ACCESSORY
   a. I/P Converter Or E/P Positioner
   b. Sol. Valve
   c. Sol. Valve Supply
   d. Air Filter Regulator
   e. Limit Filter Regulator
   f. Limit Switch

vii. REMARKS
    a. Ansi Leakage Class
    b. Cable Entry
    c. Travel Length
    d. Max. Allowable Sound Lvel
    e. Enclosure Protection
    f. Mounting Bracket & Hardware (S.S)

viii. SERVICE CONDITIONS
    a. Ambient Temp.
    b. Relative Humidity
    c. Area Classification
### E. VARIABLE FREQUENCY DRIVE

<table>
<thead>
<tr>
<th>Make</th>
<th>Model</th>
<th>Ambient Temp</th>
<th>45 °C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Operating Temp</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Enclosure Type</td>
<td></td>
</tr>
<tr>
<td>Input Supply</td>
<td>415+/- 10%,50 Hz +/- 3%</td>
<td>Rectifier</td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td>Smps Type</td>
<td>Inpection</td>
<td></td>
</tr>
<tr>
<td>Dc Link Voltage</td>
<td>480 To 800 V</td>
<td>Documents Reqd</td>
<td></td>
</tr>
<tr>
<td>Thyristor Protection</td>
<td></td>
<td>Calibration Reports/Test Certificates</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>/O &amp; M Manual</td>
<td></td>
</tr>
<tr>
<td>Input Power Factor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>By Pass</td>
<td>External</td>
<td>Dimention Of Vfd</td>
<td></td>
</tr>
<tr>
<td>Arrangement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inverter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inverter Model</td>
<td></td>
<td>Steady State Speed</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Regulation In % Of The</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rated Speed</td>
<td></td>
</tr>
<tr>
<td>Gasket</td>
<td>No Gasket, Totally Enclosed</td>
<td>1) Load Variation</td>
<td>1% At 100 % Load Variation</td>
</tr>
<tr>
<td>Transister</td>
<td>Igbt</td>
<td>2) Voltage Variation</td>
<td>340 To 460 V</td>
</tr>
<tr>
<td>Type Of Control</td>
<td>Vector</td>
<td>3) Ambient Temperature Variation</td>
<td>0 To 50 °</td>
</tr>
<tr>
<td>Frequency Control Range</td>
<td>Minus 300 To Plus 300 Hz</td>
<td>Efficiency At 100 %, 75 %, 50%</td>
<td></td>
</tr>
<tr>
<td>Accuracy Of Frequency</td>
<td>0.06 Absolute</td>
<td>Rating Of Motor</td>
<td>97.5% At 100 %</td>
</tr>
<tr>
<td>Setpoint Resolution</td>
<td>0.01 Hz</td>
<td>Power Factor At 100 %, 75%, 50%</td>
<td>Rating Of Motor</td>
</tr>
<tr>
<td>Frequency Stability</td>
<td>0.001 For Digital</td>
<td>Derating Factor Of Motor</td>
<td></td>
</tr>
<tr>
<td>Rated Output Voltage</td>
<td>415 V</td>
<td>Thyristor/Transister Protection</td>
<td></td>
</tr>
<tr>
<td>Rated Output Frequency</td>
<td>50 Hz (5-50 Hz At Const Torque)</td>
<td>Inverter Rated Current</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50 - 100 Hz At Const Power</td>
<td>Inverter Peak Current</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maximum Torque &amp; Duration</td>
<td>150%</td>
</tr>
<tr>
<td>Overload Capacity</td>
<td>150 % For One Minute</td>
<td>Noise Level</td>
<td>Compliance With Intl Class A To En 55011</td>
</tr>
<tr>
<td>-------------------</td>
<td>----------------------</td>
<td>-------------</td>
<td>--------------------------------------</td>
</tr>
</tbody>
</table>

________________________
 Company Seal

________________________
 Signature of the Bidder
<table>
<thead>
<tr>
<th>Acceleration Time</th>
<th>Programmable</th>
<th>Heat Dissipation Panel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deceleration Time</td>
<td>Programmable</td>
<td>Type Of Cooling</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Isolation Transformer</td>
</tr>
</tbody>
</table>

**Protection**

<table>
<thead>
<tr>
<th>Protection Type</th>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Overload (Thermal)</td>
<td>Yes</td>
<td>Percentage Of Total</td>
</tr>
<tr>
<td>2) Instantaneous</td>
<td>Yes</td>
<td>Harmonic Distortion</td>
</tr>
<tr>
<td>3) Overvolt/Undervolt</td>
<td>Yes</td>
<td>At Motor End</td>
</tr>
<tr>
<td>4) Ground Fault</td>
<td>Yes</td>
<td>Individual</td>
</tr>
<tr>
<td>5) Stall Protection</td>
<td>Yes</td>
<td>Total</td>
</tr>
</tbody>
</table>

**Input/Output Coke**

<table>
<thead>
<tr>
<th>Coke Type</th>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ano (4-20 Ma)</td>
<td>Required</td>
<td>For Speed Variation</td>
</tr>
<tr>
<td>4 Nos</td>
<td>Ammeter</td>
<td>Required</td>
</tr>
<tr>
<td>1 No 4-20 Ma</td>
<td>Voltmeter</td>
<td>Required</td>
</tr>
<tr>
<td>1 No</td>
<td>Freq/Speed</td>
<td>Required</td>
</tr>
</tbody>
</table>

**Company Seal**

**Signature of the Bidder**
### F. LEVEL TRANSMITTERS

<table>
<thead>
<tr>
<th>Type</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tube for Probe (MOC)</td>
<td></td>
</tr>
<tr>
<td>Extension Pipe</td>
<td>Length:</td>
</tr>
<tr>
<td></td>
<td>MOC:</td>
</tr>
<tr>
<td>Measuring Cell linearity</td>
<td></td>
</tr>
<tr>
<td>Diaphragm</td>
<td></td>
</tr>
<tr>
<td>Measuring Range</td>
<td></td>
</tr>
<tr>
<td>Accuracy</td>
<td></td>
</tr>
<tr>
<td>Automatic Compensation</td>
<td>Temperature</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Signal</td>
<td></td>
</tr>
<tr>
<td>Voltage Protection</td>
<td></td>
</tr>
<tr>
<td>Housing MOC</td>
<td></td>
</tr>
<tr>
<td>Make</td>
<td></td>
</tr>
</tbody>
</table>

_________________________  ___________________________
Company Seal               Signature of the Bidder
G. LEVEL SWITCHES (CAPACITANCE TYPE)

i. GENERAL
   a. Tag No.
   b. Quantity
   c. Service
   d. Measuring Range
   e. Mounting

ii. ENCLOSURE PROTECTION
   a. Enclosure Protection
   b. Enclosure Protection Mat’L
   c. Conn. Size
   d. Flange Mat’L
   e. Flange Rating
   f. Power Supply
   g. Switch Relay type
   h. Qty
   i. Contact Rating
   j. Cable Entry Single/ Double
   k. Time Delay On & Off
   l. Fail Safe Setting
   m. Probe/ Electrode mat’L
   n. Ref. Electrode mat’L

iii. DESIGN DATA
   a. Fluid
   b. Press. (Nor./ Max) Kg/ Cm²g
   c. Temp. (Nor/ Max) °C
   d. SP. Gravity
   e. Probe Length
   f. Ref. Electrode Mat’L

iv. SERVICE CONDITION
   A Ambient Temp.

Company Seal ___________________________ Signature of the Bidder ___________________________
SCHEDULE –XI

SEWAGE TREATMENT PLANT - OPERATING DETAILS

Bidder shall furnish the O & M Manual highlighting the following aspects but not limited to:

Daily Maintenance
Weekly Maintenance
Annual Maintenance
Tests to be carried out for preventive maintenance on Daily, Weekly and Annual basis.
Staffing acquirements, structure and skill set for each type of staff
Operating instructions
Safety measures/precaution
Replacement of spare parts, tools & tackles
Requirement of consumables

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Item</th>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td><strong>Electrical Loads</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Total connected load</td>
<td>Kva</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Maximum running load</td>
<td>Kva</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Average running load</td>
<td>Kva</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Expected maximum demand for 20 min. period when the work is operating at full capacity</td>
<td>Kw</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Average power factor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Annual average power requirement for the 2 yrs. O&amp;M period</td>
<td>KWH</td>
<td></td>
</tr>
<tr>
<td>II.</td>
<td><strong>Chemical Usage</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>(a) Average dose for Chemical 1</td>
<td>Mg/l</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>(a) Maximum dose for Chemical 2</td>
<td>Mg/l</td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td>Average dose for Chemical 2</td>
<td>Mg/l</td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td>Maximum dose for Chemical 2 (Bidder to specify name of the all Chemicals used item wise)</td>
<td>Mg/l</td>
<td></td>
</tr>
<tr>
<td>III.</td>
<td><strong>Coagulant Usage (if required by Process)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Coagulant dose</td>
<td>Mg/l</td>
<td></td>
</tr>
</tbody>
</table>

Company Seal ___________________ Signature of the Bidder ___________________
SCHEDULE - XII

CONTRACTORS FUNCTIONAL GUARANTEES

1. General

This schedule sets out the functional guarantees required for the calculation of Liquidated Damages for failing O&M performance guarantees.

The Bidder shall provide values of electrical energy and chemical usage for the quantity and quality of raw sewage given in the technical specifications.

2. Functional Guarantees

The contractor’s guarantee for the performance in the O&M period to be as follows:

2.1 Quality of Treated Effluent

The quality of treated effluent shall be as follows:
As specified in "Section 1- Project objective-scope of work".

2.2 Chemical Usage

$ Chemical Usage

The average annual usage of Chemical during the 4 years O&M period is guaranteed to be. Figures to be given separately for each type of chemical used in the plant. Not more than ______ kg.

$ Coagulant AID Usage (if process requires, bidder to furnish details of the coagulant AID.

The average annual usage of Coagulant during the 4 year O&M period Period is guaranteed to be. Not more than ______ Kg Coagulant

Company Seal

Signature of the Bidder
Schedule – XIII

SCHEDULE OF MAJOR MAINTENANCE REPAIR AND REPLACEMENT

To be finalized after discussion with selected bidder.

____________________ ____________________
Company Seal Signature of the Bidder
### SCHEDULE –XIV

**POWER AND FUEL NORMS OF THE FACILITY**

<table>
<thead>
<tr>
<th>(A)</th>
<th>Electricity Supply Specification</th>
<th>Annual requirement for fixed units of electricity (kwh)</th>
<th>Variable Electricity requirement per million gallons of treated sewage (Kwh per MG of treated sewage)</th>
<th>Nominal flow</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>First year of O&amp;M period</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Second year of O&amp;M period</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Company Seal**

**Signature of the Bidder**
## SCHEDULE – XV
SLUDGE PRODUCED FROM THE STP

<table>
<thead>
<tr>
<th>Year of O&amp;M Period</th>
<th>Average monthly sludge Produced in Cum.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

**Net Electricity Energy Charge**

<table>
<thead>
<tr>
<th>Year of O&amp;M Period</th>
<th>Peak (hourly) Consumption (KWH)</th>
<th>Average for the year (KWH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

_________________  ____________________
Company Seal       Signature of the Bidder
**NOTES:**

1. All dimensions are in mm. and all levels are in metres unless otherwise noted.
2. Finished ground level assumed as 100.000 M.
3. All wall thickness to be decided by civil designer.
4. Boundary wall not in scope.

**TOTAL PLOT AREA (A,B,C,D) =** 7.97 Ha  
**TOTAL STP AREA =** 2.27 Ha  
**AREA REQUIRED FOR 15 MLD =** 0.61 Ha  
**AREA REQUIRED FOR 15 MLD FUTURE EXPANSION =** 1.66 Ha

---

**LEGEND:**
- Green Tree
- Area of STP
- Area for Future Expansion

**PROJECT:** 15 MLD Sewage Treatment Plant Hisar

**M/S Multi Tech Consultant**

**TITLE:** Equipment Layout for 15 MLD STP on SBR Based Technology

<table>
<thead>
<tr>
<th>CONTRACT NO.</th>
<th>DSRK</th>
<th>DSRK</th>
<th>APP.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**DATE:** 04-02-2011  
**SCALE:**  
**DRAWING NO.:** MTC-HS-A1  
**DESIGNER:**

---
EQUIPMENT LAYOUT
FOR
15 MLD STP ON SBR BASED TECHNOLOGY